

SECTION 10 1400
SIGNAGE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Interior accessibility, identification, directional and informational signs.

B. Related Requirements:

1. Division 01: General Requirements.
2. Section 08 1113: Hollow Metal Doors, Windows and Frames.
3. Division 09: Finishes.

1.02 REFERENCES

A. ASTM International:

1. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
2. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
3. ASTM D4802 - Standard Specification for Poly (Methyl Methacrylate) Acrylic Plastic Sheet.

1.03 SUBMITTALS

- A. Product Data: Submit material descriptions, finishes and color charts for each type of sign.
- B. Shop Drawings: Submit Shop Drawings indicating sign style, lettering, overall dimensions and quantities. Submit floor plans showing locations for each sign.
- C. Material Samples: Submit three samples illustrating full size sample sign, of type, style and color specified.
- D. Manufacturer's installation instructions.

1.04 QUALITY ASSURANCE

- A. Pre-Installation Conference: Notify OAR when signs are ready for installation. Arrange for conference at site. Do not proceed with installation until ARCHITECT'S approval of specific locations and methods of attachment has been obtained.
- B. Provide signs from one manufacturer.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site and protect from damage. Store until immediately prior to installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products of following manufacturers are acceptable and are the basis for intended design and quality.
 - 1. H. Toji and Company.
 - 2. Karman Ltd., Architectural Signs.
 - 3. Vomar Products Inc.
 - 4. ASI-Modulex, Inc.
 - 5. Mohawk Sign Systems, Inc.
 - 6. Accent Signage Systems.
 - 7. The Gruenke Company.
 - 8. Ada Sign Products.
 - 9. AccuBraille.
 - 10. Equal.

2.02 MATERIALS AND FABRICATION

- A. Interior Sign Materials:
 - 1. Substrate Panel: 1/8 inch minimum thick, integrally colored or clear acrylic plastic, or laminated acrylic. Conforming to ASTM D4802; non-glare (matte), UV stable, suitable for interior and exterior use.

- a. Corners shall be 1/8" radius.
 - b. Edges shall be square and eased.
 - c. Colors as selected by ARCHITECT from manufacturer's custom color range.
 - 2. Fasteners:
 - a. Stainless steel tamper-proof screws and plastic anchors.
 - b. Signs mounted on fire-rated doors shall be secured with adhesive.
- B. Characters and Symbols: Shall be fabricated by one of the processes described below:
 - 1. Computer cut raised characters and graphics shall be cut from 1/16 inch integrally colored acrylic. Raised characters and graphics shall be inlaid 1/32 inch minimum into first surface of sign background, secured with adhesive so it cannot be removed without the use of tools. Raised characters and graphics shall have beveled, eased or rounded edges. Non-tactile text and graphics shall be applied to the second surface, and background color shall be applied to the second surface and protected with film or an additional backplate. Pictograms and other symbols including the International Symbol of Accessibility, which are included on signs with raised characters and Braille, are not required to be raised.
 - 2. Raised characters and graphics including braille shall be integral to sign face and shall be formed into sign face by high pressure thermoforming using a negative mold. No applied, glued, welded tactile elements are acceptable. Raised characters and graphics shall have beveled, eased or rounded edges. No sharp, square edges are acceptable. Non-tactile text and graphics shall be applied to the second surface, and background color shall be applied to the second surface and protected with vinyl film. Pictograms and other symbols including the International Symbol of Accessibility, which are included on signs with raised characters and Braille, or other signs are not required to be raised.

2.03 COMMUNICATION ELEMENTS AND FEATURES

- A. Raised Characters Raised characters shall comply with CBC 11B-703.2.
 - 1. Character Type: Characters on signs shall be raised 1/32 inch minimum above their background and shall be sans serif uppercase characters duplicated in Braille. Characters and Braille shall be in a horizontal format.
 - 2. Character Height: Character height measured vertically from the baseline of the character shall be 5/8 inch minimum and 2 inch maximum based on the height of the uppercase letter "T".

3. Character Proportions: Characters shall be selected from fonts where the width of the uppercase letter “O” is 60 percent minimum and 110 percent maximum of the height of the letter “T”.
 4. Stroke Thickness: Stroke thickness of the uppercase letter “T” shall be 15 percent maximum of the height of the character.
 5. Character and Line Spacing shall be in conformance to CBC 11B-703.2.7 and 11B-703.2.8.
 6. Character Placement: Shall be placed in accordance to Paragraph 2.03, C below.
- B. Visual Characters: Visual characters shall comply with CBC Section 11B-703.5. Characters shall be conventional in form, and shall be uppercase or lowercase or a combination of both, as indicated on the drawings. Characters shall not be italic, oblique, highly decorative, or of other unusual forms.
1. Finish and Contrast: Characters and their backgrounds shall have a non-glare finish. Characters shall contrast with their background with either light characters on a dark background or a dark characters on a light background.
 2. Character Proportions: Characters shall be selected from fonts where the width of the uppercase letter “O” is 60 percent minimum and 110 percent maximum of the height of the uppercase of the letter “T”.
 3. Character Height: Minimum character height shall comply with CBC Table 11B-703.5.5.
 4. Height from Finish Floor or Ground: Visual characters shall be 40 inches minimum above the finish floor or ground
 5. Stroke Thickness: Uppercase letter “T” shall be 10 percent minimum and 20 percent maximum of the height of the character.
 6. Character and Line Spacing: Shall be in accordance to CBC 11B-703.5.8 and 11B-703.5.9.
- C. Braille: Contracted Grade 2 Braille, conforming to CBC 11B-703.3. Braille characters shall be inlaid optically correct acrylic Raster beads into computer drilled holes in the panel surface.
1. Dimensions and Capitalization: Braille dots shall have a domed or rounded shape and shall comply with CBC Table 11B-703.3.1. The indication of an uppercase letter or letters shall only be used before the first word of sentences, proper nouns and names, individual letters of the alphabet, initials, and acronyms.
 2. Position: Braille shall be positioned below the corresponding text in a horizontal format, flush left or centered. If text is multi-lined, Braille shall be placed below the entire line of text. Braille shall be separated 3/8 inch

minimum and 1/2 maximum from any other tactile characters and 3/8 inch minimum from raised borders and decorative elements.

- D. Pictograms: In conformance to CBC 11B-703.6. Pictograms shall have a field height of 6 inches minimum. Characters and Braille shall not be located in the pictogram field.
1. Finish and Contrast: Pictograms and their field shall have a non-glare finish. Pictograms shall contrast with their field with either a light pictogram on a dark field or a dark pictogram on a light field.
 2. Text Descriptors: Pictograms shall have text descriptors located directly below the pictogram field, and shall comply with CBC 11B-703.2, 11B-703.3 and 11B-703.4.
- E. International Symbol of Accessibility (ISA): Shall comply with CBC 11B-703.7 and CBC Figure 11B-703.7.2.1. The ISA shall consist of a white figure on a blue background. The blue color shall be approximate to FS. 15090 in Federal Standard 595C.
- F. Mounting Locations and Height: Signs with tactile characters shall be as indicated on the drawings and in conformance to CBC 11B-703.4.
1. Mounting Locations:
 - a. Identification signs for rooms and spaces shall be located on the wall adjacent to the latch side of the door, as one enters the room or space.
 - b. Signs that identify exits shall be located at the exit door when approached in the direction of egress travel.
 - c. Signs containing tactile characters shall be located so that a clear floor space 18 inches minimum by 18 inches minimum, centered on the tactile characters, is provided beyond the arc of any door swing between the closed position and 45 degree open position.
 - d. Where a tactile sign is provided at a door, the sign shall be located alongside the door at the latch side.
 - e. Where a tactile sign is provided at double doors with one active leaf, the sign shall be located at the inactive leaf.
 - f. Where a tactile sign is provided at double doors with two active leaves, the sign shall be located to the right of the right hand door.
 - g. Where there is no wall space at the latch side of a single door or at the right side of double doors, signs shall be located on the nearest adjacent wall.
 2. Mounting height above finish floor or ground: Tactile characters on signs shall be located 48 inches minimum above the finish floor or ground surface, measured from the baseline of the lowest Braille cells and 60 inches

maximum above the finish floor or ground surface, measured from the baseline of the highest line of raised characters.

2.04 ROOM IDENTIFICATION SIGNS

A. Room Identification Sign Types:

1. Room Identification Sign with Changeable Insert: 7 inches high by 9 inches wide, minimum, with 4 inches high by 9 inches wide window for name and title removable insert. Locate room name immediately below window, and centered above room number. Room name shall be raised characters 3/4 inches high minimum, and room number 1 inch minimum; and shall be accompanied with Braille indicators.
2. Room Identification Sign with Room Name and Room Number: 7 inches high by 9 inches wide, minimum. Room name shall be raised characters 3/4 inches high minimum, and room number 1 inch minimum; and shall be accompanied with Braille indicators.
3. Room Number Sign: 7 inches wide by 4 inches high; room number, 1 inch high minimum, raised character, accompanied by Braille indicator immediately below.

B. Room Identification Sign Requirements:

1. Finish and Contrast: Refer to paragraph 2.03.B.
2. Raised Characters and Proportions: Refer to paragraph 2.03.A.
3. Braille: Refer to paragraph 2.03.C.
4. Mounting Location and Height: Refer to paragraph 2.03.F.

2.05 RESTROOM SIGNAGE

A. Multiple-Occupancy restrooms shall be provided with geometric symbols and wall mounted pictograms with text descriptors.

B. Geometric Symbols:

1. Doorways leading to toilet rooms shall be identified by a geometric symbol complying with CBC Section 11B-703.7.2.6. Signage at corridors leading to boys and girls restrooms to read "BOYS and GIRLS RESTROOMS INSIDE"
2. Male Restroom Door Symbol: 1/4 inch thick equilateral triangle with edges 12 inches long, with vertex pointing upward, the triangle symbol shall contrast with the door, either light on a dark background or dark on a light background. A male silhouette shall appear within the equilateral triangle in contrasting color to it.

3. Female Restroom Door Sign: 1/4 inch thick circle 12-inch diameter, the circle symbol shall contrast with the door, either light on a dark background or dark on a light background. A female silhouette shall appear within the circle in contrasting color to it.
 4. “All Gender” Restroom Door Sign (Single occupancy restrooms): 1/4 inch thick circle, 12-inch diameter with a 1/4 inch thick equilateral triangle with the vertex pointing upward superimposed on the circle and within the 12-inch diameter. Triangle and circle shall be of contrasting colors; the circle symbol shall contrast with the door. A female and male silhouettes shall appear within the equilateral triangle in contrasting color to it, and the word “restroom” shall appear on the bottom part of the circle in contrasting color to it.
 5. Edges and Vertices on Geometric Symbols: Shall be eased or rounded at 1/16 inch minimum, or chamfered at 1/8 inch maximum. Vertices shall be radiused between 1/8 minimum and ¼ inch maximum.
 6. Location and Mounting Height: Symbols shall be mounted at 58 inches minimum and 60 inches maximum above the finish floor or ground surface measured from the centerline of the symbol. Where a door is provided the symbol shall be mounted within one inch of the vertical centerline of the door.
- C. Room Identification for Multiple-Occupancy Restrooms: Provide a 16 inch long by 6 inch tall room identification sign, including a pictogram of the International Symbol of Accessibility on a side. Restroom names shall be “Girls” or “Boys”, for students, and “Women” and “Men” for staff. Characters, Braille, pictograms and mounting locations and height shall be in conformance to Article 2.03.
- D. Room Identification for Single-Occupancy Restrooms: Provide a 16 inch long by 6 inch tall room identification sign, including a pictogram of the International Symbol of Accessibility on a side. Text descriptor shall be “All Gender Restroom”. Characters, Braille, pictograms and mounting locations and height shall be in conformance to Article 2.03.
- A. Sign Requirements:
1. Finish and Contrast: Refer to paragraph 2.03.B.
 2. Raised Characters and Proportions: Refer to paragraph 2.03.A.
 3. Braille: Refer to paragraph 2.03.C.
 4. Mounting Location and Height: Refer to paragraph 2.03.F.
 5. Persons able to use the exit stairway do so as soon as possible, unless they are assisting others.
 6. Information on planned availability of assistance in the use of stairs or supervised operation of elevators and how to summon such assistance.

7. Directions for use of the two-way communications system where provided.

2.09 DIRECTIONAL EXIT SIGNAGE

- A. At exits serving a required accessible space but not providing an approved accessible means of egress, at elevator landings and within areas of refuge, provide signage indicating the location of accessible means of egress.
 1. Finish and Contrast: Refer to paragraph 2.03.B.
 2. Character Height and Proportions: Refer to paragraph 2.03.B.
 3. Symbol of Accessibility: Refer to paragraph 2.03.E.

2.10 ASSISTIVE LISTENING DEVICE SIGN

- A. Include International Symbol of Access for Hearing Loss, CBC Figure 11B-703.7.2.4, with text “Assistive-Listening System Available”. Use upper and lower case characters. Sign shall comply with the following requirements:
 1. Finish and Contrast: Refer to paragraph 2.03.B.
 2. Character Height and Proportions: Refer to paragraph 2.03.B.
 3. Symbol of Accessibility: Refer to paragraph 2.03.E.

2.12 PUBLIC TELEPHONE WITH VOLUME CONTROL SIGN

- A. Sign shall contain a depiction of a telephone handset with radiating sound waves. Symbol shall be white on a blue background. The blue shall be equal to Color No. 15090 in Federal Standard 595B. Symbol shall comply with CBC Figure 11B-703.7.2.3.

2.13 ACCESSIBILITY ENTRANCE SIGNS AND PATH OF TRAVEL DIRECTIONAL SIGNS

- A. Entrance Sign: Provide at each building entrance an International Symbol of Accessibility sign. Signs shall be visible to persons along approaching pedestrian ways.
- B. Directional Signs: Provide where indicated on the drawings with arrow indicators and International Symbol of Accessibility.
- C. Signs shall be mounted on wall with lower edge between 48 inches and 60 inches above ground surface or finish floor. Pole mounted, overhead and projecting signs shall have the lower edge at least 80 inches from the ground surface or finish floor.
- D. Sign shall comply with the following requirements.
 1. Directional Signs: Refer to paragraph 2.03.B.

2. Symbol of Accessibility: Refer to paragraph 2.03.E.

- E. No Smoking Sign: Provide at each building entrance. Reverse cut white vinyl sign with 4 1/2-inch high no smoking symbol, mounted on glass entry doors. Under No Smoking symbol, place words “No Smoking”, ½ inch high minimum, San Serif upper and lower case characters.

2.14 PARKING SIGNS

- A. Tow-Away Sign: 18 inches by 24 inches with rounded corners. Black graphics on white background, with lettering not less than 1 inch high. Sign to read: “UNAUTHORIZED VEHICLES PARKED IN DESIGNATED ACCESSIBLE SPACES NOT DISPLAYING DISTINGUISHING PLACARDS OR SPECIAL LICENSE PLATES ISSUED FOR PERSONS WITH DISABILITIES WILL BE TOWED AWAY AT THE OWNER’S EXPENSE. TOWED VEHICLES MAY BE RECLAIMED AT [Insert location] OR BY TELEPHONING [Insert number]”.
- B. Parking Space Identification Sign: 12-inch by 18-inch with rounded corners. White reflectorized graphic on dark blue background and shall display an 8-inch high International Symbol of Accessibility per paragraph 2.03.E.
 - 1. Additional language or an additional sign below the International Symbol of Accessibility shall state I “Minimum Fine \$250”.
 - 2. Signs identifying van accessible parking spaces shall contain additional language or an additional sign with the designation “Van Accessible”.
- C. Signs shall be mounted on posts at head of each accessible parking with lower edge 80 inches minimum above ground surface or mounted on walls at a minimum height of 60 inches from ground surface.

2.15 OCCUPANT LOAD SIGNS

- A. Provide maximum occupancy load signs. Post in a conspicuous place near the main exit or exit access doorway from the room or space of rooms and areas indicated in the drawings.
- B. Minimum size: 4 inches high by 8 inches wide, 7/8 inch high letters, 1 inch high numerals.
- C. Sign to read: “MAXIMUM OCCUPANCY LOAD XXX”. Indicate occupant load shown on drawings.

2.16 EMERGENCY GAS SHUT OFF SIGN

- A. Exterior Signs: Painted aluminum, suitable for outdoor use, with pre-drilled mounting holes.
 - 1. Sign Size: Minimum 4 inches high by 8 inches wide.
 - 2. Color: Subsurface white text, red background.

3. Character Height: One inch high.
4. Text:
 - a. Site main gas shut off valve(s): “MAIN SITE EMERGENCY GAS SHUT-OFF VALVE”.
 - b. Building gas shut-off valve(s): “BUILDING EMERGENCY GAS SHUT-OFF VALVE.”

2.17 LADDER TO ROOF SIGN

- A. 1/8 inch thick acrylic.
 1. Sign Size: Minimum 4 inches high by 8 inches wide.
 2. Color: Subsurface white text, red background.
 3. Character Height: One inch high.
 4. Text: “LADDER TO ROOF”.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work.
- B. Beginning of installation means installer accepts condition of existing surfaces.

3.02 METHODS OF INSTALLATION

- A. Interior Identification Signs and Interior Directional Signs:
 1. Fasten to wall with four tamper-proof round-head screws, one at each corner of sign. Furnish plastic anchors.
 2. When concealed installation is specified, install backplate to wall as above. Fasten sign to backplate with very high-bond double-faced tape.
 3. For installation on glass, fasten sign to glass with very high bond double faced tape. On opposite side of glass, anchor matching backplate to glass with very high-bond double-faced tape.
- B. Geometric Signs: Geometric toilet room signs shall be fastened to doors with three tamper-proof oval-head counter-sunk screws.
- C. Exterior Post Mounted Directional Signs: Size of required footing shall be as indicated on the drawings. Fasten sign with tamperproof stainless steel bolts.

- D. Exterior Wall Mounted Identification Signs and Directional Signs:
1. Aluminum signs: Fasten to wall with 4 tamper-proof round-head screws, one at each corner of sign. Furnish plastic anchors.
 - a. Cement Plaster, Brick, or Masonry: Provide plastic anchors. For signs greater than 640 square inches use Leadwood Screw Anchors, concrete fasteners 1WSA 10112, or equal.
 - b. Chain Link Fence: Fasten with 9 gage hog rings, King Hughes Fasteners 5150DG50, or equal, with 11/16 inch opening at each corner of sign.
 - c. Wrought Iron Fence: Install at each corner with 3/16 inch stainless steel rivets.
 2. Acrylic signs: Install backplate to wall as indicated above. Fasten sign to backplate with high-bond double-faced tape and silicone.
- E. Exterior Building Sign:
1. Each letter shall be furnished with a minimum of three cast mounting lugs on backside, drilled and tapped to receive installation bolts.
 2. Letters shall be installed according to manufacturer's method PMC-1. Letters shall be installed $\frac{3}{4}$ inch away from wall surface, by an aluminum sleeve spacer.

3.03 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off Project site.

3.04 PROTECTION

- A. Protect Work of this section until Substantial Completion.

END OF SECTION

SECTION 10 2113
PHENOLIC TOILET COMPARTMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Solid phenolic toilet compartments, urinal screens, and vision screens.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 05 5000 – Metal Fabrications.
 - 3. Section 06 1000 - Rough Carpentry.
 - 4. Section 10 2813 - Toilet Accessories.
 - 5. Section 10 2815 – Hand and Hair Dryers.

1.02 DESIGN REQUIREMENTS

- A. Design and fabrication shall conform to requirements of ADAAG and CBC Chapter 11B.
- B. Toilet Compartments: Floor supported overhead braced type units consisting of solid phenolic pilasters, panels and doors; plated steel leveling devices with stainless steel covers; and stainless steel fittings, hardware and fastenings.
- C. Urinal Screens: Floor supported and wall hung type consisting of solid phenolic screen panels and plated steel leveling devices with stainless steel covers, stainless steel fittings and fastening.
- D. Vision Panels: Floor- and wall-mounted solid phenolic type.

1.03 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings indicating complete layout, elevations of partitions, thickness of solid phenolic panels, fastenings, proposed method of anchoring, size and spacing of anchors, details of construction, hardware, fittings, mountings, method of assembly, other related items, and installation details.
- B. Product Data: Submit manufacturer's technical data for materials, fabrication, finishing, fastenings, hardware, and installation details.

- C. Material Samples:
 - 1. Submit full range of Samples of phenolic chips for initial color selection. Chips shall be at least 2-inch by 3-inch.
 - 2. Submit Samples of hardware and fasteners.
- D. Certificates: Furnish manufacturer's certification that materials meet or exceed Specification requirements.

1.04 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement:
 - 1. ASTM A167: Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
 - 2. ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 3. Chemical Resistance: Panels to meet or exceed Scientific Equipment Furniture Association's (S.E.F.A.) list of 49 standard chemicals.
 - 4. Consistency:
 - a. Panels to have uniform thickness (+0.03 inch).
 - b. Panels to have uniform flatness (maximum difference of 0.03 inch) for a 10-foot span.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to Project site with manufacturer's labels intact and legible, in sealed containers. Materials shall be kept dry.
- B. Protect compartments and screens.

1.06 COORDINATION

- A. Field Measurements: Secure field measurements prior to fabrication, for proper and adequate fabrication and installation of the Work of this section.
- B. Furnish inserts and anchorage built into other construction for installation of toilet compartments, urinal screens and vision panels.

1.07 WARRANTY

- A. Toilet Compartment Manufacturer shall provide a 25 year material warranty for solid phenolic panels and hardware.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer:

1. Qualifications of Toilet Compartment Manufacturer: Partition Manufacturer shall have been regularly engaged in the construction of Phenolic Toilet Compartments of the type specified for a minimum of five years.

B. Solid Phenolic Panels:

1. Formica Solid Phenolic panels with -42 sparkle finish, Formica Corporation.
2. Wilsonart.
3. Nevamar Surface Systems.
4. Equal.

C. Hardware:

1. Galaxy Hardware, Series 8033.
2. Jacknob Corporation.
3. Equal.

2.02 MATERIALS

A. Toilet compartments panels, doors and pilasters; urinal screens and visual screens.

1. Core: Phenolic impregnated Kraft papers. Panel shall be at least 93 pounds per cubic foot to ensure full saturation of Kraft core.
2. Face Sheet: Over decorative papers impregnated with melamine resin and integrally compression molded with the core.
3. Fire Resistance: The panels shall have the following surface burning characteristics and smoke generation values in accordance with UL classification and labeling in accordance with ASTM E84 tests and shall be self-extinguishing.
 - a. Flame spread: Maximum 30 for $\frac{3}{4}$ inch thick panels; 30 for $\frac{1}{2}$ inch thick panels.
 - b. Smoke developed: Maximum 70 for $\frac{3}{4}$ inch thick panels; 85 for $\frac{1}{2}$ inch thick panels.
4. Panels shall be UL registered and labeled.

5. Panel shall be resistant to cleaning solvents and uric acid.
6. Product/Material Specification:
 - a. Modulus of Elasticity: 1.5 million psi minimum.
 - b. Shear Strength: 2,000 psi minimum.
 - c. Compressive strength: 24,000 psi minimum.
 - d. Water Absorption: 3 percent maximum.
 - e. Use Temperature: 350 degrees F maximum.
 - f. Surface and Edges: Non-porous.
 - g. Material Resistance: Will not support fungus or bacteria.
 - h. Uniform Load Deflection: ¼ inch maximum per Table A:

<u>Table A: Uniform Load (lbs) which causes ¼ inch deflection at Center</u>				
(Shelves not fixed at either end, static load on E modulus of 2.0 by 106)*				
Uniform Load in pounds:				
<u>Thickness</u>	<u>12 by 24-inch</u>	<u>12 by 36-inch</u>	<u>12 by 48-inch</u>	<u>24 by 36-inch</u>
½ inch	370	110	45	220
¼ inch	1,400	400	170	800
*Loads can be affected by temperature, humidity, time, and other environmental factors. Users should test shelves in appropriate environment. It is assumed that deflection greater than ¼ inch is undesirable aesthetically, even though rupture has not occurred.				

- B. Stainless Steel: ASTM A167, Type 304.
- C. Concealed Fasteners and Leveling Devices:
 1. Concealed Fasteners: Stainless steel.
 2. Leveling Devices: Zinc or cadmium coated steel, Stainless steel.

2.03 FABRICATION

- A. Doors shall be minimum ¾ inch thick, panels minimum ½ inch thick, pilasters minimum ¾ inch thick and screens minimum ½ inch thick. Edges shall be machined to a radius of 3/16 inch; exposed surfaces shall be free of fabrication marks.
- B. Pilasters: Flush, formed of ¾ inch thick solid phenolic panels. Edges shall be machined to a radius of 3/16 inch.

1. Door Dimensions: Unless otherwise indicated, furnish 24-inch wide in-swinging doors for standard toilet compartments, 36-inch wide clear opening out-swinging doors when located at the end, and 36-inch wide clear opening out-swinging doors when located at the side for stalls equipped for use by the physically disabled
 2. Anchorage: Provide stainless steel anchorage, complete and threaded rods, washers, and leveling adjustment nuts at pilasters, to permit connection to floor slab. Furnish devices, which are designed to support pilasters from structure without transmitting load to floor fill.
 3. Overhead Bracing: Provide anti-grip, decorative, heavy duty, extruded aluminum head rail with clear anodized finish.
- C. Panels and Urinal Screens: Flush, formed of ½ inch thick solid phenolic panels with a one inch corner radius. Height and width as indicated in drawings.

2.04 HARDWARE

- A. Door hardware shall be cast Type 304 stainless steel, as follows:
1. Hinges: 11 gage Cast Stainless Steel Hinge. Hinge shall be cast of type 304 stainless steel and shall have a Satin finish. Hinge shall be gravity type for self-closing action and shall be fully adjustable up to 360 degrees. Pivot pin shall be made of type 304 stainless steel. Only stainless steel components shall be used in the construction of the Hinge. Plastic inserts are unacceptable. Hinges shall provide emergency access by lifting the door. Hinges shall be pre-drilled for mounting to door and pilaster with Stainless Steel through-bolts. Stamped stainless steel is not acceptable.
 - a. Galaxy Hardware: CS-560 (LeftHand IN/RightHand OUT) or CS-561 (RightHand IN/LeftHand OUT).
 - b. Jacknob Corporation: 7273 (RightHand IN/LeftHand OUT) or 7283 (LeftHand IN/RightHand OUT).
 - c. Equal.
 2. Continuous Hinge: Continuous 14 gage stainless steel hinge (48.5”) shall be made of Type 302/304 Stainless Steel and shall have a Satin Finish. Hinge shall be 3” wide and shall have four (4) Stainless Steel wire springs for self-closing action. Pivot pin shall be .250” in diameter, and shall be made of Type 304 Stainless Steel. Hinges shall provide emergency access by lifting the door. Hinges shall be pre-drilled for mounting to door and pilaster with Theft Proof Stainless Steel Torx Head with Pin Through-Bolts. Brass inserts are unacceptable. Each Hinge Set is to be packaged in a separate carton, and is to be labeled by stock number, manufacturer, and left or right hand. Furnish one per door.
 - a. Galaxy Hardware: SS-953 (LeftHand IN/RightHand OUT) or SS-954 (RightHand IN/LeftHand OUT).

- b. Jacknob Corporation: 7339 (RightHand IN/LeftHand OUT) or 7349 (LeftHand IN/RightHand OUT).
 - c. Equal.
- 3. Strike and Keeper with Emergency Access: Refer to Detail #1 of this section. Strike and keeper shall be heavy duty ASTM A167, Type 304 cast stainless steel with a polished satin finish. All outside corners and edges shall be rounded to ensure there are no sharp edges. The strike and keeper shall provide emergency egress by lifting of the door. The strike and keeper shall be 2.50" high, with the mounting holes at 1.50" O.C. The wall thickness shall be a minimum of .125". The keeper shall have a minimum 7/8 inch tab to prevent impaling injuries. The strike and keeper shall be mounted to the pilaster with theft proof stainless steel Torx Head with pin through-bolts. Strike and keeper shall have an integral rubber bumper door stop rated and able to withstand a sudden impact of 350 lbs. Stamped stainless steel strike and keepers are unacceptable. Extra door stops that encumber the door opening and create a hazard are unacceptable. The stock number shall be molded into the back of strike and keeper for ease in identification. Furnish one per door.
 - a. Galaxy Hardware: CS-458 (inswing strike & keeper), or CS-456 (outswing strike & keeper).
 - b. Equal.
- 4. Slide Latch: Heavy duty cast stainless steel with satin finish. Slide latch shall be surface mounted. The slide bar shall be .150 inch thick, 1.020 inch wide and 3.720 inch long. Latch shall have an internal stainless steel buffering spring to prevent damage when door is inadvertently slammed against the latch. Mounting holes are to be spaced at 3.50 inch on center. Latch knob shall be riveted to the slide bar and welded to insure that the knob will not come off. Stock number shall be molded into the back of the slide latch for ease identification. Furnish one per door. Stamped stainless steel is not acceptable.
 - a. Galaxy Hardware: CS-233.
 - b. Jacknob Corporation: 5053
 - c. Equal.
- 5. Coat Hook: Heavy duty cast stainless steel with satin finish. Coat hook and bumper shall be 2.340 inch high, 1.230 inch wide and shall protrude out from the door 3.05 inch. The hook portion shall have a finished diameter of .250 inch thick. The stock number shall be molded into the back of the Coat Hook and Bumper for ease in identification. Furnish one per door. Stamped stainless steel is not acceptable. Mount at 48 inches maximum above finished floor in accessible toilet compartments.

- a. Galaxy Hardware: CS-274.
 - b. Jacknob Corporation.
 - c. Bobrick: B-212.
 - d. Equal.
6. Door Stop: Heavy duty cast stainless steel with satin finish. Plated Zarnac Door stops are unacceptable. Door Stop shall have a 2.125 inch base diameter and shall protrude 1.80 inch from the Wall. The bumper at the end of the Door Stop shall be .250 inch thick. The diameter of the shaft shall be .6875 inch. The stock number shall be molded into the back of the Door Stop for ease in identification. Stamped stainless steel is not acceptable.
- a. Galaxy Hardware: CS-276.
 - b. Jacknob Corporation: 4123.
 - c. Equal.
7. Pull Handle:
- a. Heavy duty cast stainless steel with satin finish. Plated Zamac Door pulls are unacceptable. Pull Handle shall protrude from the face of the door .940 inch and shall be 4.735 inch long. The Pull Handle shall have mounting holes drilled and tapped for 10/24 threads at 3.50 inch on center. The Pull Handle shall be .655 inch wide and shall be mounted back to back with the slide latch. The stock number shall be molded into the back of the pull handle for ease in identification. Stamped stainless steel is not acceptable. Provide u-pull shape handle on each side of accessible toilet compartment doors.
 - 1) Galaxy Hardware: CS-277.
 - 2) Jacknob Corporation: 6253.
 - 3) Equal.
 - b. Accessible Door Pull: 5-1/8 inch by 3 inch high stainless steel pull:
 - 1) Galaxy Hardware: PH-200.
 - 2) Jacknob Corporation: 6253.
 - 3) All Partitions A0625.
 - 4) Equal.
- B. Pilaster Shoes: ASTM A167, Type 302/304 Stainless Steel, minimum 3-inch high, 18 gauge, finish with #3 Directional polish, attached with stainless steel through bolts.

- C. Brackets: One piece double ear bracket or single ear bracket (at end partition) extending within 3 inches of top and bottom panel edges. Extruded 6063-T5 Aluminum with a satin anodized finish or 304 stainless steel. The minimum weight shall be 1.685 pounds per lineal foot. Inside opening of Bracket shall be .50 inch for panels, .75 inch for pilasters. Holes for mounting to wall and panel/pilaster shall be pre-drilled. Holes are to be spaced at 9 inches on center along the full length of the bracket for a total of twelve holes (double ear) for mounting to the wall and six holes (single ear) for mounting to the panel/pilaster. Each bracket is to have a minimum wall thickness of .125 inch.
- D. Overhead Bracing (Headrail): Continuous heavy duty extruded 6063-T5 Aluminum Headrail with anti-grip profile. Head rail shall have integral reinforcing channel and curtain track. Head rail shall have Satin Anodized finish. Provide headrail corner brackets, wall brackets, and headrail end caps as required. The headrail and headrail brackets shall have a minimum wall height of 2 inch. The minimum wall thickness of the headrail and head rail brackets shall be .125 inch.
 - a. Galaxy: AL-115 (16' antigrip headrail), EC-120 (3/4" END CAP), HP-132 (Headrail to wall bracket pack), HP-970 (Corner headrail bracket pack).
 - b. Jacknob Corporation: 80188 – Extruded Aluminum Headrail, 2109 Headrail Wall Brackets, 6672 Headrail End Caps.
 - c. Equal.
- E. Chrome-plated, non-ferrous cast alloy material shall not be furnished for hinges, brackets, locks, latches and other fittings and accessories.

PART 3 - EXECUTION

3.01 EXAMINATION AND PREPARATION

- A. Before covering wall framing with finish materials, examine framing to ensure that backing plates and structural framing have been installed in such position as to receive all attachment screws.
- B. Verify spacing of plumbing fixtures to ensure compatibility with installation of compartments.
- C. Do not start the Work of this section until all deficiencies have been corrected.

3.02 INSTALLATION

- A. Install partitions and screens as shown in the Shop Drawings and in accordance with manufacturer's instructions and as specified. Install straight, level and plumb.
- B. No evidence of drilling, cutting or patching shall be visible in finished Work.
- C. Fasten panel brackets securely to walls and ceilings with recommended anchoring devices.

- D. Fasten panels and pilasters to brackets with through bolts and nuts.
- E. Fasten urinal screen panels to walls with a continuous bracket.
- F. Provide ½ inch spaces between wall surface and panels or pilasters.
- G. Provide for adjustment of floor variations with non-breakable plastic shoes on pilasters. Conceal floor fastenings in pilaster shoes.
- H. Furnish each toilet compartment door with top and bottom hinges, and door latch.
- I. Install door strike keeper on each pilaster in alignment with door latch.
- J. Furnish each toilet compartment door with one coat hook and bumper.

3.03 TOLERANCES OF INSTALLED WORK

- A. Maximum Variation from Plumb or Level: 1/8 inch.
- B. Maximum Misplacement from Intended Position: 1/8 inch.

3.04 ADJUSTING AND CLEANING

- A. Hardware Adjustment: After installation, adjust hardware for proper operation. Install hinges on in-swinging doors to hold open approximately 30 degrees from the closed position when unlatched. Install hinges on out-swinging doors to return to the fully closed position. Door shall be plumb with pilasters when door is closed.
- B. Adjust and align door hardware to uniform clearance at vertical edges of doors. Clearance space shall not exceed ¼ inch.
- C. Cleaning: Clean compartments, hardware, and doors before Substantial Completion and leave free from imperfections. Remove protective coverings.

3.05 CLEANUP

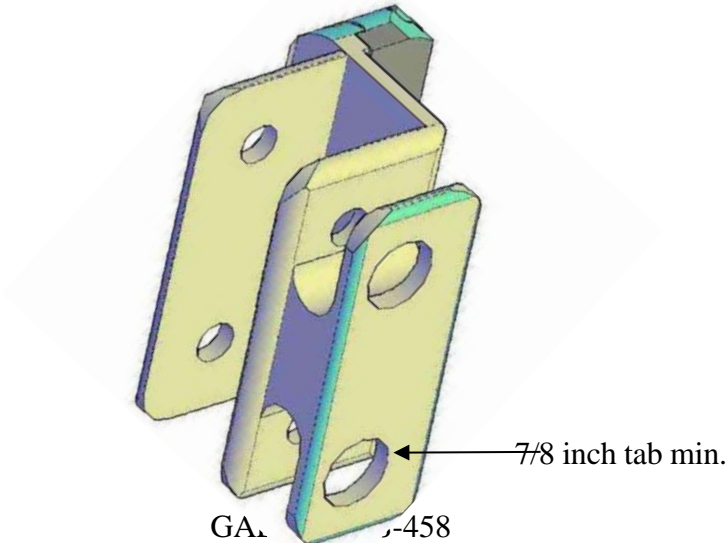
- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.06 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

DETAIL #1 – STRIKE AND KEEPER



SECTION 10 2239

FOLDING PANEL PARTITIONS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Manually operated, single panel partitions.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 05 5000 - Metal Fabrications.
3. Section 06 1000 - Rough Carpentry.
4. Section 08 7100 - Door Hardware.
5. Section 09 2900 – Gypsum Board.
6. Section 09 5113 – Acoustical Panel Ceilings.

1.02 PROJECT REQUIREMENTS

- A. Performance Requirements: Panels shall furnish a STC of 50 minimum when tested in accordance with ASTM E90.
- B. Regulatory Requirements: Panels shall furnish a Class A flame spread rating when tested in accordance with ASTM E84.

1.03 SUBMITTALS

- A. Shop Drawings: Submit complete Shop Drawings indicating construction and installation details.
- B. Product Data: Submit manufacturer's catalog data indicating products proposed for installation.
- C. Material Samples: Submit manufacturer's vinyl Samples indicating entire color and texture range, for selection by Architect.

1.04 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement:

1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 2. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 3. ASTM E119 - Standard Test Method for Fire Tests of Building Construction and Materials.
 4. ASTM E557 - Standard Guide for Architectural Design and Installation Practices for Sound Isolation between Spaces Separated by Operable Partitions.
 5. FS CCC-W-408A – Wall covering, Vinyl Coated.
- B. Qualifications of Installer: Installer shall be certified and trained by manufacturer to install the products of this section.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver panel partitions to the Project site in manufacturer's protective packaging.
- B. Store panels in a dry, sheltered area protected from exposure to moisture and weather.
- C. Protect materials from damage.

1.06 WARRANTY

- A. Manufacturer shall provide a 2-year material and workmanship warranty.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A.	<u>Manufacturer</u>	<u>Product Designation</u>	<u>STC</u>
	Modernfold	Acousti-Seal Premier	50
	Hufcor, Inc.	Series 641	50
	Advanced Equipment Corp. ,	Alpha	50
	Equal		50 minimum

2.02 FOLDING PANEL PARTITIONS

- A. Folding panel partitions shall be manually operated, single panel, center stacking, top supported, with multi-finger vinyl sweep seals activated automatically when panels are in closed position or activated through use of a lever.
- B. Panels shall be 2 ¾-inch thick minimum and shall consist of two face sheets of gypsum board, hardboard or plywood bonded to a wood or metal perimeter frame. Panels shall be supplied in widths as indicated on drawings.
- C. Seals: Vertical seals between panels shall consist of tongue and groove astragals providing a 1/2 inch minimum interlock for panel stability plus light and sound seals. Bottoms and tops of panels shall be equipped with continuous contact multi-finger vinyl sweep seals. Seals shall be easily replaceable without disassembling wall or individual panels.
- D. Suspension system shall consist of a continuous roll formed 11 gage minimum steel track. Each panel shall be supported by a 4-wheel steel ball bearing trolley.
- E. Vinyl Panel Finish: Shall meet or exceed FS CCC-W-408A, Type II, class A flammability per ASTM E84.
- F. Pass door shall be 3-foot by 7-foot flush door. Provide manufacturers standard accessible door assembly.
- G. Door Hardware:
 - 1. Lever handles both sides of door.
 - 2. Automatic door closer.
 - 3. Door viewer.
 - 4. Self-Illuminated exit signs: Photo luminescent exit sign – surface mount
- H. Marker boards shall be porcelain enamel steel formed around panel edges, with installed edge molding. Edges shall be dark bronze molding. Marker board and tack boards shall be 48 inches high, located as indicated on Drawings.
- I. Tackboards shall be 48 inches high located as indicated on Drawings. Tack boards shall be fiberboard covered with jute-textured vinyl fabric. Edges shall be trimmed with metal molding, finish as selected by Architect.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Before the Work of this section is started, examine room, floor and supporting framework. Verify that variation in floor surface level is not greater than allowable tolerances recommended by folding panel partition manufacturer. Correct deficiencies before starting the Work of this section.

3.02 INSTALLATION

- A. Installation shall be in accordance with manufacturer's written recommendations, and ASTM E557.
- B. Fasten track to structural support with steel hangers or brackets as indicated.

3.03 FIELD QUALITY CONTROL

- A. Verification of Performance: The Owner reserves the right to verify performance of in-place systems.
- B. Manufacturer's Field Services: Manufacturer's authorized representative shall visit the Project site at least once a day during installation of the Work of this section.

3.04 ADJUSTING

- A. Adjust for smooth and balanced movement of panels on track. Adjust each panel seal for optimum contact and acoustical performance.

3.05 CLEANING

- A. Perform final detailed cleaning and dusting, ready for occupancy. Vacuum panel faces and edges of seals.

3.06 DEMONSTRATION

- A. Perform demonstration and two hour training session to Owner personnel.
 - 1. Demonstrate operation of panels, from stacked open position to fully sealed position.
 - 2. Instruct in movement and placement of panels and activation of seals.
 - 3. Instruct in removal, repair and reinstallation of typical panel, including readjustment of seals.

3.07 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.08 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 10 2813
TOILET ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Toilet accessories.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 06 1000- Rough Carpentry.
3. Section 05 4100 – Structural Metal Stud Framing.
4. Section 10 2113 - Phenolic Toilet Compartments.
5. Section 10 2815 – Hand and Hair Dryers.

1.02 REGULATORY REQUIREMENTS

- A. Comply with CBC Chapter 11B requirements and ADAAG recommendations for accessibility.

1.03 SUBMITTALS

- A. Shop Drawings: Submit a schedule of accessories and Shop Drawings indicating installation methods and fasteners.

1.04 QUALITY ASSURANCE

- A. Coordinate related Work as required to ensure proper and adequate provision in framing of backing and wall finish for installation of accessories.
- B. Coordinate requirements of Section 10 2113 - Plastic Toilet Compartments to ensure that correct openings are provided in partitions for toilet accessories where required.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Protect accessories from damage.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Accessories shall be provided with necessary anchoring devices and fasteners appropriate for surfaces on which items are to be fastened.

2.02 MATERIALS

- A. Liquid Soap Dispenser: 20 gage stainless steel, 40-ounce. capacity, tamper-proof cap and concealed vandal-proof mounting. Continental V 444SS, ASI 0347, Bobrick B-2111, or equal. Provide soap dispensers at classrooms with sinks, restrooms, kitchen, faculty and staff eating and lounge areas with sinks, custodian rooms and showers.

- B. Toilet Paper Boxes:

- 1. For Children's and Public Restrooms:

- a. Non-accessible toilet compartments: Surface mounted units are required.
 - b. Accessible adult toilet rooms or compartments: semi-recessed Bobrick B-3888, ASI-0031, Bradley 5412 (double roll tissue holder without paper roll spindle stops), or equal.
 - c. Accessible elementary or kindergarten toilet rooms or compartments: semi-recessed Bradley 5124 (double roll tissue holder without paper roll spindle stops), or equal

- 2. For Staff Restrooms:

- a. Non-accessible toilet compartments: ASI 0264-1A2, Bobrick B-27460 (double roll tissue holder), Bradley, or equal.
 - b. Accessible toilet rooms or compartments:
 - 1) Semi-recessed Bobrick B4388 or 3888, ASI 0031, Bradley 5412 (double roll tissue holder without paper roll spindle stops), or equal.
 - 2) Surface mounted ASI 0264-1A2, Bobrick B-27460 (double roll tissue holder), Bradley, or equal.
 - 3) Semi-recessed or surface mounted toilet paper dispensers to conform to accessibility clearances and requirements.

- C. Paper Towel Boxes: Surface mounted, Type 304 stainless steel, satin finish. Door with tumbler lock and piano hinge ASI 0245-SS, Bobrick B-263, Crown Zellerbach, or equal.

- 1) Paper towel boxes are to be provided at faculty and staff restrooms, early education center student restrooms, kindergarten restrooms, kitchens, faculty and staff dining and lounge areas with sinks, custodial rooms and classroom with sinks. Plans should indicate locations.
- D. Grab Bars: 1-1/4 inches diameter by 18 gage stainless steel tubing, of size and configuration indicated. Ends shall be screwed to 11 gage stainless steel wall plate, with snaplock cover flanges. Grab bars over 36 inches in length shall be furnished with stainless steel support at mid point. Exposed stainless steel to be 180 grit satin finish. ASI 3700 series, Tubular Specialties Manufacturing, Inc. series Q-CS-1, Bobrick, or equal.
 - E. Mirrors: Framed mirror, with one piece roll-formed 3/4 inch by 3/4 inch Type 304 stainless steel angle frame, with satin finish. Corners shall be heliarc welded, ground and polished smooth. Glass shall be No. 1 quality 1/4 inch float glass, electrolytically copper-plated. Frame shall be furnished with a continuous integral stiffener on sides. Back of mirror shall be protected by 1/8 inch thick, waterproof, shock-absorbing polyethylene padding and 20 gage galvanized steel back attached to frame with concealed screws. Mirror shall be provided with a 20 gage wall hanger. ASI 0600, Bobrick B-290 series, Bradley, or equal. Size as indicated on Drawings.
 - F. Toilet Seat Cover Dispensers (Faculty and Staff Toilet Rooms only): Surface-mounted, Type 304 stainless steel, satin finish. ASI 0477SM, Bobrick B-221, Bradley, or equal.
 - G. Sanitary Napkin Vendors and Disposals
 1. Vendors: Surface mounted, Type 304 stainless steel, satin finish, tumbler lock, single 25 cent coin operation. ASI 0864, Bobrick B-2800, Bradley, napkin/tampon dispenser, or equal.
 2. Disposals in non-accessible toilet compartments Surface-mounted, Type 304 stainless steel, satin finish, ASI 0473-A, Bobrick B-270, Bradley, or equal.
 3. Disposals in accessible toilet rooms or compartments: recessed, semi-recessed or 3-inch maximum projection from wall surface; Bobrick B 353 (recessed), ASI 0473 (recessed), Bradley, or equal. Provide disposals at women's restrooms, unisex toilets, girls restrooms at middle and high schools, and nurses restrooms at schools. Plans should indicate locations.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Check openings in substrates to receive accessories. Verify openings are correctly located and sized to receive accessories, and that locations will comply with disability access requirements. Confirm that blocking, backing or support is properly located and adequate for the accessory installation.

- B. Verify spacing of plumbing fixtures and toilet partitions. Confirm spacing and locations are compatible with proposed accessory locations and will allow compliance with disability access requirements.

3.02 INSTALLATION

- A. Provide sufficient clearance from obstructions such as cabinets, shelves, ledges, etcetera to allow for refiling of dispensers.
- B. Install toilet accessories in accordance with manufacturer's written recommendations and accessibility requirements. Fasten components firmly in place.
- C. Drill holes to correct size and application that is concealed by item with ¼ inch tolerance.
- D. Install recessed accessories into wall openings with sheet metal screws into metal frames.
- E. Install surface-mounted accessories to backing plates with machine screws, plumb, and aligned.
- F. Grab Bars:
 - 1. Fasten to toilet partition with 3-inch diameter stainless steel back plates with studs, couplings, and stainless steel machine screws.
 - 2. At wood stud walls, fasten wood blocking with threaded stainless steel wood screws of sufficient length to penetrate blocking 1 ¼-inch minimum.
 - 3. At metal stud walls, provide 1/8 inch cold-rolled steel plate, drilled and tapped for machine screws, or 16 gage cold-rolled steel plate complete with threaded sleeves for stainless steel machine screws. Weld plates to studs.
 - 4. At concrete or masonry walls, install bars with sheet metal screws and expansion anchors.
 - 5. At plaster or gypsum board walls, provide spacers of same thickness as wall material to prevent crushing of wall material.
- G. Mirrors: Install mirror on manufacturer supplied concealed wall hanger and fasten with two theft-resistant locking screws.
- H. Stainless Steel Medicine Cabinet: Fasten cabinet to wall.
- I. Before Substantial Completion, deliver keys and maintenance instructions and product data to OAR.

3.03 ADJUSTING AND CLEANUP

- A. Adjust accessories for proper operation.
- B. Remove rubbish, debris, and waste material and legally dispose of off the Project site.

3.04 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 22 0500

COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this and the other sections of Division 22.
- B. This Division is an integrated whole comprising interrelated and interdependent Section and shall be considered in its entirety in determining requirements of the Work.
- C. Refer to other sections of this Division for additional requirements or information regarding the subjects of this Section.

1.02 SECTION INCLUDES

- A. This Section includes general administrative and procedural requirements for mechanical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01:
 - 1. Submittals.
 - 2. Coordination drawings.
 - 3. Record documents.
 - 4. Maintenance manuals.
 - 5. Rough-ins.
 - 6. Plumbing installations.
 - 7. Cutting and patching.

1.03 DESCRIPTION

- A. Provide a complete and operable installation, including all labor, supervision, materials, equipment, tools, apparatus, transportation, warehousing, rigging, scaffold-

ing and other equipment and services necessary to accomplish the work in accordance with the intent and meaning of these drawings and specifications

1.04 DEFINITIONS

- A. "Provide" means furnish, install and connect unless otherwise described in specific instances. B. "Piping" means pipes, fittings, valves and all like pipe accessories connected thereto.
- C. "Ductwork" means ducts, plenums, compartments, or casings including the building structure, which are used to convey or contain air.
- D. "Extend", "Submit", "Repair" and similar words mean that the Contractor (or his designated subcontractor) shall accomplish the action described.
- E. "Codes" or "Code" means all codes, laws, statutes, rules, regulations, ordinances, orders, decrees, and other requirements of all legally constituted authorities and public utility franchise holders having jurisdiction.
- F. "Products", "Materials" and "Equipment" are used interchangeably and mean materials, fixtures, equipment, accessories, etc.
- G. "Utility Areas" are defined as mechanical, electrical, janitorial, and similar rooms or spaces which are normally used or occupied only by custodial or maintenance personnel. "Public Areas" are defined as the rooms or spaces, which are not included in the utility areas definition.
- H. "Building Boundary" includes concrete walkways immediately adjacent to the building structure.
- I. "Below Grade" means buried in the ground.
- J. "Substantial Mechanical Completion" means all components of all systems are functioning but lacking in final adjustment.
- K. Pressure rating specified (such as for valves and the like) means design working pressure for and with references to the fluid, which the device will serve.

1.05 RELATED WORK

- A. Coordination: Refer to Architectural, Civil, Structural, and Electrical Drawings for the construction details and coordinate the work of this Division with that of other Divisions. Order the work of this Division so that progress will harmonize with that of other Divisions and all work will proceed expeditiously. The work of this

Division shall include direct responsibility for the correct placing and connection of mechanical work in relation to the work of other Divisions.

- B. Examine other Divisions for work related to the Work of this Division, especially Electrical.

1.06 EXISTING CONDITIONS

- A. Visit the site prior to bidding and investigate the existing conditions, which affect or will be affected by the work of this Division. Become thoroughly familiar with the working conditions and take into account any special or unusual features peculiar to this job. By the act of submitting a Bid, the Contractor will be deemed to have complied with the foregoing, to have accepted such conditions, and to have made allowance therefore in preparing his Bid.
- B. The locations of existing concealed utility lines are shown in accordance with reference data received by the Architect. The Architect does not guarantee the accuracy of such data. The points of connection are therefore approximate and the Bidder shall include adequate funds in his Bid to cover costs of connection regardless of their exact location.
- C. Exercise extreme caution during trenching operations. Repair the damage caused by such operations to existing utility lines at no cost to the Owner, whether the lines are shown on drawings or not.

1.07 DRAWINGS AND SPECIFICATIONS

- A. These drawings and specifications do not include necessary components for construction safety. B. All provisions shall be deemed mandatory except as expressly indicated as optional by the word "may" or "option".
- C. Except where dimensioned, the drawings relating to this division are a diagrammatic presentation of the design concept, which indicates the general area where piping and ductwork is to be run. The drawings do not necessarily indicate any and all offsets and configurations required for coordination with other trades. The contractor is responsible for the correct placing of his work, and the proper location and connection of his work in relation to the work of other trades.

1.08 PERMITS AND INSPECTIONS

- A. Obtain, schedule and pay for permits, licenses, approvals, tests, and inspections required by legally constituted authorities and public utility franchise holders having jurisdiction over the work.

- B. Afford the Architect's representative every facility for evaluating the skill and competence of the mechanics and to examine the materials. Concealed work shall be reopened when so directed during his periodic visits.

1.09 CODES AND REGULATIONS

- A. By submitting a Bid, Contractor is deemed to represent himself as competent to accomplish the work of this Division in conformance with applicable Codes. In case of conflict between the Contract Documents and Code requirements, the Codes shall take precedence. Should such conflicts appear, cease work on the parts of the contract affected and immediately notify the Architect in writing. It shall be the Contractor's responsibility to correct, at no cost to the Owner, any work he executes in violation of Code requirements. Specific references to codes elsewhere in this Division are either to aid the Contractor in locating applicable information or to deny him permission to use options, which are permitted by Codes.
- B. Applicable Codes: (Current editions unless otherwise noted)
 - 1. All local codes; city and/or county as applicable.
 - 2. OSHA requirements
 - 3. California Code of Regulations (CCR) Titles (as applicable)
 - 4. Fire Marshal Regulations
 - 5. State, County, City Health Department Ordinances and Regulations
 - 6. Regulations of all other authorities having jurisdiction.
 - 7. California Mechanical Code.
 - 8. California Plumbing Code.
- C. Where conflict or variation exists amongst Codes, the most stringent shall govern.

1.10 SUBMITTALS

- A. General: Follow the procedures specified in Division 01.
- B. Mechanical Submittals: Increase the number of mechanical related shop drawings, product data, and samples submitted to allow for required distribution by one additional copy, which will be retained by the Mechanical Consulting Engineer.

- C. Product Data: Assemble "product data" into tabbed brochures according to main areas of work i.e. Fire Protection; Plumbing; H.V.A.C.; Temperature Control; Testing, Adjusting, and Balancing.
1. Assemble each brochure with tabbed separators for each Specification Section where products are noted to be submitted, with separate tabs for each product listed.
 2. Temperature "control shop drawings" may be submitted separately after preparations for review.
 3. For items such as valves, hangers and accessories, indicate specific items and where they are to be used.
 4. Contractor need only to submit for review those items specified to be submitted, unless requested by the Architect for special review.
- D. Submit for review, only the specific items required in this Section or other Sections of Division 22. E. Additional submittals shall include, but not limited:
1. Air balance reports and equipment data record drawings.
 2. Certification of completion of testing.
 3. Certification of completion of operation instructions.
 4. Operating instruction brochure.
 5. Maintenance instruction brochures.
 6. Equipment guarantees.
 7. 1/4" = 1'-0" or larger scale layouts of "Equivalent" equipment or "Or Approved Equal" equipment.
 8. Coordination Drawings, where requested or required.
- F. Submittal materials will be reviewed for substantial conformity with the intent of the contract plans and specifications only. Such review does not indicate approval of dimensions, quantities, coordination with other trades, or work methods of the contractor, which are indicated thereon.
- G. Additional copies may be required by individual sections of these specifications.

1.11 COORDINATION

- A. The Contractor shall be responsible for coordinating the layout of all building elements to avoid conflict of the work of the structural, mechanical, electrical systems, and architectural features of the building.
- B. The cost of any extra work of any kind caused by a conflict due to this lack of coordination shall be borne by the Contractor.
- C. Contractor shall designate an individual competent and versed in the mechanical trades to coordinate the mechanical work with the work of other trades.

1.12 COORDINATION OF DRAWINGS

- A. Prepare coordination drawings in accordance with Division 01 to a scale of 1/8" = 1'-0" or larger; detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of the installations are of importance to the efficient flow of the Work, including but not necessarily limited to the following:
 - 1. Indicate the proposed locations of piping, ductwork, equipment, and materials. Include the following:
 - a. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
 - b. Equipment for connections and support details.
 - 2. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, sprinklers, and other ceiling-mounted items.
- B. Submittal of "Or Approved Equal" substitutions of equipment will not be reviewed unless accompanied by coordination drawings.

1.13 RECORD AND DOCUMENTATION

- A. Prepare record documents in accordance with the requirements in Division 01. In addition to the requirements specified in Division 01, indicate the following installed conditions:
 - 1. Record as specified in Division 01 the locations and invert elevations of underground installations.

2. Accumulate the following and deliver to the Owner's representative prior to final acceptance of the work.
3. Record (As-Built) Drawings:
 - a. Maintain in good order in the field office a complete set of prints for all work being done under Division 15. Update the drawings daily with neat and legible annotations in red ink showing the work as actually installed.
 - b. The actual size, location and elevation of all buried lines, valve boxes, manholes, monuments, and stub-outs shall be accurately located and dimensioned from building walls or other permanent landmarks.
 - c. Furnish the originals.
4. Operation and Maintenance Manual: Furnish an operation and maintenance manual covering the stipulated mechanical systems and equipment. Seven copies of the manual, bound in hardback binders or an approved equivalent shall be provided to the Architect.
5. Furnish one complete manual prior to the time that system or equipment tests are performed.
6. Furnish the remaining manuals before the contract is completed.
7. The following identification shall be inscribed on the cover: OPERATION AND MAINTENANCE MANUAL – ADMINISTRATION BUILDING ADDITION.
8. Provide a table of contents. Insert tab sheets to identify discrete subjects. Instruction sheets shall be legible and easily understood, with large sheets of drawings folded in. The manual shall be complete in all respects for all materials, piping, valves, devices and equipment, controls, accessories and appurtenances stipulated. Include as a minimum the following:
 - a. Updated approved materials lists, shop drawings and catalog information of all items of mechanical system equipment.
 - b. System layout showing piping, valves and controls.
 - c. Wiring and control diagrams with data to explain detailed operation and control of each component.
 - d. A control sequence describing start-up, operation and shutdown.
 - e. Detailed description of the function of each principal component of the system.
 - f. Procedure for starting.

- g. Procedure for operating.
 - h. Shut-down instructions.
 - i. Installation instructions.
 - j. Adjustments, maintenance and overhaul instructions.
 - k. Lubrication schedule including type, grade, temperature range and frequency.
 - l. Safety precautions, diagrams and illustrations.
 - m. Test procedures.
 - n. Performance data.
 - o. Parts list, with manufacturer's names and catalog numbers.
 - p. Preventive maintenance schedule.
 - q. Service organization with name, address and telephone number.
 - r. Valve identification chart and schedule.
- B. Standards Compliance: Where equipment or materials are specified to conform with requirements of standards of recognized technical or industrial organizations such as American National Standards Institute (ANSI) American Society for Mechanical Engineers (ASME) American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE), American Society for Testing and Materials (ASTM), Underwriters Laboratories (UL), American Gas Association (AGA), American Refrigeration Institute (ARI), or National Electrical Manufacturer's Association (NEMA), that use a label or published listing as a method of indicating compliance, proof of such conformance shall be submitted and approved. The label or listing of the specified organization will be acceptable evidence.
- C. Certificates of Conformance or Compliance: Submit original and not pre-printed certifications. Do not make statements in the certifications that could be interpreted to imply that the product does not meet all requirements.
- D. Certified Test Reports: Certified Test Reports are reports of tests conducted on previously manufactured materials or equipment identical to that proposed for use. Before delivery of materials and equipment, submit certified copies of test reports specified in the individual sections.

- E. Factory Tests: Factory tests are tests, which are required to be performed on the actual materials or equipment, proposed for use. Submit results of the tests in accordance with the requirements for laboratory test results of this Contract.
- F. Permits and Certificates of Inspection: Furnish the originals.
- G. Testing procedures and test results required in this and other sections. Furnish 2 copies.
- H. Other data required by other sections of this Division. Furnish 2 copies.

1.14 MAINTENANCE MANUALS

- A. Prepare maintenance manuals in accordance with Division 01.

1.15 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

1.16 EQUIVALENT EQUIPMENT

- A. These specifications and/or drawings names and specifies certain equipment in detail. It also names equivalent equipment by manufacturer, which is not considered to be a "substitution".
- B. Submit equivalent equipment to the Architect for review per the requirements of Division 01, and Section "Basic Mechanical Requirements."
- C. Equipment of Manufacturers named in Division 22 will be considered equivalent to that specified in detail and/or named on the drawings if:
 - 1. The proposed equipment is of equivalent quality, capacity.
 - 2. Equipment is as fully equipped, fits the space allotted, and has physical configuration and weight similar to the equipment specified in detail.
- D. A complete lay out of an equipment room or area must be submitted for equivalent equipment. Notice space limitations. Layouts to include plans and section views at a scale of not less than 1/4" = 1 ft.
- E. The Architect shall determine the acceptability of "Equivalent Equipment."

1.17 CONSTRUCTION COST BREAK DOWN

- A. Prepare and submit for review a construction cost breakdown for the major subdivisions of the mechanical work in accordance with General and Supplemental Conditions and Division 1.
- B. Subdivide each item on the breakdown into two headings: labor and materials. Include overhead and profit in each entry.
- C. Submit one copy of the breakdown directly to the Engineer and the remaining copies sent through regular channels.

1.18 TOOLS

- A. Provide all special tools needed for proper operation and routine adjustment and maintenance of systems and equipment. Deliver tools to Owner's representative and request a receipt for same.

1.19 WARRANTIES

- A. Refer to Division 1 Section for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements.
- B. Where periods more than one year are specified in the specifications, such longer periods shall govern. However, when any component fails at any time during this period, the warranty period for such component and all other components, which are inactive because of, said failure shall be suspended. The warranty period for such components shall resume running for the remaining portion of the warranty period when failed component is completely repaired and in operation; however, in no case shall the resumed portion of the warranty period be less than 3 months in duration.
- C. Neither payment for work, nor total or partial occupancy of work by the Owner, within or prior to the warranty period specified, shall be construed as acceptance of faulty work or shall condone any negligence or omission of Contractor in doing the work.
- D. Compile and assemble the warranties specified in Division 15, into a separated set of vinyl covered, three ring binders, tabulated and indexed for easy reference.
- E. Provide complete warranty information for each item to include product or equipment to include date of beginning of warranty or bond; duration of warranty or bond; and names and addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.20 SEISMIC RESTRAINT

- A. Provide seismic restraint for mechanical equipment, piping, and ductwork.
- B. Contractor shall submit certification of suitability of seismic restraint methods signed by Structural Engineer registered in State of California.
- C. Contractor may refer to details applicable in the SMACNA, "GUIDELINES FOR SEISMIC RESTRAINT OF MECHANICAL SYSTEMS", using the 'g' forces for "other buildings" classification CCR Title 24. Deliver a copy of these Guidelines to the Owner's Resident Inspector.

1.21 SYSTEM OPERATIONAL TEST

- A. The Contractor shall inform the Owner in writing one week prior to starting this testing in order that the Owner's representative may be present.
- B. After balancing and prior to final inspection, the contractor shall operate all systems continuously trouble free and stable for a minimum period of fourteen (14) consecutive days including Saturday and Sunday. Each day shall be a minimum of an 8-hour day. Should a problem arise, the fourteen (14) day period shall be restarted and repeated until successfully operated for full 14 days. A written report certified by the Owner's representative shall indicate the successful completion of a stable and trouble free 14-day period.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Standard Products: Materials and equipment shall be essentially the standard cataloged products of manufacturers regularly engaged in production of such materials or equipment and shall be their latest standard designs that comply with the specification requirements.
- B. Materials and equipment shall duplicate items that have been in satisfactory commercial or industrial use at least two years prior to bid opening, unless more stringent requirements are specified. Where two or more units of the same type of equipment are required, these units shall be products of a single manufacturer. The components thereof, however, are not required to be exclusively of the same manufacturer.
- C. Each major component of equipment shall have manufacturer's name, address, model, and serial number on a nameplate securely affixed in a conspicuous place. The nameplate of the distributing agent will not be acceptable.

- D. Whenever on the plans, or in these specifications, products are identified by the name of one manufacturer, it is intended that equivalent products of other manufacturers are acceptable, unless otherwise indicated, if accepted as a substitution by the Architect.
- E. Where three or more manufacturers are listed as "acceptable manufacturers" however, then the products furnished shall be the product of one of the manufacturers listed. Manufacturers listed as "acceptable manufacturers" shall be considered "Equivalents" and shall meet quality and performance of a particular one specified by both name and catalog number.

2.02 PRODUCT LISTING

- A. When two or more items of same material or equipment are required (plumbing fixtures, pumps, valves, air conditioning units, etc.) they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, pipe, tube, fittings (except flanged and grooved types), sheet metal, wire, steel bar stock, welding rods, solder, fasteners, motors for dissimilar equipment units, and similar items used in Work, except as otherwise indicated.

2.03 NAMEPLATE DATA

- A. Provide permanent operational data nameplate on each item of power operated mechanical equipment, indicating manufacturer, product name, model name, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location.

2.04 SUBSTITUTIONS

- A. General: Submittals of "Substitutions" shall be in accordance with requirements of Division 1. B. By proposing a substitution, it is deemed that the Contractor shall bear the cost of any change (whether architectural, structural, electrical or mechanical) necessary to accommodate the substitution, if said substitution is accepted.
- C. Specific: Refer to other sections of this Division for additional requirements.

2.05 SUBMITTALS

- A. General: Make submittals in accordance with requirements of Division 1.
- B. Specific: Refer to other sections of this Division for additional requirements.

PART 3 EXECUTION

3.01 WORKMANSHIP AND INSTALLATION METHODS

- A. Workmanship shall be in the best standard practice of the trade.
- B. Install equipment in accordance with the manufacturer's instructions and recommendations unless otherwise noted or specified.

3.02 TEST

- A. General:
 - 1. Demonstrate that all components of the work of this Division have been provided and that they operate in accordance with the Contract Documents.
 - 2. Provide instruments and personnel for tests and demonstrations. Submit signed test results.
- B. Specific: Refer to the other sections of this Division for test requirements.

3.03 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications in Divisions 02 through 23 for rough-in requirements.

3.04 MECHANICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:
 - 1. Coordinate mechanical systems, equipment, and materials installation with other building components.
 - 2. Verify all dimensions by field measurements.
 - 3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
 - 4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in- place concrete and other structural components, as they are constructed.

5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
7. Coordinate connection of mechanical system with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.
9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
10. All mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components in full compliance with the equipment manufacturer's recommendations. If the drawings or the manufacturer does not provide a specific space requirement for servicing equipment, provide as a minimum, horizontal distance of 36" from face of equipment to opposite vertical surface.
11. Install access panels or doors, in sizes large enough to allow adequate access for testing and maintenance, where units are concealed behind finished surfaces.
12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
13. Any equipment located above a ceiling that has any component which is serviceable shall be installed within 12" of the top of the ceiling, and so that all components are accessible.

3.05 CUTTING AND PATCHING

- A. General: Perform cutting and patching in accordance with Division 01. In addition to the requirements specified in Division 01, the following requirements apply:

1. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
- B. Perform cutting, fitting, and patching of mechanical equipment and materials required to:
1. Uncover Work to provide for installation of ill-timed Work.
 2. Remove and replace defective work.
 3. Remove and replace Work not conforming to requirements of the Contract Documents.
 4. Remove samples of installed Work as specified for testing.
 5. Install equipment and materials in existing structures.
 6. Upon written instructions from the Architect, uncover and restore Work to provide for Architect/Engineer/Inspector observation of concealed Work.
- C. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including but not limited to removal of mechanical piping, heating units, plumbing fixtures and trim, and other mechanical items made obsolete by the new Work.
- D. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
- E. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
- F. Patch existing finished surfaces and building components using experienced installers and new materials matching existing materials. For installer's qualifications refer to the materials and methods required for the surface and building components being patched.
- 3.06 DELIVERY, HANDLING, STORAGE OF MATERIALS AND PROTECTION OF WORK
- A. Protect materials against dirt, water, chemical and mechanical damage both while in storage and during construction.
- B. Cover materials in such a manner that no finished surfaces will be damaged, marred or splattered with plaster or paint, and all moving parts will be kept clean and dry.

- C. Replace or refinish any damaged materials including fronts of control panels, ductwork fittings, and shop-fabricated ductwork.
- D. Keep cabinets and other openings closed to prevent entry of foreign matter. E. Specific: Refer to other sections of this Division for additional requirements.

3.07 PROJECT CONDITIONS

- A. Check and coordinate for clearance, accessibility and placement of equipment either by going through openings provided or by placing equipment during construction. Ordering of equipment to be shipped disassembled, or disassembly of equipment at Project Site and reassembly of equipment to accomplish this requirement shall be executed without additional cost. Where provided openings are inadequate to accommodate equipment, provide new openings and restoration of same, all at no additional cost. Obtain written approval for new openings before proceeding.
- B. Verify location of all plumbing fixtures and equipment within finished spaces with the Architectural Drawings. In the event that Mechanical Drawings do not indicate exact locations, or are in conflict with the Architectural Drawings, obtain information regarding proper locations. Installation of work without proper instruction under such circumstances will result in relocation of work, when directed, without additional cost.

3.08 INSTRUCTION TO OWNER PERSONNEL

- A. When specified in other sections, the Contractor shall furnish, without additional expense to the Owner, the services of competent instructors who will give full instruction to the designated personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the equipment or system specified. Each instructor shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance of work. Instruction shall be given at the Owner's convenience. The number of man-days (eight-hours) of instruction furnished shall be as specified in other sections. When more than four man-days of instruction are specified, approximately half of the time shall be used for classroom instruction. All other time shall be used for instruction with the equipment or system. When significant changes or modifications are made under the terms of the contract, provide additional instructions to acquaint the operating personnel with the changes or modifications.
- B. Contractor shall electronically record, both visual and audio, instruction to Owner's personnel on the maintenance and operation of the mechanical systems.

- C. Submit certification, signed by Owner's agent that instructions have been completed and the electronic record has been reviewed and delivered to the Owner.
- D. Printed operating instructions and a copy of wiring diagrams are to be mounted in all equipment areas, framed and behind glass or encased in plastic. Printed operating instructions shall include steps for starting up and securing equipment. As a precedent to final acceptance four (4) copies of instructions are to be submitted to the Architect for review. Contractor shall turn over to Owner in a neat brochure form, equipment guarantee and maintenance instructions.

3.09 CLEANING

- A. Cleaning shall be done as the work proceeds. Periodically remove waste and debris to keep the site as clean as is practical.
- B. Refer to the Division 01 Sections for general requirements for final cleaning.
- C. Leave exposed parts of the mechanical work in a neat, clean and usable condition, with painted surfaces unblemished and plated metal surfaces polished.
- D. Thoroughly clean all materials, equipment and appliances. Clean and prepare all surfaces to be painted. Clean the entire premises of unused materials, debris, spots and marks to the satisfaction of the Architect and District Representative.
- E. Remove, thoroughly clean and replace all strainers and automatic valves after the system has been put in operation until system is clear of all foreign matter and repeat this operation after ten (10) days and again after the system has been in operation thirty (30) days. Submit certification that this operation has been completed.

3.10 SAFETY REQUIREMENTS

- A. Enclose and guard belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts in accordance with OSHA requirements. Insulate, guard, and cover any high- temperature equipment and piping so located as to endanger personnel or create a fire hazard.

END OF SECTION 220500

SECTION 22 0523

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1. Submittal scheduling 01 32 00
2. Submittal Procedures 01 33 00
3. Substitution Procedures 01 25 00

Should the Contractor desire to substitute any material, equipment or other items for those specified, he shall submit a complete list, including detailed equipment layouts. Any changes required by the furnishing and installation of substituted material, equipment and other item shall be arranged for and paid for by the contractor; any expense incurred is part of this contract.

4. Equivalent Equipment 01 25 00

In addition to detailed specifications of materials and equipment, the specifications make reference to "substitutions" which is not to be construed as equivalent.

"Equivalent equipment" will be considered as complying with the contract documents if the quality, features, performance, physical shape and appearance of the "equivalent equipment" are in the Architect's opinion the same or similar to those of the material and equipment described in detailed specifications.

5. Drawings and Specifications: The drawings and specifications are deemed to be complementary. In case of discrepancy or overlapping conflicting requirements between the drawings and the specifications, the contractor shall provide the more expensive alternate unless he has obtained a written clarification prior to bid opening. Anything shown on the drawings and not mentioned in the specifications, and not shown on the drawings, shall be deemed to have mentioned in both. Should the material and equipment shown on the drawings not be specified by name, model number and description, the contractor shall provide such material and equipment in accordance with the Architect's selection unless he has obtained a written clarification prior to bid opening.

1.02 SUMMARY

A. Section Includes:

1. Bronze ball valves.

B. Related Sections:

1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
3. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

1.03 DEFINITIONS

- A. C.W.P: Cold Working Pressure

1.04 SUBMITTALS

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

1.05 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set gate, and globe valves closed to prevent rattling.
4. Set ball valves open to minimize exposure of functional surfaces.

5. Block checks valves in either closed or open position.
- B. Use the following precautions during storage:
1. Maintain valve end protection.
 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valves in Insulated Piping: With 2-inch stem extensions and the following features.
1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
- E. Valve-End Connections:
1. Flanged: With flanges according to ASME B16.1 for iron valves.
 2. Solder Joint: With sockets according to ASME B16.18.
 3. Threaded: With threads according to ASME B1.20.1.
- F. Valve Bypass and Drain Connections: MSS SP-45.

2.02 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.

- b. Apollo
 - c. Hammond Valve.
2. Description:
- a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded or Soldered.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for ball, gate and globe valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

3.03 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, or gate valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.05 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Class 125, Class 150, bronze disc.
3. Ball Valves: Two piece, full port, bronze trim.

END OF SECTION 220523

SECTION 22 0529

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1. Submittal scheduling 01 32 00
2. Submittal Procedures 01 33 00
3. Substitution Procedures 01 25 00

Should the Contractor desire to substitute any material, equipment or other items for those specified, he shall submit a complete list, including detailed equipment layouts. Any changes required by the furnishing and installation of substituted material, equipment and other item shall be arranged for and paid for by the contractor; any expense incurred is part of this contract.

4. Equivalent Equipment 01 25 00

In addition to detailed specifications of materials and equipment, the specifications make reference to "substitutions" which is not to be construed as equivalent.

"Equivalent equipment" will be considered as complying with the contract documents if the quality, features, performance, physical shape and appearance of the "equivalent equipment" are in the Architect's opinion the same or similar to those of the material and equipment described in detailed specifications.

5. Drawings and Specifications The drawings and specifications are deemed to be complementary. In case of discrepancy or overlapping conflicting requirements between the drawings and the specifications, the contractor shall provide the more expensive alternate unless he has obtained a written clarification prior to bid opening. Anything shown on the drawings and not mentioned in the specifications, and not shown on the drawings, shall be deemed to have mentioned in both. Should the material and equipment shown on the drawings not be specified by name, model number and description, the contractor shall provide such material and equipment in accordance with the Architect's selection unless he has obtained a written clarification prior to bid opening.

1.2 SUMMARY

B. This Section includes the following hangers and supports for plumbing system piping and equipment:

1. Steel pipe hangers and supports.

2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Equipment supports.

C. Related Sections include the following:

1. Division 05 Section “Metal Fabrications” for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 21 Section “Water-Based Fire-Suppression Systems” for pipe hangers for fire-suppression piping.
3. Division 22 Section “Expansion Fittings and Loops for Plumbing Piping” for pipe guides and anchors.
4. Division 22 Section “Vibration and Seismic Controls for Plumbing Piping and Equipment” for vibration isolation devices.

1.3 DEFINITIONS

- D. Terminology: As defined in MSS SP-90, “Guidelines on Terminology for Pipe Hangers and Supports.”

1.4 PERFORMANCE REQUIREMENTS

- E. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- F. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- G. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 SUBMITTALS

- H. Product Data: For the following:
1. Steel pipe hangers and supports.
 2. Thermal-hanger shield inserts.
- I. Welding certificates.

1.6 QUALITY ASSURANCE

- J. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

- B. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 “Hanger and Support Applications” Article for where to use specific hanger and support types.
- C. Manufacturers:
1. Hubbard Enterprises/HOLDRITE®
 2. B-Line Systems, Inc.; a division of Cooper Industries.
 3. ERICO/Michigan Hanger Co.
- D. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- E. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- F. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- G. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.
1. The total weight of piping and components upon each trapeze span shall not exceed the manufacturer's load rating. Load ratings must include a minimum 2 X safety factor.
 - a. Hubbard Enterprises/HOLDRITE EZ-Strut™ or owner approved equivalent.

2.4 METAL FRAMING SYSTEMS

- H. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- I. Manufacturers:
1. B-Line Systems, Inc.; a division of Cooper Industries.
 2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
 3. Tolco Inc.
- J. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.
- K. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

- L. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
- M. Manufacturers:
 - 1. Hubbard Enterprises/HOLDRITE®
 - 2. ERICO/Michigan Hanger Co.
 - 3. PHS Industries, Inc.
- N. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass.
- O. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- P. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- Q. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

- R. Powder – Actuated Fasteners Shall Not Be Used
- S. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers:
 - a. Hubbard Enterprises/HOLDRITE®
 - b. B-Line Systems, Inc.; a division of Cooper Industries.
 - c. Hilti, Inc.

2.7 EQUIPMENT SUPPORTS

- T. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 MISCELLANEOUS MATERIALS

- U. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- V. Plenum Rated Pipe Clamps: ASTM E-84 25/50 plastic clamps from Hubbard Enterprises/HOLDRITE.
- W. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

- X. Roof top supports: Roof top support application for hydronic piping, domestic hot and cold water piping, condensate piping and natural gas piping as manufactured by Cooper B-Line.
 - 1. Description: UV resistant 100% recycled rubber base, channels, channel nuts, pipe straps/clamps, rollers and roller support; assembly shall be compatible with strut systems.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Support of pipe, tubing and equipment shall be accomplished by means of engineered products, specific to each application. Makeshift, field devised methods shall not be allowed.
- F. Use padded hangers for piping that is subject to scratching.
- G. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS ½ to NPS 30 .
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS ¾ to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS ½ to NPS 8.
 - 5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS ½ to NPS 30.
- H. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS ¾ to NPS 20.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS ¾ to NPS 20, if longer ends are required for riser clamps.
 - 3. For vertical mid-span support of piping 4” and under, use Hubbard Enterprises/HOLDRITE Stout rackets™ with Hubbard

Enterprises/HOLDRITE Stout Clamps or two-hole pipe clamps (MSS Type 26).

- I. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- J. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 - 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
 - 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 - 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 - 5. C-Clamps (MSS Type 23): For structural shapes.
 - 6. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 - 7. Overhead pipe runs of 1" and less to utilize Hubbard Enterprises/HOLDRITE #125, #125-L or #121 Series brackets.
- K. Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 - 2. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- L. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
- M. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- N. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- O. Use mechanical-expansion anchors instead of building attachments where required in concrete construction. Power-actuated fasteners are prohibited, unless approved in writing by the Architects and the Structural Engineer.
- P. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

- Q. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- R. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers. For piping 2" and below, manufactured specialty products formed from pregalvanized commercial steel are to be used, such as the Hubbard Enterprises/HOLDRITE EZ-Strut.
1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 2. Field fabricates from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- S. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- T. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- U. Fastener System Installation:
1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- V. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- W. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- X. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to Facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- Y. Install lateral bracing with pipe hangers and supports to prevent swaying.
- Z. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, 2'/2" and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- AA. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- BB. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- CC. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS ¼ to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 5. Insert Material: Length at least as long as protective shield.
 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
- DD. Roof top supports: Dura-Blok products as manufactured by Copper B-Line.
1. Support bases only.
 2. Support base with 14 gauge B44 channel.
 3. Support base with 12 gauge B12 channel.
 4. Support base with 12 gauge B22 channel.
 5. Dura-Blok bases shall be attached to roof with Henry 204 non-hardening, non-running plastic roof cement. No nail, screws and bolts shall be used to penetrate the finished roof.

3.3 EQUIPMENT SUPPORTS

- EE. Engineered, Factory-fabricated, galvanized steel supports are to be used when suspending equipment from overhead structures or when supporting equipment above the floor.
1. Suspended water heater installations shall include a drain pan with minimum 2-1/2" high sidewalls and a minimum ¾" drain connection.
 2. Water heaters of 50 gallons or less, suspended from the structure above, shall be installed with an engineered and manufactured product like the Suspended Water Heater Platform with integral drain body from Hubbard Enterprises/HOLDRITE or Owner-approved equivalent.
 3. Water heaters placed on a stand, to elevate them above the floor, shall be installed using a manufactured galvanized steel stand, engineered to meet the intended weight load. Use the QuickStand series from Hubbard Enterprises/HOLDRITE.

- 4. Water heaters installed in seismic zones shall be supported from the adjoining structure by the use of approved safety restrain devises. Use QuickStarp from Hubbard Enterprises/HOLDRITE or Owner-approved equivalent.
 - FF. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
 - GG. Grouting: Place grout under supports for equipment and make smooth bearing surface.
 - HH. Provide lateral bracing, to prevent swaying, for equipment supports.
- 3.4 METAL FABRICATIONS
- II. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
 - JJ. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
 - KK. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.
- 3.5 ADJUSTING
- LL. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- 3.6 PAINTING
- MM. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
 - NN. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 220529

SECTION 22 0553

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1. Submittal scheduling 01 32 00
2. Submittal Procedures 01 33 00
3. Substitution Procedures 01 25 00

Should the Contractor desire to substitute any material, equipment or other items for those specified, he shall submit a complete list, including detailed equipment layouts. Any changes required by the furnishing and installation of substituted material, equipment and other item shall be arranged for and paid for by the contractor; any expense incurred is part of this contract.

4. Equivalent Equipment 01 25 00

In addition to detailed specifications of materials and equipment, the specifications make reference to "substitutions" which is not to be construed as equivalent.

"Equivalent equipment" will be considered as complying with the contract documents if the quality, features, performance, physical shape and appearance of the "equivalent equipment" are in the Architect's opinion the same or similar to those of the material and equipment described in detailed specifications.

5. Drawings and Specifications The drawings and specifications are deemed to be complementary. In case of discrepancy or overlapping conflicting requirements between the drawings and the specifications, the contractor shall provide the more expensive alternate unless he has obtained a written clarification prior to bid opening. Anything shown on the drawings and not mentioned in the specifications, and not shown on the drawings, shall be deemed to have mentioned in both. Should the material and equipment shown on the drawings not be specified by name, model number and description, the contractor shall provide such material and equipment in accordance with the Architect's selection unless he has obtained a written clarification prior to bid opening.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.

1.3 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.

4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
 - D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Black.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link or beaded chain.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of [50 feet (15 m)] <Insert dimension> along each run. Reduce intervals to [25 feet (7.6 m)] <Insert dimension> in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. Pipe Label Color Schedule:
 - 1. Domestic Water Piping:
 - a. Background Color: Green.
 - b. Letter Color: Black.
 - 2. Sanitary Waste and Storm Drainage Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape:
 - a. Cold Water: 2 inches, round.
 - b. Hot Water: 2 inches, round.

 - 2. Valve-Tag Color:
 - a. Cold Water: Green.
 - b. Hot Water: Green.

 - 3. Letter Color:
 - a. Cold Water: White.
 - b. Hot Water: White.

END OF SECTION 220553

SECTION 22 0700

PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1. Submittal scheduling 01 32 00
2. Submittal Procedures 01 33 00
3. Substitution Procedures 01 25 00

Should the Contractor desire to substitute any material, equipment or other items for those specified, he shall submit a complete list, including detailed equipment layouts. Any changes required by the furnishing and installation of substituted material, equipment and other item shall be arranged for and paid for by the contractor; any expense incurred is part of this contract.

4. Equivalent Equipment 01 25 00

In addition to detailed specifications of materials and equipment, the specifications make reference to "substitutions" which is not to be construed as equivalent.

"Equivalent equipment" will be considered as complying with the contract documents if the quality, features, performance, physical shape and appearance of the "equivalent equipment" are in the Architect's opinion the same or similar to those of the material and equipment described in detailed specifications.

5. Drawings and Specifications The drawings and specifications are deemed to be complementary. In case of discrepancy or overlapping conflicting requirements between the drawings and the specifications, the contractor shall provide the more expensive alternate unless he has obtained a written clarification prior to bid opening. Anything shown on the drawings and not mentioned in the specifications, and not shown on the drawings, shall be deemed to have mentioned in both. Should the material and equipment shown on the drawings not be specified by name, model number and description, the contractor shall provide such material and equipment in accordance with the Architect's selection unless he has obtained a written clarification prior to bid opening.

1.2 SUMMARY

B. Section Includes:

1. Insulation Materials:
 - a. Flexible elastomeric.
 - b. Mineral fiber.
2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Sealants.
6. Factory-applied jackets.
7. Field-applied fabric-reinforcing mesh.
8. Field-applied jackets.
9. Tapes.
10. Securements.
11. Corner angles.

C. Related Sections include the following:

1. Division 21 Section "Fire-Suppression Systems Insulation."
2. Division 23 Section "HVAC Insulation."

1.3 SUBMITTALS

- D. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets both factory and field applied.
- E. Field quality-control reports.

1.2 QUALITY ASSURANCE

- F. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and

adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.3 DELIVERY, STORAGE, AND HANDLING

- G. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 1. Products: Subject to compliance with requirements, provide one of the following, but are not limited to, the following:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. Or approved equal.
- G. Mineral-Fiber, Preformed Pipe Insulation:
 1. Products: Subject to compliance with requirements, provide one of the following, but are not limited to, the following]:
 - a. Johns Manville; Micro-Lok.

- b. Knauf Insulation; 1000(Pipe Insulation.
 - c. Or approved equal.
 - 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in “Factory-Applied Jackets” Article.
- H. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. Ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in “Factory-Applied Jackets” Article.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Or approved equal.

2.2 INSULATING CEMENTS

- I. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
 - 1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Insulco, Division of MFS, Inc.; SmoothKote.
 - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote
 - c. Or approved equal.

2.3 ADHESIVES

- J. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to it and to surfaces to be insulated, unless otherwise indicated.
- K. Cellular-Glass and Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-96.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-33.
 - c. Or approved equal.
- L. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA Inc.; Aero seal.
 - b. Armacell LCC; 520 Adhesive.
 - c. Or approved equal.
- M. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. Or approved equal.
- N. PVC Jacket Adhesive: Compatible with PVC jacket.
 1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. Or approved equal.

2.4 MASTICS

- O. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
- P. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, provide the following provide one of the following:
 - a. Childers Products, Division of ITW; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. Or approved equal.
 - 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 - 5. Color: White.
- Q. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-10.
 - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
 - c. Or approved equal.
 - 2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 200 deg F.
 - 4. Solids Content: 63 percent by volume and 73 percent by weight.
 - 5. Color: White.

2.5 SEALANTS

R. Joint Sealants:

1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45.
 - c. Or approved equal.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
5. Color: White or gray.

S. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76.
 - b. Or approved equal.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

2.6 FACTORY-APPLIED JACKETS

- ### T. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
 - 2) Or approved equal.

2.7 FIELD-APPLIED JACKETS

- U. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- V. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Or approved equal.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: White.
 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
 5. Factory-fabricated tank heads and tank side panels.

2.8 TAPES

- W. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Or approved equal.
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- X. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
 - b. Compac Corp.; 130.
 - c. Or approved equal.
 2. Width: 2 inches.
 3. Thickness: 6 mils.
 4. Adhesion: 64 ounces force/inch in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch in width.

2.9 SECUREMENTS

- Y. Staples: Outward-clinching insulation staples, nominal 3/4-inch wide, stainless steel or Monel.

- Z. Wire: 0.062-inch soft-annealed, stainless steel soft-annealed, galvanized steel.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C & F Wire.
 - b. Childers Products.
 - c. Or approved equal.

2.10 CORNER ANGLES

AA. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- C. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- D. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
- E. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- F. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- G. Install multiple layers of insulation with longitudinal and end seams staggered.
- H. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- I. Keep insulation materials dry during application and finishing.

- J. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- K. Install insulation with least number of joints practical.
- L. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- M. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- N. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- O. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

- P. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- Q. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- R. For above ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.3 PENETRATIONS

- S. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- T. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Division 07 Section “Penetration Firestopping”, firestopping and fire-resistive joint sealers.

3.3 GENERAL PIPE INSULATION INSTALLATION

- U. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- V. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating

cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- W. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

- X. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.4 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- Y. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- Z. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

AA. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

BB. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.5 MINERAL-FIBER INSULATION INSTALLATION

CC. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

DD. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

EE. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

FF. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.6 FIELD-APPLIED JACKET INSTALLATION

GG. Provide PVC jackets on all exposed piping insulation and in equipment rooms and where indicated on the drawings. Install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturers recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.7 FINISHES

HH. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

- a. Finish Coat Material: Interior, flat, latex-emulsion size.
- II. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- JJ. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- KK. Do not field paint aluminum or stainless-steel jackets.

3.8 FIELD QUALITY CONTROL

- LL. Perform tests and inspections.
- MM. Tests and Inspections:
 - 1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
 - 2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- NN. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 PIPING INSULATION SCHEDULE, GENERAL

- OO. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- PP. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.

3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 INDOOR PIPING INSULATION SCHEDULE

QQ. Domestic Hot and Recirculated Hot Water:

- a. Mineral-Fiber, Preformed Pipe Insulation, Type I: Size per plan.

END OF SECTION 220700

SECTION 22 1116
DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1. Submittal scheduling 01 32 00
2. Submittal Procedures 01 33 00
3. Substitution Procedures 01 25 00

Should the Contractor desire to substitute any material, equipment or other items for those specified, he shall submit a complete list, including detailed equipment layouts. Any changes required by the furnishing and installation of substituted material, equipment and other item shall be arranged for and paid for by the contractor; any expense incurred is part of this contract.

4. Equivalent Equipment 01 25 00

In addition to detailed specifications of materials and equipment, the specifications make reference to “substitutions” which is not to be construed as equivalent.

“Equivalent equipment” will be considered as complying with the contract documents if the quality, features, performance, physical shape and appearance of the “equivalent equipment” are in the Architect’s opinion the same or similar to those of the material and equipment described in detailed specifications.

5. Drawings and Specifications The drawings and specifications are deemed to be complementary. In case of discrepancy or overlapping conflicting requirements between the drawings and the specifications, the contractor shall provide the more expensive alternate unless he has obtained a written clarification prior to bid opening. Anything shown on the drawings and not mentioned in the specifications, and not shown on the drawings, shall be deemed to have mentioned in both. Should the material and equipment shown on the drawings not be specified by name, model number and description, the contractor shall provide such material and equipment in accordance with the Architect’s selection unless he has obtained a written clarification prior to bid opening.

1.2 SUMMARY

- B. Section Includes:
 - 1. Domestic water pipes, tubes, fittings, and specialties inside the building.
 - 2. Escutcheons.
 - 3. Sleeves and sleeve seals.
 - 4. Wall penetration systems.
- C. Related Section:
 - 1. Division 22 Section Domestic Water Piping Specialties

1.3 PERFORMANCE REQUIREMENTS

- D. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to Section 1632 Part 2 C.B.C.

1.4 SUBMITTALS

- E. Product Data: For Pipe, Tube, Fittings and Couplings.
- F. Water Samples: Specified in "Cleaning" Article.
- G. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Fire-suppression-water piping.
 - 2. Domestic water piping.
- H. Field quality-control reports.

1.5 QUALITY ASSURANCE

- I. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.6 COORDINATION

- J. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in Part 3 “Piping Schedule” Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER PIPE FITTINGS

- B. Hard Copper Pipe: ASTM B 88, Type L and ASTM B 88, Type M water pipe, drawn temper.
 - 1. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 - 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends
 - 4. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.
 - b. Viega; Plumbing and Heating Systems.
 - c. Or approved equal.

2.3 PIPING JOINING MATERIALS

- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 SPECIALTY VALVES

- E. Comply with requirements in Division 22 Section “General-Duty Valves for Plumbing Piping” for general-duty metal valves.
- F. Comply with requirements in Division 22 Section “Domestic Water Piping Specialties” for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.5 TRANSITION FITTINGS

- G. General Requirements:
 - 1. Same size as pipes to be joined.
 - 2. Pressure rating at least equal to pipes to be joined.
 - 3. End connections compatible with pipes to be joined.
- H. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

2.6 DIELECTRIC FITTINGS

- I. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- J. Dielectric Unions:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - b. Zurn Plumbing Products Group; Wilkins Water Control Products.
 - c. Or approved equal.
 - 2. Description:
 - a. Pressure Rating: 150 psig at 180 deg F.
 - b. End Connections: Solder-joint copper alloy and threaded ferrous.

2.7 ESCUTCHEONS

- K. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- L. One Piece, Cast Brass: Polished, chrome-plated finish with setscrews.
- M. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.
- N. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and setscrew.
- O. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

P. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.8 SLEEVES

Q. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

R. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

2.9 SLEEVE SEALS

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

1. Metraflex, Inc.
2. Pipeline Seal and Insulator, Inc.
3. Or approved equal.

T. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Plastic.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.10 WALL PENETRATION SYSTEMS

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

1. SIGMA.

V. Description: Wall-sleeve assembly, consisting of housing and gland, gaskets, and pipe sleeve.

1. Carrier-Pipe Deflection: Up to 5 percent without leakage.
2. Housing: Ductile-iron casting with hub, waterstop, anchor ring, and locking devices. Include gland, bolts, and nuts.
3. Housing-to-Sleeve Gasket: EPDM rubber.

4. Housing-to-Carrier-Pipe Gasket: AWWA C111, EPDM rubber.
5. Pipe Sleeve: ASTM A 53/A 53M, Schedule 40, zinc-coated steel pipe.

2.11 GROUT

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- D. Buried Pipe Wrapping
 1. All copper pipes for installation below ground shall be shop wrapped.
 2. Prior to wrapping, pipe shall be cleaned with a non-oily solvent and then cleaned thoroughly with a wire brush.
 3. After cleaning, pipe shall be spirally wrapped with 2" wide 20 mils thick Manville Trantex VID-20 polyvinyl chloride pressure sensitive tape with 1/2" lap without wrinkles.
 4. All fittings and field joints in buried copper piping shall be wrapped. Prior to wrapping, fittings and field joints shall be washed with a non-oily solvent and then cleaned with a wired brush. After cleaning, fittings and field joints shall be coated and wrapped as follows:
 - a. Coat of Koppers "Jet-Set" coal tap primer, applied uniformly to dry surface.
 - b. Two layers of 2" wide 35 mils thick Polyken 931 black butyl rubber molding tape with 1" lap, covered with one layer of 3/4" wide 15 mils thick Polyken 930 black polyethylene pressure sensate tape with 1/4" lap.

- c. Field wrapping shall extend 3 in. over undisturbed shop applied pipe coating.
- E. Install sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are herein before specified in Part 2 – Products.
- F. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are herein before specified in Part 2 – Products.
- G. Install shutoff valve, five (5) feet outside building at each domestic water service entrance.
- H. Install shutoff valve immediately upstream of each dielectric fitting.
- I. Install domestic water piping level and plumb.
- J. Install seismic restraints on piping. Comply as herein before specified in Part 1
- K. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- L. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- M. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- N. Install piping adjacent to equipment and specialties to allow service and maintenance.
- O. Install piping to permit valve servicing.
- P. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- Q. Install piping free of sags and bends.
- R. Install fittings for changes in direction and branch connections.
- S. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- T. Install pressure gauges on suction and discharge piping from each plumbing pump.

- U. Install thermometers on outlet piping from each water heater.

3.3 JOINT CONSTRUCTION

- V. Ream ends of pipes and tubes and remove burrs.
- W. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- X. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
- Y. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- Z. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- AA. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE INSTALLATION

- BB. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- CC. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
- DD. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, where required to drain water piping.

3.5 TRANSITION FITTING INSTALLATION

- EE. Install transition couplings at joints of dissimilar piping.
- FF. Transition Fittings in Underground Domestic Water Piping:
 - 1. Fitting-type coupling.
- GG. Transition Fittings in Aboveground Domestic Water Piping: Plastic-to-metal transition fittings.

3.6 DIELECTRIC FITTING INSTALLATION

HH. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

3.7 PIPE HANGER AND SUPPORT INSTALLATION

II. Vertical Piping: MSS Type 8 or 42, clamps.

1. Individual, Straight, Horizontal Piping Runs:

- a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
- b. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
- c. Longer Than 100 Feet If Indicated: MSS Type 49, spring cushion rolls.

2. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

3. Base of Vertical Piping: MSS Type 52, spring hangers.

JJ. Support vertical piping at base and at each floor.

KK. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

LL. Install hangers for copper piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2 : 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
6. NPS 6: 10 feet with 5/8-inch rod.
7. NPS 8: 10 feet with 3/4-inch rod.

MM. Install supports for vertical copper tubing every 10 feet.

NN. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.8 CONNECTIONS

- OO. Drawings indicate general arrangement of piping, fittings, and specialties.
- PP. Install piping adjacent to equipment and machines to allow service and maintenance.
- QQ. Connect domestic water piping to exterior water-service piping.
- RR. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
 - 3. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.9 ESCUTCHEON INSTALLATION

- SS. Install escutcheons for penetrations of walls, ceilings, and floors.
- TT. Escutcheons for New Piping:
 - 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 - 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 - 4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with rough-brass finish.
 - 5. Bare Piping in Equipment Rooms: One piece, stamped steel with set screw
 - 6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.10 SLEEVE INSTALLATION

- UU. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- VV. Sleeves are not required for core-drilled holes.
- WW. Permanent sleeves are not required for holes formed by removable PE sleeves.
- XX. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- YY. Install sleeves in new partitions, slabs, and walls as they are built.
- ZZ. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- AAA. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- BBB. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using wall penetration systems specified in this Section.
- CCC. Seal space outside of sleeves in concrete slabs and walls with grout.
- DDD. Install sleeves that are large enough to provide ½ inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- EEE. Install sleeve materials according to the following applications:
 - 1. Sleeves for Piping Passing through Concrete Floor Slabs:
 - a. 24 Gauge Galvanized Sheet Metal.
 - 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Cast Iron Pipe.
 - a. Extend sleeves 2 inches above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 3. Sleeves for Piping Passing through Gypsum-Board Partitions:

- a. 24 Gauge Galvanized-steel sheet sleeves for pipes NPS 6 and larger.
 - b. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
4. Sleeves for Piping Passing through Concrete Roof Slabs:
- a. 24 Gauge Galvanized sheet metal.
5. Sleeves for Piping Passing through Exterior Concrete Walls:
- a. Do not use sleeves when wall penetration systems are used.
 - b. For watertight condition use cast iron pipe sleeves.
 - c. Where wet conditions do not occur use Schedule 40 PVC pipe.
6. Sleeves for Piping Passing through Interior Concrete Walls:
- a. 24 Gauge Galvanized-steel sheet.

Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestop materials and installations.

3.11 SLEEVE SEAL INSTALLATION

- FFF. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- GGG. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.12 WALL PENETRATION SYSTEM INSTALLATION

- HHH. Install wall penetration systems in new, exterior concrete walls.
- III. Assemble wall penetration system components with sleeve pipe. Install so that end of sleeve pipe and face of housing are flush with wall. Adjust locking devices to secure sleeve pipe in housing.

3.13 IDENTIFICATION

JJJ. Identify system components. Comply with requirements in Division 22 Section “Identification for Plumbing Piping and Equipment” for identification materials and installation.

3.14 FIELD QUALITY CONTROL

KKK. Perform tests and inspections.

Piping Inspections:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

LLL. Piping Tests:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to water pressure of 125 psig. Isolate test source and allow standing for not less than one (1) hour. Leaks and loss in test pressure constitute defects that must be repaired.

5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.

MMM. Domestic water piping will be considered defective if it does not pass tests and inspections.

NNN. Prepare test and inspection reports.

3.15 ADJUSTING

OOO. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.16 CLEANING

PPP. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in

either AWWA C651 or AWWA C652 or follow procedures described below:

- a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to sterilization laboratory. Repeat procedures if biological examination shows contamination.
- B. The entire domestic watersystem shall be sterilized after the piping has been tested but before acceptance of work for operation.
- C. Name of sterilization laboratory shall be submitted for Architect's review prior to the start of water sterilization.
1. No water sterilization shall be done prior to the review of the laboratory by the Architect.
- D. A certificate of sterilization, bearing the signature of an official of the water sterilization, shall be submitted to the Architect.

3.17 PIPING SCHEDULE

- D. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- E. Flanges may be used for aboveground piping joints unless otherwise indicated.
- F. Fitting Option: Brazed joints may be used on aboveground copper tubing.
- G. Under-building-slab, domestic water, building service piping, NPS 3 and smaller, shall be the following:
 1. Hard Drawn copper pipe, ASTM B 88, Type L ASTM B 88M with wrought-copper solder-joint fittings.

- H. Under-building-slab, domestic water, shall be the following:
 - 1. Hard Drawn Copper Pipe with ASTM B 88, Type K; wrought-copper solder-joint fittings; and brazed joints.
- I. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
 - 1. Hard copper pipe, ASTM B 88, Type L wrought- copper solder-joint fittings;
- J. Aboveground domestic water piping, NPS 2-1/2 to NPS 4 , shall be the following:
 - 1. Hard copper pipe, ASTM B 88, Type L wrought- copper solder-joint fittings.

3.18 VALVE SCHEDULE

- K. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly, with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
 - 2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
 - 3. Drain Duty: Hose-end drain valves.
- L. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116

SECTION 22 1119

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1. Submittal scheduling 01 32 00
2. Submittal Procedures 01 33 00
3. Substitution Procedures 01 25 00

Should the Contractor desire to substitute any material, equipment or other items for those specified, he shall submit a complete list, including detailed equipment layouts. Any changes required by the furnishing and installation of substituted material, equipment and other item shall be arranged for and paid for by the contractor; any expense incurred is part of this contract.

4. Equivalent Equipment 01 25 00

In addition to detailed specifications of materials and equipment, the specifications make reference to "substitutions" which is not to be construed as equivalent.

"Equivalent equipment" will be considered as complying with the contract documents if the quality, features, performance, physical shape and appearance of the "equivalent equipment" are in the Architect's opinion the same or similar to those of the material and equipment described in detailed specifications.

5. Drawings and Specifications The drawings and specifications are deemed to be complementary. In case of discrepancy or overlapping conflicting requirements between the drawings and the specifications, the contractor shall provide the more expensive alternate unless he has obtained a written clarification prior to bid opening. Anything shown on the drawings and not mentioned in the specifications, and not shown on the drawings, shall be deemed to have mentioned in both. Should the material and equipment shown on the drawings not be specified by name, model number and description, the contractor shall provide such material and equipment in accordance with the Architect's selection unless he has obtained a written clarification prior to bid opening.

1.2 SUMMARY

- B. This Section includes the following domestic water piping specialties:
 - 1. Air gap fittings.
 - 2. Backflow preventers.
 - 3. Solenoid valves.
 - 4. Water pressure-reducing valves.
 - 5. Balancing valves.
 - 6. Thermostatic controller assemblies.
 - 7. Strainers.
 - 8. Hose bibs and stops.
 - 9. Water hammer arresters.
 - 10. Trap-seal primer.

- B. Related Sections include the following:
 - 1. Division 22 Section “Domestic Water Piping” for water meters.
 - 2. Division 22 Section “Emergency Plumbing Fixtures” for water tempering equipment.
 - 3. Division 22 Section “Drinking Fountains and Water Coolers” for water filters for water coolers.

1.3 PERFORMANCE REQUIREMENTS

- C. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

1.4 SUBMITTALS

- D. Product Data: For each type of product indicated.
- E. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- F. NSF Compliance:

1. Comply with NSF 14, “Plastics Piping Components and Related Materials,” for plastic domestic water piping components.
2. Comply with NSF 61, “Drinking Water System Components – Health Effects; Sections 1 through 9.”

PART 2 - PRODUCTS

2.1 BALANCING VALVES

A. Memory-Stop Balancing Valves:

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. NIBCO INC.
 - b. Conbraco Industries, Inc.
 - c. Or approved equal.
3. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
4. Pressure Rating: 400-psig minimum CWP.
5. Size: NPS 2 or smaller.
6. Body: Copper alloy.
7. Port: Standard or full port.
8. Ball: Chrome-plated brass.
9. Seats and Seals: Replaceable.
10. End Connections: Solder joint or threaded.
11. Handle: Vinyl-covered steel with memory-setting device.

2.2 HOSE BIBBS (MILD CLIMATE) AND STOPS

- B. 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:

C. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Acorn.
2. Chicago.

D. Description:

HB-1 Acorn #8140 recessed hose box with $\frac{3}{4}$ " hose connection and non-removable backflow preventer and with wall frame & door. Provide with Chicago faucet model #387-827CP. 2 $\frac{1}{4}$ " tee handle with tapered broach. Polished chromed plated finish solid brass construction. $\frac{3}{4}$ " female NPT female inlet, $\frac{3}{4}$ " male garden hose threaded outlet.

HB-2 Chicago faucet model #387-827CP. 2 $\frac{1}{4}$ " tee handle with tapered broach, polished chromed plated finish solid brass construction. $\frac{3}{4}$ " female MPT female inlet, $\frac{3}{4}$ " male garden hose threaded outlet.

Partition Stops: Chicago 1771 $\frac{1}{2}$ " chrome plated loose key operated brass body.

Straight Stops: Chicago 45-LK $\frac{1}{2}$ " chrome plated loose key operated brass body.

2.3 WATER HAMMER ARRESTERS

E. Water Hammer Arresters:

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. Jay R. Smith.
 - b. Wade.
3. Description: Smith "Hydrotrol" 5000 Series P.D.I certified bellows type units of all stainless steel construction.
 - a. P.D.I symbol "A" hydrotrol figure number 5005.
 - b. P.D.I symbol "B" hydrotrol figure number 5010.
 - c. P.D.I symbol "C" hydrotrol figure number 5020.
 - d. P.D.I symbol "D" hydrotrol figure number 5030

4. Piston type water hammer arresters shall not be used.
- F. Drainage-Type, Trap-Seal Primer Valves:
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. MIFAB.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 3. Discription: MIFAB model #MR-500 pressure drop activated brass housing with removable filter screen, and MIFAB model MI-DU trap primer distribution unit to serve two, three or four drains from a single MR-500 primer.
 4. Trap primers shall be provided for all floor drains and floor sinks.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install balancing valves in locations where they can easily be adjusted.
- C. Install water hammer arresters in water piping according to PDI-WH 201.

3.2 CONNECTIONS

- D. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

3.3 FIELD QUALITY CONTROL

- E. Perform the following tests and prepare test reports:
 1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.
- F. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.4 ADJUSTING

- G. Set field-adjustable pressure set points of water pressure-reducing valves.
- H. Set field-adjustable flow set points of balancing valves.
- I. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 221119

SECTION 22 1316

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1. Submittal scheduling 01 32 00
2. Submittal Procedures 01 33 00
3. Substitution Procedures 01 25 00

Should the Contractor desire to substitute any material, equipment or other items for those specified, he shall submit a complete list, including detailed equipment layouts. Any changes required by the furnishing and installation of substituted material, equipment and other item shall be arranged for and paid for by the contractor; any expense incurred is part of this contract.

4. Equivalent Equipment 01 25 00

In addition to detailed specifications of materials and equipment, the specifications make reference to "substitutions" which is not to be construed as equivalent.

"Equivalent equipment" will be considered as complying with the contract documents if the quality, features, performance, physical shape and appearance of the "equivalent equipment" are in the Architect's opinion the same or similar to those of the material and equipment described in detailed specifications.

5. Drawings and Specifications The drawings and specifications are deemed to be complementary. In case of discrepancy or overlapping conflicting requirements between the drawings and the specifications, the contractor shall provide the more expensive alternate unless he has obtained a written clarification prior to bid opening. Anything shown on the drawings and not mentioned in the specifications, and not shown on the drawings, shall be deemed to have mentioned in both. Should the material and equipment shown on the drawings not be specified by name, model number and description, the contractor shall provide such material and equipment in accordance with the Architect's selection unless he has obtained a written clarification prior to bid opening.

1.2 SUMMARY

- B. This Section includes the following for soil, waste, and vent piping inside the building; and to five (5) feet exterior of building.
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.
- C. Related Sections include the following:
 - 1. Division 22 Section “Chemical Waste Systems for Laboratory Facilities” for chemical-waste and vent piping systems.

1.3 DEFINITIONS

- D. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

- E. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water
- F. Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of seismic events determined according to “Minimum Design Loads for Buildings and Other Structures.” In accordance with “Mason Industries” seismic restraint guidelines for seismic for restraint of mechanical systems. OSHPD pre-approval #OPA-0349

1.5 SUBMITTALS

- G. Product Data: For pipe, tube, fittings, and couplings.
- B. LEED Submittal:
 - 1. Product Data for Credit EQ 4.1: Solvent cements and adhesive primers, including printed statement of VOC content.
 - 2. Product Data shall indicate hubless cast iron soil pipe and fittings “Green Spec. Listed,” product shall comply to ASTM A74, ASTM A888 and CISPI 301 standards.
- C. Field quality-control inspection and test reports.

1.6 QUALITY ASSURANCE

- H. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 PIPING MATERIALS

- B. Refer to Part 3 “Piping Applications” Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- C. Pipe and Fittings: ASTM A 888 or CISPI 301; Latest issue shall apply.
 - 1. Manufactures:
 - a. Charlotte
 - b. AB&I
 - c. Tyler
- D. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop. All no-hub shielded couplings must have four bands minimum. Sizes 5” through 10” shall have six bands minimum.
 - 1. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
 - a. Manufacturers:
 - 1) Husky SD4000
 - 2) Clamp-All Corp.
 - 3) Ideal Div.; Stant Corp.
 - 4) Mission Rubber Co. Heavy Weight
 - 5) Tyler Pipe; Soil Pipe Div.

2. Heavy-Duty, Shielded, Cast-Iron Couplings: ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.
 - a. Manufacturers:
 - 1) MG Piping Products Co.

2.4 STEEL PIPE AND FITTINGS

- E. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A or B, Standard Weight or Schedule 40, galvanized. Include ends matching joining method.
- F. Drainage Fittings: ASME B16.12, galvanized, threaded, cast-iron drainage pattern.
- G. Pressure Fittings:
 1. Steel Pipe Nipples: ASTM A 733 made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.
 2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
 3. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, standard pattern.
 4. Cast-Iron Flanges: ASME B16.1, Class 125.
 5. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized.

2.5 PVC PIPE AND FITTINGS

- H. Cellular-Core PVC Pipe: ASTM D-1784, Schedule 40.
 1. Joints: Bell and spigot with rubber ring.
 2. PVC Fittings: Bell and spigot rubber ring ASTM D-1784.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- B. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- C. Aboveground, soil and waste piping NPS 4 and smaller shall be the following:
 - 1. Hubless cast-iron soil pipe and fittings heavy-duty four band shielded, hubless-coupling joints.
 - 2. Steel pipe, drainage fittings, and threaded joints.
- D. Aboveground, soil and waste piping NPS 5 and larger shall be the following:
 - 1. Hubless cast-iron soil pipe and fittings heavy-duty six band shielded, hubless-coupling joints.
 - 2. Steel pipe, drainage fittings, and threaded joints.
- E. Aboveground, vent piping NPS 4 and smaller shall be the following:
 - 1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, hubless-coupling joints.
 - 2. Steel pipe, drainage fittings, and threaded joints.
 - a. Option for Vent Piping, NPS 2½ and NPS 3½: Hard copper tube, Type M; copper pressure fittings; and soldered joints.
- F. Aboveground, vent piping NPS 5 and larger shall be the following:
 - 1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
 - 2. Steel pipe, drainage fittings, and threaded joints.
- G. Underground; below building slab soil, waste, and vent piping NPS 4 and smaller shall be the following:
 - 1. Hubless cast-iron soil pipe and fittings with MG cast-iron couplings and stainless steel bolts.
- H. Yard, outside of building, soil and waste piping shall be the following:
 - 1. Solid wall PVC Pipe with bell and spigot and rubber ring.
 - 2. Dissimilar Pipe- Material Couplings for nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD. Shall be made with “Calder rubber couplings with stainless steel clamps.
- I. Underground, below the slab, soil and waste piping NPS 5 and larger shall be the following:

1. Hubless cast-iron soil pipe and fittings with MG cast iron couplings; and stainless steel bolts.
- J. Yard, outside of building, soil and waste piping shall be the following:
1. Solid-wall, Schedule 40, PVC Pipe with bell and spigot with rubber.
 2. Dissimilar Pipe- Material Couplings for nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD. Shall be made with “calder rubber couplings with stainless steel clamps.

3.3 PIPING INSTALLATION

- K. Basic piping installation requirements are specified in Division 22 Section “Common Work Results for Plumbing.”
- L. Install seismic restraints on piping. Seismic-restraint devices are specified in Division 22 Section “Vibration and Seismic Controls for Plumbing Piping and Equipment.”
- M. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- N. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section “Common Work Results for Plumbing.”
- O. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.
- P. Provide special precautions for sanitary soil waste (sanitary drainage) and rain water(storm drainage) pipe over electrical rooms, kitchens, food preparation and serving areas to protect these areas from pipe leakage. Comply with the requirements of CCR Title 24, Part 5, Section 311.9.
- Q. Install cast-iron soil piping according to CISPI’s “Cast Iron Soil Pipe and Fittings Handbook,” Chapter IV, “Installation of Cast Iron Soil Pipe and Fittings.”
- Install encasement on underground piping according to ASTM A 674 or AWWA C105.
- R. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep ¼ bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

- S. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert.
- T. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- U. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- V. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

- W. Basic piping joint construction requirements are specified in Division 22 Section “Common Work Results for Plumbing.”
- X. Join hubless cast-iron soil piping according to CISPI 310 and CISPI’s “Cast Iron Soil Pipe and Fittings Handbook” for hubless-coupling joints.
- Y. All joints of buried hubless cast iron pipe and cast iron couplings shall be field wrapped.
 - 1. Prior to wrapping, fittings and field joints shall be washed with a non-oily solvent and then cleaned with a wire brush. After cleaning, fittings and field joints shall be coated and wrapped as follows:
 - a. Coat of Koppers “Jet-Set” coal tap primer, applied uniformly to dry surfaces.
 - b. Two layers of 2” wide 35 mils thick Polyken 931 black butyl rubber molding tape with 1” lap, covered with one layer of ¾” wide 15 mils thick Polyken 930 black polyethylene pressure sensitive tape with ¼” lap.
 - c. Field wrapping shall extend 3 inches beyond point.
- Z. Joints of hubless cast iron soil pipe above ground shall be made up with Class I rated couplings as approved by Factory Mutual Research Corporation, Approval Standard Class Number 1680, “Clamp-All” coupling, or equal.

3.5 VALVE INSTALLATION

- AA. General valve installation requirements are specified in Division 22 Section “General-Duty Valves for Plumbing Piping.”

3.6 HANGER AND SUPPORT INSTALLATION

- BB. Seismic-restraint devices are specified in Division 22 Section “Vibration and Seismic Controls for Plumbing Piping and Equipment.”

- CC. Pipe hangers and supports are specified in Division 22 Section “Hangers and Supports for Plumbing Piping and Equipment.” Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Install individual, straight, horizontal piping runs according to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer than 100 Feet, if indicated: MSS Type 49, spring cushion rolls.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

- DD. Install supports according to Division 22 Section “Hangers and Supports for Plumbing Piping and Equipment.”

- EE. Support vertical piping and tubing at base and at each floor.

- FF. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8” (10mm) minimum rods.

- GG. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6: 60 inches with 3/4-inch rod.
5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.

- HH. Install supports for vertical cast-iron soil piping every 15 feet.

- II. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4: 84 inches with 3/8-inch rod.
 - 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 - 3. NPS 2: 10 feet with 3/8-inch rod.
 - 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
 - 5. NPS 3: 12 feet with 1/2-inch rod.
 - 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
 - 7. NPS 6: 12 feet with 3/4-inch rod.
 - 8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.
- JJ. Install supports for vertical steel piping every 15 feet.
- KK. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- LL. Drawings indicate general arrangement of piping, fittings, and specialties.
- MM. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- NN. Connect drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

3.8 FIELD QUALITY CONTROL

- OO. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- PP. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- QQ. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- RR. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, and test hydrostatically under 5 P.S.I. pressure for not less than one (1) hour.
 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 6. Prepare reports for tests and required corrective action.

3.9 CLEANING

- SS. Clean interior of piping. Remove dirt and debris as work progresses.
- TT. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- UU. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221316

SECTION 22 1319

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1. Submittal scheduling 01 32 00
2. Submittal Procedures 01 33 00
3. Substitution Procedures 01 25 00

Should the Contractor desire to substitute any material, equipment or other items for those specified, he shall submit a complete list, including detailed equipment layouts. Any changes required by the furnishing and installation of substituted material, equipment and other item shall be arranged for and paid for by the contractor; any expense incurred is part of this contract.

4. Equivalent Equipment 01 25 00

In addition to detailed specifications of materials and equipment, the specifications make reference to "substitutions" which is not to be construed as equivalent.

"Equivalent equipment" will be considered as complying with the contract documents if the quality, features, performance, physical shape and appearance of the "equivalent equipment" are in the Architect's opinion the same or similar to those of the material and equipment described in detailed specifications.

5. Drawings and Specifications The drawings and specifications are deemed to be complementary. In case of discrepancy or overlapping conflicting requirements between the drawings and the specifications, the contractor shall provide the more expensive alternate unless he has obtained a written clarification prior to bid opening. Anything shown on the drawings and not mentioned in the specifications, and not shown on the drawings, shall be deemed to have mentioned in both. Should the material and equipment shown on the drawings not be specified by name, model number and description, the contractor shall provide such material and equipment in accordance with the Architect's selection unless he has obtained a written clarification prior to bid opening.

1.02 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
 - 1. Cleanouts.
 - 2. Floor drains.
 - 3. Floor sinks.
 - 4. Miscellaneous sanitary drainage piping specialties.
- B. Related Sections include the following:
 - 1. Division 22 Section "Storm Drainage Piping Specialties" for roof drains and overflow drains.
 - 2. Division 22 Section "Plumbing Fixtures" for hair interceptors.

1.03 DEFINITIONS

- A. PE: Polyethylene plastic.
- B. PVC: Polyvinyl chloride plastic.

1.04 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.01 CLEANOUTS

- A. Metal Cleanouts:
 - 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:
 - 3. Basis-of-Design Product: Subject to compliance with requirements, provide Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc. or a comparable product by one of the following:
 - a. Wade

b. Josam Company; Josam Div.

c. MIFAB, Inc.

4. Description:

a. Cleanouts shall have cast iron body with countersunk slotted tapered thread bronze plug.

b. Exterior Cleanouts:

1. Cast Iron Pipe: Smith 4283 assembly in access box; access box as hereinbefore specified in Section 15050.

2. Polyvinyl Chloride Pipe: Smith 4283 assembly with stainless steel clamp coupling in access box; access box as hereinbefore specified in Section 22 05 00.

c. Interior Wall Cleanouts:

1. Smith 4472 assembly with stainless steel shallow cover.

2. Where job conditions do not permit use of shallow covers, Smith 4715 chrome plated bronze deep covers shall be used.

d. Interior Floor Cleanouts: Smith 4023 assembly with scoriated adjustable screw secured polished round nickel bronze tops.

2.02 FLOOR DRAINS

A. Cast-Iron Floor Drains:

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:

3. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn or a comparable product by one of the following:

a. Wade

b. Josam Company; Josam Div.

c. MIFAB, Inc.

2.03 FLOOR SINKS

A. Cast Iron Floor Sinks

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:
3. Basis-Of-Design Product: Subject to compliance with requirements, provide Zurn or a comparable product by one of the following:
 - a. J.R. Smith

2.04 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Vent Caps and Flashing Assemblies:

1. Description: Stoneman "Stormtite" Assemblies: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
 - a. Steel pipe 1100-3 Assembly.
 - b. Cast iron pipe 1100-5 Assembly.
2. Size: Same as connected stack vent or vent stack.
3. For flashing refer to division 07.

B. Air Gap Fitting:

1. Description: Smith 3951 bronze unit with screwed outlet.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.

2. Locate at each change in direction of piping greater than 45 degrees.
 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
1. Position floor drains for easy access and maintenance.
 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- H. Install through-penetration firestop assemblies in stacks at floor penetrations.
- I. Assemble open drain fittings and install with top of hub above floor.
- J. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- K. Install trap-seal primer fittings on inlet to floor drains and floor sinks.
1. Size: Same as floor drain inlet.
- L. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- M. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

- N. Install vent caps on each vent pipe passing through roof.
- O. Install wood-blocking reinforcement for wall-mounting-type specialties.
- P. Install traps on plumbing specialty drain outlets.
- Q. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.02 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections.
Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.03 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

3.04 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 224000

PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1. Submittal scheduling 01 32 00
2. Submittal Procedures 01 33 00
3. Substitution Procedures 01 25 00

Should the Contractor desire to substitute any material, equipment or other items for those specified, he shall submit a complete list, including detailed equipment layouts. Any changes required by the furnishing and installation of substituted material, equipment and other item shall be arranged for and paid for by the contractor; any expense incurred is part of this contract.

4. Equivalent Equipment 01 25 00

In addition to detailed specifications of materials and equipment, the specifications make reference to "substitutions" which is not to be construed as equivalent.

"Equivalent equipment" will be considered as complying with the contract documents if the quality, features, performance, physical shape and appearance of the "equivalent equipment" are in the Architect's opinion the same or similar to those of the material and equipment described in detailed specifications.

5. Drawings and Specifications The drawings and specifications are deemed to be complementary. In case of discrepancy or overlapping conflicting requirements between the drawings and the specifications, the contractor shall provide the more expensive alternate unless he has obtained a written clarification prior to bid opening. Anything shown on the drawings and not mentioned in the specifications, and not shown on the drawings, shall be deemed to have mentioned in both. Should the material and equipment shown on the drawings not be specified by name, model number and description, the contractor shall provide such material and equipment in accordance with the Architect's selection unless he has obtained a written clarification prior to bid opening.

1.2 1.2 SUMMARY

B. This Section includes the following conventional plumbing fixtures and related components:

1. Faucets for lavatories and sinks.
2. Flushometers.
3. Toilet seats.
4. Protective shielding guards.
5. Fixture supports.
6. Water closets.
7. Urinals.
8. Lavatories.
9. Commercial sinks.
10. Service basins.
11. Laboratory sink trim.
12. Laboratory trim.

C. Related Sections include the following:

1. Division 10 Section "Toilet, Bath, and Laundry Accessories."
2. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.
3. Division 22 Section "Emergency Plumbing Fixtures."
4. Division 22 Section "Drinking Fountains and Water Coolers."
5. Division 31 Section "Facility Water Distribution Piping" for exterior plumbing fixtures.

1.3 1.3 DEFINITIONS

D. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts,

shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

- F. PVC: Polyvinyl chloride plastic.
- G. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 1.4 SUBMITTALS

- H. Product Data: For each type of plumbing fixture indicated include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- I. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.
- J. Warranty: Special warranty specified in this Section.

1.5 1.5 QUALITY ASSURANCE

- K. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 - 1. Exception: If fixtures, faucets or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- L. 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.
- M. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act" and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- N. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- O. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- P. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- Q. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
 3. Slip-Resistant Bathing Surfaces: ASTM F 462.
 4. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 5. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
 6. Vitreous-China Fixtures: ASME A112.19.2M.
 7. Water-Closet, Flush Valve: ASME A112.19.5.
 8. Waterless Urinals, ASME A112.19.19-2006 standard for vitreous china non-water urinals and/or IAPMO 161-2007
- R. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
 2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 3. Faucets: ASME A112.18.1.
 4. Hose-Connection Vacuum Breakers: ASSE 1011.
 5. Hose-Coupling Threads: ASME B1.20.7.
 6. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 7. NSF Potable-Water Materials: NSF 61.
 8. Pipe Threads: ASME B1.20.1.
 9. Supply Fittings: ASME A112.18.1.
 10. Brass Waste Fittings: ASME A112.18.2.
- S. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
1. Atmospheric Vacuum Breakers: ASSE 1001.
 2. Brass and Copper Supplies: ASME A112.18.1.
 3. Dishwasher Air-Gap Fittings: ASSE 1021.

4. Manual-Operation Flushometers: ASSE 1037.
 5. Brass Waste Fittings: ASME A112.18.2.
- T. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Disposers: ASSE 1008 and UL 430.
 2. Flexible Water Connectors: ASME A112.18.6.
 3. Floor Drains: ASME A112.6.3.
 4. Grab Bars: ASTM F 446.
 5. Hose-Coupling Threads: ASME B1.20.7.

PART 2 - PRODUCTS

- A. Refer to Plumbing Equipment Schedule on the Plumbing drawings sheet P-0.2.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- D. Plumbing fixtures shall be furnished in white color unless otherwise herein specified.
- E. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- F. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
- G. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- H. Install counter-mounting fixtures in and attached to casework.

- I. Install fixtures level and plumb according to roughing-in drawings.
- J. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
 - 1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section “General-Duty Valves for Plumbing Piping.”
- K. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- L. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- M. Plumbing fixture trim and exposed supplies and wastes shall be polished chrome plated brass unless otherwise herein specified.
- N. Exposed wastes between trap and wall may be galvanized steel nipples with polished chrome plated casings.
- O. Concealed wastes above ground may be galvanized steel pipe, and concealed supplies and traps above ground may be rough brass.
- P. Install flushometer valves for accessible water closets and with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- Q. Install toilet seats on water closets.
- R. Install trap-seal liquid in dry urinals.
- S. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- T. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- U. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- V. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- W. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.

- 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- X. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.
- Y. Install dishwasher air-gap fitting at each sink indicated to have air-gap fitting. Install on countertop at sink. Connect inlet hose to dishwasher and outlet hose to disposer.
- Z. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- AA. Set service basins in leveling bed of cement grout. Grout is specified in Division 22 Section "Common Work Results for Plumbing."
- BB. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.3 CONNECTIONS

- CC. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- DD. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- EE. Provisions shall be made for cold water supply to all urinals (3/4" pipe size). Piping shall be capped for future replacement of 1 gpf hand flush valve type urinals.

3.4 FIELD QUALITY CONTROL

- FF. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- GG. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- HH. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- II. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- JJ. Install fresh batteries in sensor-operated mechanisms.

1.6 3.5 ADJUSTING

- KK. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- LL. Operate and adjust disposers and controls. Replace damaged and malfunctioning units and controls.
- MM. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
- NN. Replace washers and seals of leaking and dripping faucets and stops.
- OO. Install fresh batteries in sensor-operated mechanisms.

3.6 CLEANING

- PP. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - 2. Remove sediment and debris from drains.
- QQ. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.9 PROTECTION

- RR. Provide protective covering for installed fixtures and fittings.
- SS. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

SECTION 23 0500

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 1. Piping materials and installation instructions common to most piping systems.
 2. Transition fittings.
 3. Dielectric fittings.
 4. Mechanical sleeve seals.
 5. Sleeves.
 6. Escutcheons.
 7. Grout.
 8. Equipment installation requirements common to equipment sections.
 9. Painting and finishing.
 10. Concrete bases.
 11. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. CPVC: Chlorinated polyvinyl chloride plastic.
 - 2. PE: Polyethylene plastic.
 - 3. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Transition fittings.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Escutcheons.
- B. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved

in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 2. AWWA C110, rubber, flat face, 1/8-inch-thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
 1. CPVC Piping: ASTM F 493.
 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings: CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
1. Manufacturers:
 - a. Eslon Thermoplastics.
 - b. Or equal.
- B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
1. Manufacturers:

- a. Thompson Plastics, Inc.
 - b. Or equal
- C. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
 - 1. Manufacturers:
 - a. NIBCO INC.
 - b. Or equal.

2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, rated as appropriate for use but not less than for 250-psig minimum working pressure at 180 deg F.
 - 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Eclipse, Inc.
 - d. Epco Sales, Inc.
 - e. Hart Industries, International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Industries, Inc.; Wilkins Div.
 - h. Or equal.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150-psig minimum working pressure or not less than as required to suit system pressures.
 - 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epco Sales, Inc.

- d. Watts Industries, Inc.; Water Products Div.
 - e. Or equal.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - e. Or equal.
 - 2. Separate companion flanges and steel bolts and nuts shall have 150-psig minimum working pressure or not less than as required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and rated as appropriate for use but not less than 300-psig minimum working pressure at 225 deg F.
 - 1. Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.
 - c. Or equal.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and rated as appropriate for use but not less than 300-psig minimum working pressure at 225 deg F.
 - 1. Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.
 - e. Or equal.

2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - e. Or equal.
 - 2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Stainless steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
- E. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.8 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.

- 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.

- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep- pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
 - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw.
 - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
 - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw.
 - l. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
 - b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- O. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- P. Verify final equipment locations for roughing-in.
- Q. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.

2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 4. PVC Nonpressure Piping: Join according to ASTM D 2855.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
1. Plain-End Pipe and Fittings: Use butt fusion.
 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

- D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.

- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.9 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Thermal-hanger shield inserts.
 - 4. Fastener systems.
 - 5. Equipment supports.
 - 6. Metal framing systems.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 - 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.3 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports
 - 2. Thermal-hanger shield inserts.
- B. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
- B. Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 “Hangers and Support Applications” Article for where to use specific hanger and support types.
- C. Available Manufacturers:
 - 1. AAA Technology & Specialties Co., Inc.
 - 2. Bergen-Power Pipe Supports.
 - 3. B-Line Systems, Inc.; a division of Cooper Industries.
 - 4. Carpenter & Paterson, Inc.
 - 5. Empire Industries, Inc.
 - 6. ERICO/Michigan Hanger Co.
 - 7. Globe Pipe Hanger Products, Inc.
 - 8. Grinnell Corp.
 - 9. GS Metals Corp.
 - 10. National Pipe Hanger Corporation.
 - 11. PHD Manufacturing, Inc.
 - 12. PHS Industries, Inc.
 - 13. Piping Technology & Products, Inc.
 - 14. Tolco Inc.
 - 15. Or equal.

- D. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

- B. Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. GS Metals Corp.
4. Thomas & Betts Corporation.
5. Tolco Inc.
6. Unistrut Corp.; Tyco International, Ltd.
7. Or equal.

- C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.4 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

- B. Manufacturers:

1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.

7. Or equal.
- C. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with vapor barrier.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.
- G. Mechanical-Expansion Anchors: Insert-wedge-type [zinc-coated] [stainless] steel, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 1. Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head.
 - e. MKT Fastening, LLC.
 - f. Or equal.

2.5 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.6 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi, 28-day compressive strength

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricates from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- H. Install lateral bracing with pipe hangers and supports to prevent swaying.
- I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install

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concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

- J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- L. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils

- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 23 3113

METAL DUCT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rectangular ducts and fittings.
2. Round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.
7. Seismic-restraint devices.

B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports and seismic restraints shall be per OPM or DSA approved detail on the drawings.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.

2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.

D. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:

- a. Lighting fixtures.
- b. Air outlets and inlets.
- c. Speakers.
- d. Sprinklers.
- e. Access panels.
- f. Perimeter moldings.

E. Welding certificates.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

- 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
- 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
- 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Lindab Inc.
 - b. McGill AirFlow LLC.
 - c. SEMCO Incorporated.
 - d. Sheet Metal Connectors, Inc.
 - e. Spiral Manufacturing Co., Inc.
 - f. Or approved equal
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger Than 90 inches in diameter with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
1. Galvanized Coating Designation: G60 (Z180).
 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. CertainTeed Corporation; Insulation Group.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning.
 - e. Or approved equal
3. Maximum Thermal Conductivity:
 - a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
4. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
5. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
 - a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."
1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
 2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
 3. Butt transverse joints without gaps, and coat joint with adhesive.
 4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
 5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
 6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
 7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
 8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
 9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
 - a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
 10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used; secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.5 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 - 2. Tape Width: 4 inches.
 - 3. Sealant: Modified styrene acrylic.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 - 7. Service: Indoor and outdoor.
 - 8. Service Temperature: Minus 40 to plus 200 deg F.
 - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
 - 10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Water-Based Joint and Seam Sealant:
 - 1. Application Method: Brush on.
 - 2. Solids Content: Minimum 65 percent.
 - 3. Shore A Hardness: Minimum 20.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. VOC: Maximum 75 g/L (less water).
 - 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 - 8. Service: Indoor or outdoor.

9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
 2. Type: S.
 3. Grade: NS.
 4. Class: 25.
 5. Use: O.
 6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- F. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "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." Duct lateral support shall be per DSA approved drawings.
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.7 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2. Ductmate Industries, Inc.
 - 3. Hilti Corp.
 - 4. Kinetics Noise Control.
 - 5. Loos & Co.; Cableware Division.
 - 6. Mason Industries.
 - 7. TOLCO; a brand of NIBCO INC.
 - 8. Unistrut Corporation; Tyco International, Ltd.
 - 9. Or approved equal
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building

structure at the other end. Include matching components and corrosion-resistant coating.

- D. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.
- E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated. Duct lateral support shall be per DSA approved drawings.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct

insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finishes, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 2. Outdoor, Supply-Air Ducts: Seal Class A.
 - 3. Outdoor, Exhaust Ducts: Seal Class C.
 - 4. Outdoor, Return-Air Ducts: Seal Class C.
 - 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.

6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports." Duct lateral support shall be per DSA approved drawings.
- B. Building Attachments shall be per DSA approved drawings.
- C. Hanger Spacing: Comply with SMACNA's "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 maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures per DSA approved drawings.

3.5 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install ducts with hangers and braces per DSA approved drawings.

3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 DUCT CLEANING

- A. Clean new duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
 - 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
 - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
 - 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:
 - 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
 - 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
 - 1. Air outlets and inlets (registers, grilles, and diffusers).
 - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 - 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 - 4. Coils and related components.
 - 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
 - 6. Supply-air ducts, dampers, actuators, and turning vanes.
 - 7. Dedicated exhaust and ventilation components and makeup air systems.
- E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

F. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm:
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and

Flexible," Figure 2-3, "Vaness and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

- c. Velocity 1500 fpm or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vaness and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vaness and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 4) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.

- c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

G. Branch Configuration:

- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
- 2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION

SECTION 23 3713

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rectangular and square ceiling diffusers.
2. Perforated diffusers.
3. Louvers face diffusers.
4. Fixed face registers and grilles.
5. Modular Core Supply Grilles
6. Adjustable Bar Register
7. Adjustable Bar Grille

B. Related Sections:

1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

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

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Rectangular and Square Ceiling Diffusers:

1. Manufacturers:

- a. Price Industries.
 - b. Titus.
 - c. Metal Aire.
 - d. Or equal.
2. Devices shall be specifically designed for variable-air-volume flows.
 3. Material: Aluminum.
 4. Finish: Baked enamel, color selected by Architect.
 5. Face Size: As indicated on plan.
 6. Mounting: Snap-in.
 7. Pattern: Two position.
 8. Dampers: Opposed blade only.
 - a. Manual, key operated through register face.
 - b. Cable operated
 - c. Electronic motorized
 9. Accessories, as may be applicable:
 - a. Equalizing grid.
 - b. Plaster ring.
 - c. Safety chain.
 - d. Wire guard.
 - e. Sectorizing baffles.
 - f. Operating rod extension.

B. Perforated Diffuser :

1. Manufacturers:
 - a. Price Industries.
 - b. Titus.
 - c. METALAIRE, inc.
 - d. Or equal.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Aluminum filler panels and pattern controllers, with aluminum face.
4. Finish: Baked enamel, color selected by Architect.
5. Face Size: 23 ¾" by 23 ¾" for standard T-bar.
6. Duct Inlet: Round.
7. Face Style: Flush.
8. Mounting: surface mount.
9. Pattern Controller: Four louvered deflector patches.
10. Dampers: Opposed blade
11. Accessories:
 - a. Equalizing grid.
 - b. Plaster ring.
 - c. Safety chain.
 - d. Wire guard.
 - e. Sectorizing baffles.
 - f. Operating rod extension.

C. Louver Face Diffuser:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Price Industries.
 - b. Titus.
 - c. Tuttle & Bailey.
 - d. Or equal.
3. Devices shall be specifically designed for variable-air-volume flows.

4. Material: Steel
5. Finish: Baked enamel, color selected by Architect
6. Mounting: Snap in.
7. Pattern: Four-way core style.
8. Dampers: Radial opposed blade.
9. Accessories:
 - a. Square to round neck adaptor.
 - b. Adjustable pattern vanes.
 - c. Throw reducing vanes.
 - d. Equalizing grid.
 - e. Plaster ring.
 - f. Safety chain.
 - g. Wire guard.
 - h. Sectorizing baffles.
 - i. Operating rod extension.

D. Modular Core Supply Grilles:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide Price Industries or comparable product by one of the following:
 - a. Air Research Diffuser Products, Inc.
 - b. Anemostat Products; a Mestek company.
 - c. Carnes.
 - d. Hart & Cooley Inc.
 - e. Krueger.
 - f. METALAIRE, Inc.
 - g. Nailor Industries Inc.
 - h. Price Industries.

- i. Titus.
- j. Tuttle & Bailey.
- 3. Throw: Extended distance for airflow rates.
- 4. Material: Steel.
- 5. Grilles per Unit: Four.
- 6. Finish: White baked acrylic.
- 7. Border: 1-1/2-inch width with countersunk screw holes.
- 8. Blades:
- 9. Airfoil, individually adjustable horizontally.
- 10. Double deflection.
- 11. Set in modules.
- 12. Modules: Removable; rotatable.
- 13. Mounting: Surface.
- 14. Accessory: Opposed-blade steel damper.

E. Adjustable Bar Register

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 2. Basis-of-Design Product: Subject to compliance with requirements, provide Price Industries or comparable product by one of the following:
 - a. A-J Manufacturing Co., Inc.
 - b. Anemostat Products; a Mestek company.
 - c. Carnes.
 - d. Dayus Register & Grille Inc.
 - e. Hart & Cooley Inc.
 - f. Krueger.
 - g. METALAIRE, Inc.
 - h. Nailor Industries Inc.
 - i. Titus.

- j. Tuttle & Bailey.
- 3. Material: Aluminum.
- 4. Finish: Baked enamel, color selected by Architect.
- 5. Face Blade Arrangement: Horizontal 1/2 inch apart.
- 6. Core Construction: Removable.
- 7. Rear-Blade Arrangement: Vertical 1/2 inch apart.
- 8. Frame: 1 inch wide.
- 9. Mounting Frame: Filter.
- 10. Mounting: Countersunk screw
- 11. Damper Type: Adjustable opposed blade
- 12. Accessories:
 - a. Front-blade gang operator.
 - b. Filter.

F. Adjustable Bar Grille

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, but are not limited to, the following:
- 2. Basis-of-Design Product: Subject to compliance with requirements, provide Price Industries or comparable product by one of the following:
 - a. Anemostat Products; a Mestek company.
 - b. Carnes.
 - c. Krueger.
 - d. METALAIRE, Inc.
 - e. Nailor Industries Inc.
 - f. Titus.
- 3. Material: Aluminum.
- 4. Finish: Baked enamel, color selected by Architect.
- 5. Face Blade Arrangement: Horizontal 1/2 inch apart.
- 6. Core Construction: Integral.

7. Rear-Blade Arrangement: Vertical 1/2 inch apart.
8. Frame: 1 inch wide.
9. Mounting Frame: Filter.
10. Mounting: Countersunk screw

2.2 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 23 0513

BASIC HVAC MATERIALS AND METHODS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. This Section prescribes basic materials and methods generally common to the Work of Division 23.

B. Related Requirements:

1. Division 01: General Requirements.
2. Division 07: Thermal and Moisture Protection: Polyvinyl-Chloride Roofing.
3. Division 23: Heating, Ventilating, and Air-Conditioning.
4. Division 26: Electrical.
5. Section 31 2323: Excavation and Fill for Utilities.

1.2 SUBMITTALS

- A. Provide in accordance with Division 01, Section 23 0500 and specific requirements of each section of Division 23.

1.3 QUALITY ASSURANCE

- A. Standards: Comply with applicable national, state, and local codes and standards: ASTM, ASME, and ANSI. Federal Specifications, AWWA, CISPI, NFPA, FM Global, UL, CPC (California Plumbing Code), CMC (California Mechanical Code), CSA.
- B. Qualifications of Manufacturer: Products used in the Work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production as reviewed by the Architect.

1.4 COORDINATION

- A. Coordinate related Work in accordance with provisions of Section 01 3113: Project Coordination.

PART 2 – PRODUCTS

2.1 GENERAL

- A. Provide the following products if they are indicated in the Contract Documents or if they are required for the proper installation, function or operation of equipment, systems or components indicated in the Contract Document.
- B. Provide the following products as a complete assembly with required accessories for a complete and functioning entity in compliance with governing codes and applicable standards as specified in Section 23 0500, manufacturer's instructions or as required.
 - 1. Omission of minor details in the Contract Documents does not waive and/or otherwise relinquish compliance with the above requirements.

2.2 MANUFACTURERS AND MATERIALS

- A. B. Air and Dirt Separators:

Bell and Gossett, Spirotherm, Wessels, or equal.

- C. Balancing Valves:

BBV-1 Dual purpose, balancing and shut-off:

- 1. Direct operated Pressure Regulator: Class 200# SAG duct iron body, silicone chrome spring, stainless steel 316L Bellows/push rod.
- 2. Pilot operated Pressure Regulator Class 250# SAG cast iron body, cast iron cover, stainless steel valve stem, valve seat.
Sarco Type BRV 2, 71, 25P Armstrong GD 45 GP 28
Hoffman series 754

D.

- E. Ball Valves: Bronze, 2 inches and smaller:

BV-1 Class 150, 600 psi, CWP, 2 piece construction reinforced Teflon seats, full port, adjustable packing gland, stainless ball and stem, threaded ends.

Hammond UP-8303A/UP-8305/UP-8513, NIBCO T-685-80-LF/TS-685-66-LF, Milwaukee UPBA400S/450S, or equal.

- F. Butterfly Valves:

BFV-1 Centerline Series A, 200 psi CWP tight shut-off.

1. Body: Lug type ductile iron. Suitable for bi-directional dead-end service at rated pressure without use of downstream flange.
2. Disc: Bronze, or aluminum bronze.
3. Stem: One or two-piece, 400 series stainless steel.
4. Seat and O-Rings: EPDM.
5. Upper and Lower Stem Bearings: Copper alloy or non-metallic material.
6. Operators: Valves 6 inches and smaller, with lever handle. Valves 8-inch and larger, with manual gear operator and disc position indicator.
7. Manufacturers:
 - a) Valves 2.5 to 6-inch: NIBCO, Milwaukee ML-233E, Hammond 6411-03, or equal.
 - b) Valves 8-inch and larger: Milwaukee ML 333E, Hammond 6411-03, NIBCO LD 2000, or equal.
8. Grooved ends: Valves 6 inches and smaller, Victaulic No. 700 or NIBCO No. GD-4765-3 with lever handles. Valves 8 inches and larger, Victaulic VIC-300 Masterseal Series 761, NIBCO No. GD-4765-5, Gruvlok Fig. 7700 Series, or equal, with manual gear operator and disc position indicator.

G. Check Valves:

1. Bronze, 2-inch and smaller:

CHV-1 Class 125, 200 CWP swing check, Teflon disc, threaded ends. .
NIBCO T-413-Y, Milwaukee 509-T, Hammond IB-940, or equal.

CHV-2 Class 150, 300 psi, CWP, swing check, bronze, Teflon disc, threaded ends:
Stockham B-321; Crane 11TF, NIBCO T-433, Milwaukee 510-T, Hammond IB-946, or equal.
2. Cast Iron 2-1/2 and larger:

CHV-3 Class 125, 200 psi, CWP, IBBM, renewable seat and disc, bolted cap, threaded ends:
Crane 372, Stockham G-927, NIBCO T-918-B, or equal.

CHV-4 Class 125, 200 psi, CWP, IBBM, renewable seat, bronze or cast iron disc, bolted cap, flanged ends:

Stockham G-931, Crane 373, NIBCO F-918 B, Milwaukee F-2974-M, Hammond IR-1124-HI, or equal.

CHV-5 Class 250, 500 psi, CWP, iron body, renewable bronze seat and disc, bolted cap, flanged ends:

Stockham F-947, Crane 39E, NIBCO F-968B, Milwaukee F-2970-M, Hammond IR-322, or equal.

CHV-6 On pump discharge, Class 250, 400 psi, CWP, wafer check, center guided disc, spring actuated:

NIBCO W-960B, Keckley Co. Style CW, Val-Matic 1400, or equal.

CHV-7 300 psi, ASTM A395 and A536 ductile iron body, stainless steel shaft and spring, grooved end:

Victaulic Series 716, or series 779 with Venturi-like taps, Gruvlok Fig. 7800, Grinnell Model 590, or equal.

EDIT NOTE: APPLICATION: SAME AS CHV-6, EXCEPT FOR HIGH PRESSURE SYSTEM.

H. I. Flow Control Valve – Manual:

FC-1 Flow control valves: Bell and Gossett Series CB circuit setter balancing valve, line size, with integral pointer (to register degree of valve opening), differential pressure meter connections with built-in check valves and lockable memory stops. Armstrong Series CBV circuit-balancing valves, Victaulic/TA Hydronics, or equal.

J. Venturi Flow Measuring Device:

FMD-1 Preso B-plus Series, Victaulic “Style 733”, Griswold QuickSet Metering Stations, or equal, venturi type flow measuring device. Provide on the main heating hot water and chilled water lines and other locations as required for balancing, as indicated, between straight sections of pipe. Upstream pipe section shall be not less than 5 diameters in length and downstream section shall be not less than 2 diameters in length. Venturis shall be furnished complete with quick disconnect valves, safety shut-off with memory valves and attached metal identification tag.

1. 2-inch or smaller shall be furnished with threaded connections.
2. 2 ½-inch or larger shall be furnished with flanged or grooved connections.

K. Electronic Flow Readout Meter:

FM-1 Flow meter shall combine the functions and ranges of several gages into a single board range meter. Meter shall function as a compound pressure gage measuring the high side and low side pressure simultaneously and display each

reading in sequence. Meter shall be furnished complete with a shut-off, bypass, and blow down valve network installed on a portable meter panel. A carrying case shall be provided with storage for accessories. Meter shall automatically select the proper range, compensate for temperature, and reset itself. Memory function shall store up to 90 sets of pressure and temperature. Pressure reading shall be accurate to plus or minus 2 percent of reading from 0.01 to 150 psi. Temperature readings shall be accurate to plus or minus 0.5 degrees F and plus or minus 1.0 degree F. from minus 65 degrees F to 250 degrees F. The flow metering device shall be Hydrodata Multimeter HDM-250 as manufactured by Shortridge Instruments Inc., or equal, and shall be furnished with pressure gage, portable meter panel and with valve network, carrying case, battery charger, instruction manual and certificate of calibration, two 6 feet long by 1/2 inch OD pressure hoses with quick disconnects, two 8 foot by 1/4 inch OD drain hoses, and a set of adapters.

L. Gate Valves:

1. Bronze, 2 inches and smaller:

GV-1 Class 125, 200 psi CWP, bronze body and bonnet non-rising stem, inside screw, screw-in bonnet, solid disc, threaded ends:

Hammond IB645, Crane 1701, Milwaukee 105, American 3F, NIBCO T-113, or equal.

GV-2 Same as GV-1, except solder ends:

NIBCO S 113, Milwaukee 115, Hammond IB 647, or equal.

GV-3 Class 125, 200 psi WOG, rising stem, inside screw, screw-in bonnet, solid disc, threaded ends:

Stockham B-100, Crane 428, NIBCO T-111, Milwaukee 148, Hammond IB-640, or equal.

GV-4 Same as GV-3 except solder ends:

NIBCO S-111, Milwaukee 149, Hammond IB-635, or equal.

GV-5 Class 125, 200 psi CWP, rising stem, union bonnet, solid disc, threaded ends:

Stockham B-105, Crane 428 UB, NIBCO T-124, Milwaukee 1152, Hammond IB-617, or equal.

GV-6 Class 150, 300 psi CWP, rising steam, union bonnet, solid wedge, threaded ends:

Crane 431 UB, Stockham B-120, NIBCO T-134, Milwaukee 1151, Hammond IB-629, or equal.

2. Iron Body Gate Valves; 2 1/2 inches and larger:

GV-7 Class 125, O S and Y, IBBM, bolted bonnet, solid disc, flanged ends:

Hammond IR1140HI, Stockham G623, Crane 465-1/2, NIBCO F-617-0, Milwaukee F 2885M, or equal.

GV-8 Class 250, 500 psi, CWP, O S and Y, IBBM, bolted bonnet, solid wedge flanged ends:

Crane 7-1/2E, NIBCO F-667-0, Hammond IR 1138 HI, Milwaukee F 2894 M, or equal.

M. Globe Valves:

1. Bronze, 2-inch and smaller:

GLV-1 Class 125, 200 psi, CWP, screw-in bonnet, Teflon disc, threaded ends:

Hammond IB440, Milwaukee 502, Stockham B-13-T, NIBCO T-211-Y, Crane 5TF, or equal.

GLV-2 Class 125, 200 psi, CWP, screw in bonnet, Teflon disc, solder ends.

Hammond IB-418, Milwaukee 1502, NIBCO S-211-Y, or equal.

GLV-3 Class 150, 300 psi, CWP, union bonnet, Teflon disc, threaded ends:

Hammond IB413T, Stockham B-22T, Milwaukee 590T, NIBCO T-235-Y, or equal.

GLV-4 Class 150, 300 psi, CWP, union bonnet, Teflon disc, soldered ends

Hammond IB423, Stockham B-24T, Milwaukee 1590T, NIBCO S-235-Y, or equal.

2. Iron Globe Valves, 2 1/2-inch and larger:

GLV-5 Class 125, 200 psi, CWP, OS&Y, IBBM, renewable seat and disc, bolted bonnet, flanged ends:

Hammond IR116 HI, Stockham G-512, Crane 351, Milwaukee F2981 M, NIBCO F-718-B, or equal.

GLV-6 Class 250, OS&Y, IBBM, bolted bonnet, flanged ends:

Hammond IR 330 HI, Stockham F-532, Crane 21E, Milwaukee F2983M, NIBCO F-768-B, or equal.

N. Heater Vent Pipe:

1. Schedule Number:

HVP-1 Shall be UL approved for service specified. Concealed heater vent pipe, including pipe in or through attic spaces, shall be Los Angeles City approved double wall metal vent pipe. For recessed wall heaters, furnish B.W. type. All others may be Type B, or B.W. Clearances must comply with Los Angeles City code and conditions of UL listing.

American Metal Products Co., Inc., Simpson Dura-Vent, AmeriVent, Hart & Cooley Mfg. Co., Metalbestos, or equal.

EDIT NOTE: COMPONENT PARTS OF A VENT ASSEMBLY, INCLUDING VENT CAP, SHALL BE COMPANION ITEMS OF SAME MANUFACTURER. EACH ITEM SHALL BE UL-APPROVED AND LISTED.

- R. Pressure Gage: Aluminum or steel case, minimum 4-1/4 inches dial; pressure type or combination vacuum-pressure type, with provisions for field calibration. Dial indicator to indicate pressure in psi with accuracy to within plus or minus 0.5 percent of maximum dial reading. Furnish gages with restriction screw, size 60, to eliminate vibration impulses. Black case and ring, bourdon tube of seamless copper alloy with brass tip and socket. Three way gage cock, constructed of brass with stuffing box, 1/2 inch couplings, with fixed or movable cap nut to shut off pressure gage.

PG-1 Pressure type, black drawn steel case, 4 1/2-inch glass dial, range approximately twice line pressure.

Marsh Keckley, Terice, Weksler, Weiss, or equal.

- S. T. Strainers:

STR-1 Description: Wye type with monel or stainless steel strainer cylinder (manufacturer's standard mesh), and gasketed machine strainer cap. Where indicated on Drawings, provide with valved (globe valve) blowout piping, same size as blowout plug.

1. 2-inch and smaller:
C.M. Bailey No.100-A, 250 lb., cast iron body, threaded, Keckley 'B', Spirax Sarco Y-type, or equal.
2. 2 1/2-inch and larger:
C.M. Bailey No.100-A, 125 lb., cast iron body, flanged, or Victaulic style 732, 300 psi, ductile iron body, grooved, fusion bonded epoxy coated.
C.M.Bailey, Armstrong, Muessco, Keckley 'A', or equal.

STR-2 Y pattern cast iron bodies, 125 psi, monel screen. Open area at least twice the cross-sectional area of IPS pipe in which strainer is installed and may be woven wire or perforated type. Screwed ends for sizes up to 2 inches, flanged ends fusion bonded epoxy coated for 2 1/2 inches and larger perforations, in accordance with the following:

1. Steam service - 40 square mesh.

2. Other services - 16 square mesh.

Bailey No.100, Armstrong, RP&C, Keckley, or equal.

U. Temperature Control Valves:

TCV-1 Motor-operated valve, Forged brass bodies rated at no less than 400 psi working pressure; Chrome plated brass ball and stem, female NPT union ends, dual EPDM lubricated O-rings and TEFZEL characterizing disc.

Operated by Electronic Valve Actuator, manufactured, brand labeled or distributed by Belimo, TA, Honeywell, or equal.

TCV-2 Valves, automatic, electric, 3-way control.

Packed type bronze body and trim. Metal-to-metal seats designed for tight shut-off. Constant total flow throughout full plug travel. Valve designed for 150 psig steam working pressure. Valve operated by spring return motor with gear train. Valves screwed for sizes 2 inches and smaller.

Honeywell, Powers, Barber-Colman, Leonard, or equal.

TCV-3 Valves, automatic, electric, 3-way control.

Nickel-plated forged brass body rated at no less than 400 psi, stainless steel ball and blowout proof stem, NPT female end fittings, with dual EPDM O-ring packing design, fiberglass reinforced Teflon flow characterizing disc. **[NPS ¾ inch and Smaller for Terminal Units: Nickel plated forged brass body rated at no less than 600 psi, chrome plated brass ball and blowout proof stem, NPT female fiberglass reinforced Teflon flow characterizing disc.]**

Belimo, Flow Control Industries, Inc., Delta Control Products, or equal

V. Thermometers

1. Industrial:

T-1 Straight type with fixed or ratable stem, extruded or cast brass or cast aluminum case and brass separable well 6 inches minimum scale, angle or straight type range 30 degrees - 240 degrees F.

Weksler, Terice, Weiss, Ashcroft, Marshalltown, or equal.

T-2 Round type 3 ½-inch minimum dial range of 100 between 30 degrees and 155 degrees F, color coded red above 150 degrees F. Brass chrome plated case. Ashcroft, U.S. Gage, Marsh, Weiss, or equal.

2. Remote:

T-3 Liquid-filled capillary type with bulbs as required for remote and insertion mounting dials of 3 1/2-inch minimum diameter, non-ferrous internal parts, external means for re-calibration, glass or plastic lens and steel or non-ferrous case suitable for wall, duct or panel mounting range 30 degrees to 240 degrees F.

W. X. Valves (Air Vent):

VAV-1 Hot or chilled water air release valves shall be cast brass rated for 150 psig design pressure and 270 F operating temperature.

Spirotherm, Bell & Gossett, Taco, or equal.

VAV-2 Hot or chilled water space heating system air valve, brass with nickel trim 1/4 inch connection, disc type for manual or automatic venting.

Hoffman 500, Spirotherm, Watts, or equal.

VAV-3 Brass petcock, 1/4 inch connection by 1/4 inch copper tube to high point of coil or line by means of a tapped cap on top of 6 inches vertical nipple. Petcock to be installed approximately 5 feet 6 inches above finish floor.

Amtrol, Watts, Dole, or equal.

Y. Z.

AA. Unions:

1. Unions shall be furnished and installed in accordance with the following requirements (unless flanges are furnished):
 - a. At each threaded or soldered connection to equipment and tanks, except in Freon or fuel gas, piping systems, whether indicated or not.
 - b. Immediately downstream of any threaded connection to each manually operated threaded valve or cock, and each threaded check valve, yard box or access box except those in Freon piping systems, whether indicated or not.
 - c. At each threaded connection to threaded automatic valves (except those in Freon piping systems) such as reducing valves and temperature control valves, whether indicated or not.
 - d. If grooved piping is used, couplings shall serve as unions. Additional unions are not required
2. Unions shall be located so that piping can be easily disconnected for removal of equipment, tank, or valve.
3. Dielectric for dissimilar models.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions under which Work of this Section shall be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Provide all materials and equipment for the Work. Furnish and install necessary apparatus, parts, materials, and accessories.
- B. Pipe Installation:
 - 1. Install piping parallel to wall and provide an orderly grouping of proper materials and execution.
 - 2. Piping shall clear obstructions, preserve headroom, provide openings and passageways clear, whether indicated or not. Verify the Work of other Divisions to avoid interference.
 - 3. If obstructions or the Work of other Divisions prevent installation of piping or equipment as indicated by the Drawings, perform minor deviations as required by the Architect.
 - 4. Install piping after excavation or cutting has been performed. Piping shall not be permanently enclosed, furred in, or covered before required inspection and testing is performed.
 - 5. Exposed polished or enameled connections from fixtures or equipment shall be installed with no resulting tool marks or threads at fittings. Residue or exposed pipe compound shall be removed from exterior of pipe.
 - 6. Piping shall be concealed in chases, partitions, walls, and between floors, unless otherwise directed or specifically noted on Drawings. When penetrating wood studs, joists, and other wood members, provide such members with reinforcement steel straps of Continental Steel & Tube Co., ULINE, Independent Metal Strap, or equal.
 - 7. Reduce fitting where any change in pipe size occurs. Bushings shall not be furnished unless specifically reviewed by the Architect, or indicated on Drawings.
 - 8. Piping subject to expansion or contraction shall be anchored in a manner, which permits strains to be evenly distributed. Swing joints or expansion loops shall be installed. Seismic restraints shall be installed so as not to interfere with expansion and contraction of piping. 9. Immediately after lines have been installed, openings shall be capped or plugged to prevent entrance of foreign materials. Caps shall be left in place until removal is necessary for completion of installation.

10. Couplings shall not be installed except where required pipe runs between other fittings are longer than standard length of type of pipe being installed and except where their installation is specifically reviewed by the Architect.
11. Water piping shall be installed generally level, free of traps, unnecessary offset, arranged to conform to building requirements, clear of ducts, flues, conduits, and other Work. Piping shall be arranged with valves installed to provide for complete drainage and control of system. Piping shall not be installed which causes an objectionable noise from flow of water therein under normal conditions. Refer to Section 23 0500: Common Work Results for HVAC.
12. Water lines may be installed in same trench with sewer lines, provided bottom of water line is 12 inches minimum above top and to the side of sewer line.
13. Hot and chilled water circulating piping installed for space heating or cooling shall pitch up to a high point at a slope of 1/4 inch in 10 feet in the direction of flow. Where supply and return lines are exposed, both lines shall pitch in same direction. Otherwise, where possible, lines shall pitch up toward compression tank.
14. Changes in pipe sizes shall be furnished with eccentric reducers, flat on top. Offsets to clear obstruction shall not be installed so as to produce air pockets.

C. Pipe Sleeves and Plates:

1. Provide and install pipe sleeves of Schedule 40 black steel pipe or Schedule 40 PVC plastic pipe in concrete or masonry walls, footings, and concrete floors below grade. Provide and install adjustable submerged deck type sleeves at locations where pipes pass through concrete floors, except concrete slab floors on grade, and at locations where soil pipe for floor type water closets passes through concrete floors.
2. Sleeves shall provide 1/2 inch clearance around pipes, except plastic pipe shall have 1-inch clearance. Caps of deck type sleeves shall be removed just prior to installation of pipe. Area around sleeves shall be smooth and without high or low spots. Sleeves in walls shall not extend beyond exposed surface of wall. Sleeves in concrete floors and walls shall be securely fastened to forms to prevent movement while concrete is being placed.
3. Piping installed on a roof shall clear the roof surface by 10 inches minimum, with or without insulation. Bottom of individual fittings may infringe on 10 inches clear space but not groups of fittings or fittings located within 27 inches of each other.
4. Stiles shall be provided to facilitate crossing of piping when parallel piping runs are laterally greater than 12 inches out-to-out, or any pipe is higher than 18 inches, and more than 40 feet long or runs between 2 or more major pieces

of equipment or housings greater than 20 feet apart. Stiles shall be not less than 20 inches wide with a minimum tread depth of 10 inches. Where stiles are required, they shall be located so greatest obstructed distance is 30 feet.

5. Where pipes pass through waterproofed walls, floors, or floors on grade, sealant with Link-Seal Modular Seals, or equal, between pipe and sleeve to provide a waterproof joint. Where earth is in contact with pipe on both sides of a wall or foundation, the waterproof joint is not required. Commercial rubber compression units may be furnished instead of sealed sleeves if reviewed by the Architect.
6. Pipe sleeves shall be provided where pipes intersect footings or foundation walls and sleeve clearances shall provide for footing settlement, but not less than one inch all around pipe.

D. Copper Tubing and Brass Pipe with Threadless Fittings:

1. Silver brazed joints shall be used for attaching fittings to non-ferrous metallic refrigerant piping.
2. Non-pressure gravity fed condensate lines may be soldered with 95/5 solder.
3. Silver brazing alloy, Class BCUP-5. Surfaces to be joined shall be free of oil, grease, and oxides. Socket of fitting and end of pipe shall be thoroughly cleaned with emery cloth and wiped to remove oxides. After cleaning and before assembly or heating, flux shall be installed to each joint surface and spread evenly. Heat shall be applied in accordance with instructions in the Copper Tube Handbook issued by Copper Development Associates. Joints constructed of rough bronze fittings shall be provided as recommended by manufacturer.
4. Do not overheat piping and fittings when installing silver brazing.
5. Joints in non-ferrous piping for services not covered above shall be installed with solder composed of 95/5 tin/antimony, ASTM B32, Grade 5A. Surfaces to be jointed shall be free of oil, grease, and oxides. Sockets of fitting and end of pipe shall be thoroughly cleaned with emery cloth to remove oxides. Solder flux shall be sparingly installed and solder added until joint is completely filled. Do not overheat. Excess solder, while plastic, shall be removed with a small brush in order to provide an uninterrupted fillet completely around joint. Random inspection of joints shall be conducted by Project Inspector to ensure joints are lead-free.
6. Grooved end joints for copper piping shall be assembled in accordance with the latest manufacturer recommendations. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. Grooving tools shall be as manufactured by Victaulic, RIDGID, MAG Tool, or equal.

- E. Ring-Type Pipe: Joints shall be installed in accordance with manufacturer's instructions with grooved couplings, fittings and rubber rings. Couplings and pipe shall be compatible and of the same manufacturer. Rings shall be accurately located and installed by grooves in coupling. Pipe shall be installed with zero deflection unless otherwise specified. Pressure pipe shall be furnished with thrust blocks at each offset point.
- F.
- G. Grooved End Pipe Joints: Grooved end joints for carbon steel piping shall be assembled in accordance with the latest manufacturer recommendations. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. Grooving tools shall be as manufactured by Victaulic, RIDGID, MAG Tool, or equal.
- H. Joints shall be Vic-Press 304TM, or equal, made with Victaulic Series 'PFT' tools and the appropriate sized jaw. Pipe shall be certified for use with Vic-Press 304TM system, and shall be square cut, properly deburred and cleaned, and marked at the required location to insure full insertion into the fittings and/or couplings.
- I. Valves: Valves shall conform to the following:
1. Piping systems shall be furnished with valves at points indicated on Drawings and specified, arranged to provide complete regulating control of piping system throughout building and the Project site.
 2. Valves shall be installed in a neat grouping, so that parts are easily accessible and maintained.
 3. Pressure Independent Characterized Control valve type shall be suitable for service on which installed.
 4. Valves shall be full size of line in which they are installed, unless otherwise indicated on Drawings or otherwise specified, and shall be one of types specified.
 5. Provide chain operators on valves 2-inch and larger located 7 feet or more above the servicing floor level.
 6. Valves for similar service shall be of one manufacturer.
 7. Except where otherwise specified, valves shall be Belimo, Victaulic, Stockham, Crane, Jenkins, Milwaukee, Hammond, American Valve, NIBCO, Hoffman, or equal.
 8. Ball valves below grade in yard boxes shall have stainless steel handles.
 9. Temperature relief valves and combination temperature and pressure relief valves shall be as specified and furnished as set forth in this Section. Discharge

pipe from relief valves shall be not less than discharge area of valve or valves it connects, based on discharge area of valves, and shall terminate as indicated and free of any traps. Valves shall be installed at following locations:

- a. A combination temperature and pressure relief valve or combination of valves on each heating hot water boiler. Temperature sending element shall extend into water inside boiler.
10. Manual air vent valve assemblies shall be installed at each high point of hot water space heating and chilled water piping systems. Valves shall discharge through 1/4 inch diameter copper tubing and drain to nearest floor sink. Automatic type air vent valve shall only be installed where specifically indicated. Radiator, convectors, and finned pipe convectors shall be fitted with packless radiator valves, angle or straight pattern. Each convector or radiator installed as part of a space hot water heating system shall be furnished with a manual-type air vent valve.
- J. Strainers: Strainers shall be installed on each water main (except for fire line) downstream of the meter, above grade, when a pressure regulator assembly is not installed. Main strainer shall be of Y-flange or groove type. On closed loop chilled and heating hot water systems pump systems, a strainer shall be installed at each pump inlet and upstream of each flow control valve assembly. The control valve assembly may include a modulating temperature control valve and a flow-limiting valve, manufactured by Griswold, AutoFlow, Flow Control Industries, Inc., or equal.
- K. Flashings:
1. Each pipe, duct, or gas-fired equipment vent passing through roof shall be installed with waterproof flashing.
 2. Flashing or flanges on pipes, vents, and ducts passing through a tile or slate roof shall be constructed of sheet lead. Flashing for pipes and heater vents passing through a roof shall be 4 pound soft sheet lead. Flashing and flanges for ducts and heater vents passing through exterior walls shall be 22 gage sheet metal. Flanges and flashing shall be installed waterproof at point of connection with pipe or duct. No soldered joints on roof flashings will be allowed.
 3. Lead flashing and flanges shall be constructed of 4 pound sheet lead with burned joints. Flange of lead flashing or lead flange on a duct shall extend out onto roof a minimum of 12 inches from pipe or duct. Lead flashing shall extend up the pipe or duct not less than 7 inches.
 4. Sheet metal flashing shall be constructed of 24 gage galvanized sheet steel. Flanges on these flashings shall extend out onto roof a minimum of 10 inches from pipe or duct. Flanges on ducts through exterior walls shall extend out from duct a minimum of 2 1/2 inches. Flanges on gas-fired equipment single-wall vents shall be of ventilated type. Type B gas vents through a roof shall be furnished with non-ventilated flashing as per NFPA Pamphlet 211.

5. Cast iron, steel, brass, and copper pipe, which terminate less than 18 inches above roof, shall be furnished with a combination counter-flashing and vandal-proof hood for protection against water, birds and foreign matter. Cast iron, steel, brass and copper pipe, which does not terminate within 18 inches of roof, shall be furnished with a counter-flashing sleeve. Pipe, which terminates more than 18 inches above roof, shall be furnished with protection against entrance of water, birds, and foreign matter.
 6. Counter-flashing and combination counter-flashing sleeves and vandal-proof hoods shall be cast iron, vandal-proof, threaded, sealed or approved gas-heated sleeve type. Counter-flashing sleeves on each of these items shall extend down over flashing a minimum of 3/4 inch.
 7. Flashing and flanges on ducts shall be installed waterproof at point of connection to the duct by riveting and soldering. Storm collars shall be securely screwed and installed waterproof around appliance vent pipe immediately above flashing.
 8. Vent piping above roof shall be furnished with a combination counter-flashing sleeve and vandal-proof hood.
- L. Equipment Installation: Install roof or floor mounted equipment on level platforms, housekeeping pads or curbs and provide sound, vibration and seismic control measures per Section 23 0548, unless indicated otherwise whether indicated on drawings or not.

END OF SECTION

SECTION 23 0700
HVAC INSULATION

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Condensate drain piping from air conditioning equipment.
2. Vacuum and condensate pump discharge lines over 50 feet in length.
3. High and low temperature equipment.
4. Heating hot water supply and return piping.
5. Chilled water supply and return piping.
6. Refrigerant piping.
7. Supply and return air ducts for heating and cooling systems air ducts.

B. Related Requirements:

1. Division 01: General Requirements.
2. Section 23 0500: Common Work Results for HVAC.
3. Section 23 0513: Basic HVAC Materials and Methods.
4. Section 23 0553: Mechanical Identification.
5. Section 23 2013: HVAC Piping.
6. Section 23 3000: Air Distribution.
7. Section 23 5000: Central Heating Equipment.
8. Section 23 8000: Heating, Ventilating and Air Conditioning Equipment.

1.2 REFERENCES

A. American Society for Testing and Materials International (ASTM):

1. ASTM C167 – Standard Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations.
2. ASTM C302 – Standard Test Method for Density and Dimensions of Preformed Pipe-Covering-Type Thermal Insulation.
3. ASTM C411 – Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
4. ASTM C423 – Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
5. ASTM C533 – Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
6. ASTM C534 – Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
7. ASTM C547 – Standard Specification for Mineral Fiber Pipe Insulation.
8. ASTM C665 – Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
9. ASTM C739 – Standard Specification for Cellulosic Fiber Loose-Fill Thermal Insulation.
10. ASTM C1104 – Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.
11. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
12. ASTM E795 – Standard Practices for Mounting Test Specimens During Sound Absorption Tests.
13. ASTM G21 – Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

B. Underwriters Laboratories Inc.:

1. UL 181 – Standard for Factory-Made Air Ducts and Air Connectors.
2. UL 723 – Standard for Test for Surface Burning Characteristics of Building Materials.

C. National Fire Protection Association:

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1. NFPA 90A – Standard for the Installation of Air-Conditioning and Ventilating Systems .
2. NFPA 90B – Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
3. NFPA 255 – Standard Method of Test of Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

- A. Submit in accordance with Division 01 and Section 23 0500: Common Work Results for HVAC.
 1. Complete material list of items to be furnished and installed under this Section.
 2. Manufacturer’s specifications and other data required demonstrating compliance with the specified requirements.
 3. Shop Drawings, catalog cuts and manufacturer’s data indicating insulation, jacketing, adhesives, and coating. Insulating materials shall be certified by manufacturer to comply with the California quality standards for insulating materials.
 4. Display sample cutaway sections.
 5. Manufacturer’s recommended method of installation procedures, which will become part of this Section.

1.4 QUALITY ASSURANCE

- A. Qualifications of Manufacturer and Installer, Materials, Fabrication, Execution, and Standard of Quality: Comply with provisions stated under Section 23 0500: Common Work Results for HVAC and Section 23 0513: Basic HVAC Materials and Methods.
- B. Test Ratings:
 1. Comply with provisions stated under Section 23 0500 and 23 0513 with emphasis on ASTM E84, NFPA 255, or UL 723. ASTM C167, ASTM C302, UL label or listing of satisfactory test results from the National Institute of Standards and Technology, or a satisfactory certified test report from an acceptable testing laboratory. Approval by the State Fire Marshal is required.

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2. Furnish labels, legibly printed with the name of the manufacturer or listings indicate that fire hazard ratings do not exceed those specified for materials proposed for installation. Flame spread index of not more than 25 and smoke developed rating not exceeding 50.
 3. Tests shall be performed on each item individually when insulation, vapor barrier covering, wrapping materials, or adhesives are installed separately at the Project site.
 4. Test insulation, vapor barrier covering, wrapping materials and adhesives as an assembly when they are factory composite systems.
- C. Regulatory Requirements: Insulation furnished and installed under this Section shall conform to the requirements of the California Building Code Parts 4, Mechanical Code, Part 5, Plumbing Code and Part 6, Energy Code.
- D. All chemically based products such as sealers, primers, fillers, adhesives, etc. shall meet the California air quality regulations.

1.5 PRODUCT HANDLING

- A. Protection, Replacement, Delivery and Storage: Comply with provisions stated under Sections 23 0500: Common Work Results for HVAC and 23 0513: Basic HVAC Materials and Methods.

PART 2 – PRODUCTSMATERIALS

- A. General:
1. Piping insulating material shall be fire resistant, non-corrosive, shall not break, settle, sag, pack or disintegrate under vibration, nor absorb more than 1 percent moisture by weight.
 2. Piping insulating material shall be furnished with thickness indicated in Table 1, unless otherwise noted on the drawings, and shall furnish thermal resistance in the range of R-4.0 to 4.6 in accordance with inch at 75 degrees F. For any other value of R, insulation thickness shall be calculated accordingly and submitted for review.
 3. Asbestos in any quantity in insulating material is not permitted.
 4. Provide insulation materials, adhesives, coatings, sealants, fitting covers, and other accessories with a fire hazard rating not to exceed 25 for flame spread, 25 for fuel contributed and 50 for smoke developed, except for materials listed as follows:

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- a. Nylon anchors for installing insulation to ducts or equipment.
 - b. Treated wood blocks.
5. Flame-proofing treatments subject to moisture damage are not permitted.

TABLE 1 – MINIMUM PIPING INSULATION THICKNESS (1)

Insulation Thickness Required (in inches)
 Space Heating Systems (Steam, Steam Condensate and Hot Water)

Piping System Type	Temp. Range (degrees F)	Run-outs up to 2 (2)	1 and less	1.25 to 2	2.5 to 4	5 to 6	8 and larger
Hi Pres Temp	Above 350	1.5	2.5	2.5	3.0	3.5	3.5
Med Pres Temp	251 to 305	1.5	2.0	2.5	2.5	3.5	3.5
Low Pres Temp	201 to 250	1.0	1.5	1.5	2.0	2.0	3.5
Hot Water	Up to 200	0.5	1.5	1.5	1.5	1.5	1.5
Steam Cond.	-	0.5	1.0	1.0	1.0	1.5	1.5
Service Water Heating Systems (recirculating, piping supply and return)							
Hot Water	Up to 180	0.5	1.0	1.0	1.5	1.5	1.5
Space Cooling Systems (Chilled water, Brine and Refrigerant)							
Chilled Water	40-60	0.5	0.5	0.75	1.0	1.0	1.0
Refrigerant/Brine	Below 40	1.0	1.0	1.5	1.5	1.5	1.5
Condensate Drain	½ inch Minimum insulation thickness.	0.5	0.5	0.5	0.5	0.5	0.5
From Air Conditioning Equipment:	Insulate condensate drain lines within building, in room, inside walls and above ceilings.	0.5	0.5	0.5	0.5	0.5	0.5

NOTES: (1) For piping exposed to ambient temperatures, increase thickness by 0.5 inch.

(2) Run-outs to individual terminal units, not exceeding 12 feet in length.

B. Lagging Adhesives: Shall be nonflammable and fire-resistant and shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50

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when tested in accordance with ASTM E84. Insulation finished with canvas shall be provided with laps adhered in accordance to manufacturer's recommendation. A finish coat of same material shall be applied to entire outer surface of lagging cloth at coverage specified by manufacturer.

- C. Canvas Jackets: Furnish 6 ounce in accordance with square foot minimum, 48 by 48 thread count canvas jacketing.
- D. Insulation Jackets:
 - 1. Exterior insulation exposed to weather shall be weatherproofed with Childers aluminum jacketing as basis of design, or Pabco, RPR, or equal. Jacketing shall be manufactured from 1100, 3105 or 5010 aluminum alloy with 3/16 inch corrugations. Smooth or embossed jackets may be permitted in special situations to match an existing installation. Jacketing shall be furnished with an integrally bonded moisture barrier over entire surface in contact with insulation. A minimum thickness of 0.016 aluminum jacketing is to be provided on ducts and piping. A minimum thickness of 0.020 shall be provided on tanks, equipment, and heat exchangers.
 - 2. Insulated elbows, of 90 degrees and 45 degrees, with a nominal iron pipe size of ½ inch to 8 inches shall be provided with Childers aluminum Ell-Jacs insulation covers as basis of design, or Pabco, RPR, or equal, manufactured from 1100 aluminum alloy of 0.024 inch thickness. Insulated elbows with a nominal pipe size of 10 inches to 18 inches shall be provided with Childers 4-piece aluminum Ell-Jacs as basis of design, or Pabco, RPR, or equal.
 - 3. Tees, Flanges, and Valve Insulation in Conjunction with Aluminum Jacketing: Furnish Childers Aluminum Special Fabrications Insulation Covers as manufactured by Childers Products Company, Pabco, RPR, or equal.
- E. Adhesives: Adhesives shall be water based, UL Classified, meet the requirements of NFPA 90A and NFPA 90B, have been tested according to relevant ASTM requirements, and be acceptable to the State Fire Marshal. Name, type and method of installation shall be submitted for review.
- F. Valve and Fitting Cover: When installed in conjunction with PVC jacketing, furnish Zeston 25/50 rated polyvinyl chloride fitting covers as manufactured by Johns Manville, Knauf Insulation, Speedline, or equal.

2 SPACE HEATING PIPING SYSTEM

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A. General: Insulate steam, steam condensate return, and hot water space heating supply and return, including valves, strainers and fittings with insulation thickness as indicated on Table 1.

B. Materials:

1. Classes of Insulation:

a. Class A: Calcium silicate molded pipe insulation, suitable for service temperature up to 1200 degrees F, ASTM C533; Johns Manville Thermo-12 Gold, or equal. Fittings: diatomaceous silica thermal insulating cement.

b. Class B: Glass fiber molded pipe insulation suitable for service temperatures up to 850 degrees F. Pipe insulation shall be one piece, preformed, and provide a minimum R factor of 4.0 at 75 degrees F mean temperature. Insulation shall be faced with all-purpose fire retardant vapor barrier jacket. Pipe insulation shall be Johns Manville Micro-Lok, Knauf Redi-Klad 1000, Owens Corning FIBERGLAS Pipe Insulation SSL II-ASJ, or equal.

c. Class C: Flexible open-cell melamine (foam insulation) suitable for service temperature -150 degrees F to 400 degrees F. Thermal conductivity at 75 degrees F, K = 0.26. Pipe insulation, one-piece pre-formed, laminated to heavy non-reinforced PVC jacket, with locking track, factory installed to jacket, to snap insulation and jacket onto pipe. Similar to TechLite 079 Series as manufactured by Accessible Products Co., or equal. Installation shall comply with manufacturers recommendations.

d. Class D: Mineral fiber pipe insulation suitable for service temperatures up to 1,200 degrees F. Pipe insulation shall be one-piece, preformed up to 3 inches thickness, and provide a minimum R factor of 4.0 at 75 degrees F mean temperature. Insulation shall be faced with all-purpose fire-retardant vapor barrier jacket. Pipe insulation shall be 8 pounds in accordance with cubic foot density by Roxul Techton 1200, Fibrex COREPLUS 1200, Industrial Insulation Group, LLC (IIG) MinWool-1200, or equal.

2. Locations and Class of Insulation Required:

TABLE 2 – LOCATIONS AND CLASS OF INSULATION REQUIRED

<u>LOCATION</u>	<u>CLASS OF INSULATION</u>
Boiler and Mechanical	A, B, C, or D

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Equipment Room	
All Other Locations	A, B, C, or D

3. Fittings on indoor piping shall be covered with flush, hand-wrapped Class A, B, C, or D insulation, to match the adjoining pipe insulation and covered with polyvinyl chloride fitting covers: Zeston 2000 25/50 by Johns Manville, Knauf Insulation Proto PVC Fitting Cover, Speedline Polyco Smoke Safe, or equal.
4. Adhesive: Fibrous Adhesive to bond calcium silicate to itself and non-porous surfaces.

2 COOLING PIPING SYSTEM INSULATION

- A. General: Insulate chilled water supply and return piping and refrigerant piping.
- B. Materials:
 1. Classes of Insulation:
 - a. Class A: Expanded polystyrene pipe insulation, self-extinguishing type, either molded or extruded; Dow Chemical Co. STYROFOAM, ITW Insulation Systems XPS PIB, Foam-Control EPS, or equal.
 - b. Class B: Glass fiber molded pipe insulation ASTM C547. Pipe insulation shall be one piece, preformed, and provide a minimum R factor of 4 at 75 degrees F mean temperature. Insulation shall be faced with all-purpose fire retardant vapor barrier jacket. Pipe insulation shall be Johns Manville Micro-Lok, CertainTeed Snap-On, Owens Corning FIBERGLAS SSL II-ASJ, or equal.
 - c. Class C: Expanded (foamed) urethane (polyurethane) or polyisocyanurate pipe insulation of self-extinguishing type molded or fabricated, Dyplast Products, LLC ISO-C1/2.0, ITW Trymer, Specialty Products & Insulation Co. Polyisocyanurate Pipe Insulation, Armacell Armalok, or equal.
 - d. Class D: Foamed plastic pipe insulation, self-extinguishing type, ASTM C534 Type 1 – tubular. Pipe insulation shall be one-piece preformed, flexible tubing type and provide a maximum K factor of 0.28 at 75 degrees F mean temperature. Pipe insulation shall be Armacell Armaflex, Aeroflex Aerocel, Rubatex INSUL-TUBE 180, or equal.

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2. Locations and Class of Insulation Required: For thickness required, refer to Table 1 of this Section.

TABLE 3 – SERVICE, LOCATION AND CLASS OF INSULATION REQUIRED

<u>SERVICE</u>	<u>LOCATION</u>	<u>CLASS OF INSULATION</u>
Condensate drains from air conditioning equipment	Indoors at all locations including above ceilings and between stud walls	D
Refrigerant suction Liquid line as required	All locations except underground	D
All other piping, except underground	All locations except underground	A, B, C

3. Adhesives:
 - a. Polystyrene adhesives: Synthetic rubber and resin adhesives specifically designed to adhere extruded and expanded rigid polystyrene and urethane insulation to themselves and to other porous and non-porous substrates.
 - b. Vapor barrier laps and penetrations: Furnish protective coating and lagging adhesive on butt joints of foil-faced vapor barriers, and where pins and staples puncture facings.

2.3 HIGH TEMPERATURE EQUIPMENT INSULATION

A. General:

1. Insulate heat exchangers, hot water storage tanks, flash tanks, boiler breechings, and similar equipment operating at elevated temperatures up to 450 degrees F or 850 degrees F with high temperature insulation, jacket and material.
2. Do not insulate condensate receivers, hot water expansion tanks, hot water pump casings, chemical feeders, and factory insulated boilers.

B. Materials:

1. Equipment insulation shall be 1-1/2 inches minimum fiberglass board or insulating blocks, or molded calcium silicate, ASTM C533-Type I, Johns Manville Thermo-12 Gold or 1000 Series Spin-Glas, Knauf Insulation

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Board, Owens Corning Fiberglas Series 700 or Fiberglas Insul-Quick, or equal.

2. Boiler breeching insulation shall be same as above except 2 inches thick minimum.
3. Adhesive: For calcium silicate, furnish fibrous adhesive of sodium silicate base.

2.4 LOW TEMPERATURE EQUIPMENT INSULATION

A. General:

1. Insulate water chillers, heat exchangers, air eliminators and similar equipment operating at reduced surface temperatures.
2. Do not insulate chilled water expansion tanks, and chemical feeders.

B. Materials:

1. Expanded polystyrene, 2 inches thick, self-extinguishing type, Dow Chemical Co.'s STYROFOAM, Owens Corning FOAMULAR, Foam-Control EPS, or equal, or 1-1/2 inches thick expanded urethane (polyurethane) or polyisocyanurate, self-extinguishing type, Dyplast Products, LLC ISO-C1/2.0, ITW Trymer, Specialty Products & Insulation Co. Polyisocyanurate Pipe Insulation, or equal.
2. Canvas Jackets: 6 ounce in accordance with square foot minimum.
3. Vapor Barrier Laps and Penetrations: Furnish protective coating and lagging adhesive on butt joints of foil-faced vapor barriers and where pins and staples puncture facings.

3 DUCTWORK AND PLENUM INSULATION

A. General: Insulate ductwork and plenums with not less than the amount of insulation tabulated in Table 4, unless noted otherwise on the drawings. Insulation may be omitted under the following conditions:

1. Exposed return air ductwork in conditioned space.
2. Return air ductwork between wall studs inside an interior wall.

TABLE 4 – INSULATION OF DUCTS AND PLENUM

INSULATION TYPES

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<u>Duct Location</u>	<u>Heating and Cooling</u>
Exposed interior supply ductwork	DW-1
On roof, and exterior of building	DW-2
In walls, within floor/ ceiling spaces	F-1
Hot and cold plenums	F-2 or DW-1
Attics, Garages, and Crawl Spaces, within unconditioned space or in basement	F-3

B. Insulation Types:

1. DW-1: 1 inch thick insulation sandwiched inside double-wall type ducts and fittings. Duct joints shall be waterproofed.
2. DW-2: 2 inch thick insulation sandwiched inside double-wall type ducts and fittings. Duct joints shall be waterproofed.
3. F-1: 1 ½ inch blanket fiberglass, factory-laminated with all-service jacket vapor barrier.
4. F-2: 2 inch blanket fiberglass, factory-laminated with all-service jacket vapor barrier.
5. F-3: 3 inch blanket fiberglass, factory-laminated with all-service jacket vapor barrier.

C. Notes:

1. Minimum insulation provided shall be as required by the current California Mechanical Code Title 24 for the most restrictive condition.
2. Refer to the materials indicated in this section for external insulation.
3. Insulation lining the duct interior is not permitted.

D. Materials:

1. Fire-Resistive Insulation Materials and Coatings: Submit State Fire Marshal pre-approved materials only.
2. Adhesives: See Paragraph 2.01.E for applicable products.

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3. External Insulation: Provide glass fiber blankets that are factory-laminated with Foil Reinforced Kraft (FRK) vapor barrier facing; Johns Manville Microlite, Owens-Corning SOFTR Duct Wrap, Knauf Insulation Friendly Feel Duct Wrap, or equal. Provide a minimum installed R value as required by the CEC Building Energy Efficiency Standards; but not less than scheduled below:

TABLE 5
INSULATION OF DUCTS AND PLENUM INSTALLED
THERMAL RESISTANCE R VALUES

Type	Labeled Thickness (in inches)	Installed R Value (hr.ft ² .°F/Btu)
F-1	1 ½	4.2
F-2	2	5.6
F-3	3	8.3
DW-1	1	4.2
DW-2	2	5.6

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Except as specified herein, install material in accordance with recommendations of manufacturer. Do not install insulation materials until tests specified in other sections are completed. Remove foreign material such as rust, scale, or dirt. Surfaces shall be clean and dry. Maintain insulation clean and dry at all times.
- B. On cold surfaces where a vapor barrier must be provided and maintained, insulation shall be installed with a continuous, unbroken moisture and vapor seal. Hangers, supports, anchors, or other projections that are fastened to cold surfaces shall be insulated and vapor sealed to prevent condensation.
- C. Surface finishes shall be extended in such a manner as to protect raw edges, ends, and surfaces of insulation.
- D. Pipe or duct insulation shall be continuous through walls, ceiling or floor openings, or sleeves; except where fire-stop or fire-safing materials are required.
- E. Metal shields shall be installed between hangers or supports and the piping insulation. Rigid insulation inserts shall be installed between the pipe and the insulation shields. Inserts shall be of equal thickness to adjacent insulation and shall be vapor sealed accordingly.
- F. Insulation shall not be installed in the following locations unless otherwise noted:

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1. On vacuum return lines less than 50 feet long.
2. On unions, flanged connections or valve handles.
3. Over edges of any manhole, clean-out hole, clean-out plug, access door or opening to a fire damper, so as to restrict opening or identification of access.
4. Over any label or stamp indicating make, approval, rating, inspection, or similar data, unless provision is made for identification and access to label or stamp.

3.2 INSTALLATION OF HEATING PIPING SYSTEM INSULATION

- A. General: Space heating hot water, domestic hot water, tempered water supply and return piping and condensate return piping, after having been tested, shall be cleaned and insulated.
- B. Application: Insulate condensate return piping, hot water heating supply and return piping, steam and steam condensate piping, domestic hot water supply and return, including tempered supply and return piping in accordance with manufacturer's instructions and as specified herein.
 1. Install insulation on valve bodies up to valve bonnet. Fill void in saddles, in accordance with Section 23 0513: Basic HVAC Materials and Methods, with insulation and seal joints.
 2. Install insulating material to fittings, valves, and strainers and smooth to thickness of adjacent covering. Leave strainer clean-out plugs accessible. Covers fabricated from polyvinyl chloride shall be furnished.
- C. Insulation Jackets in Exposed Indoor Locations:
 1. Cover completed insulation with canvas jacket tightly pasted to covering with lagging adhesive. Lap jacket seams 1-1/2 inches minimum. Finish entire jacket with coating of undiluted adhesive.
 2. Equivalent factory applied pre-sized, glass fiber reinforced, or glass fiber jackets may be furnished. Seal jacket seams with adhesive in accordance with manufacturer's instructions.
 3. Johns Manville Zeston 2000, Knauf Insulation Proto PVC Fitting Cover, Speedline Polyco Smoke Safe, or equal, fitting covers may be furnished, with molded or segmented insulation equal to specified insulation applied to fittings. Secure covers in accordance with manufacturer's instructions.

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4. In addition to above requirements, cover exposed insulated piping within a distance of 8 feet above floors with 26 gage galvanized steel jacket. Omit jacket in areas accessible only to maintenance personnel, such as mechanical equipment rooms, utility corridors, accessible pipe tunnels and manholes.
- D. Concealed Indoor Locations: Cover insulation over fittings, valves, and strainers with canvas. Provide pipe insulation with factory or field applied standard jacket of 4 ounce minimum canvas, fiberglass cloth, or glass fiber reinforced jacket. Seal jacket laps with adhesive in accordance with manufacturer's instructions.
- E. Exposed Outdoors: In addition to canvas or fiberglass cloth cover, pipe insulation exposed to weather shall be provided with an additional 0.016 inches thick aluminum jacket with 2 inches lap connected with one inch hem overlap joint located on side of pipe and turned down to shed water. Jacket shall be strapped 12 inches on center with ½ inches wide stainless steel strapping and wing seals. Aluminum jacket shall be mitered to fit fittings.

3.3 INSTALLATION OF COOLING PIPING SYSTEM INSULATION

- A. General: Chilled water supply and return piping, refrigerant piping and condensate drain lines, after having been tested, shall be cleaned and insulated.
- B. Application: Insulation on chilled water lines, refrigerant suction lines and liquid lines, if indicated, and air conditioner interior drain lines shall be jacketed with fire-resistant vapor barrier of laminated aluminum foil consisting of 2 plies with glass-yarn reinforcing. Jacket joints shall be lapped and sealed with an approved adhesive. Insulation shall be secured with aluminum bands not less than 0.005 inch thick by ¾ inches wide, spaced not over 12 inches on centers, or as recommended by manufacturer.
1. Longitudinal Seams: Butt hinged sections of covering tightly together and seal down jacket flap with adhesive, or with factory-applied, self-sealing lap with pressure-sensitive sealer protected with release paper.
 2. End Joints: Wrap joint with a 3-inch wide (minimum) self-sealing tape.
 3. Fittings and Valves: Fittings and valves shall be covered with same material of same thickness as pipe insulation, sealed with an approved, vapor-sealing tape or compound and covered with Johns Manville Zeston polyvinyl-chloride cover, Knauf Insulation Proto PVC Fitting Cover, Speedline Polyco Smoke Safe, or equal.
 4. Pipe hangers shall be insulated or attached to pipe by an insulating insert, butted between adjoining insulation sections.

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C. Additional Jackets:

1. Exposed Indoor Insulation: Cover with 26 gage galvanized sheet metal jacket to 8 feet above floors, except in mechanical equipment rooms and accessible pipe tunnels.
2. Exposed Outdoor Insulation: In addition to canvas or fiberglass cloth cover, provide 0.016 inch thick aluminum jacket with one inch wide aluminum bands and seals. Install appropriate jackets on valves and fittings.

3.4 INSTALLATION OF HIGH TEMPERATURE EQUIPMENT INSULATION

A. General: Provide insulation over parts of heat exchangers and similar equipment requiring insulation having removable head or sections.

B. Application:

1. Equipment: Securely tie insulation on with copper clad wire. Install tack coat weather barrier coating at a thickness specified by manufacturer. While tack coat is still wet, a layer of 10 open weave glass cloth membrane shall be embedded with fabric seams overlapped a minimum of 2 inches. Install a finish coat fully covering membrane at coverage rate specified by manufacturer.
2. Boiler Breechings: Wire securely V-rib wire lath, ¾ inches minimum depth to boiler breechings, connections and stacks inside boiler rooms, and cover with insulation and jacket as specified above.
3. Manholes and Hand Holes: Maintain accessible by beveling off permanent insulation around manhole and cover manhole plate with removable blanket.

3.5 INSTALLATION OF LOW-TEMPERATURE EQUIPMENT INSULATION

A. General: Provide removable sections of insulation over parts of chillers and similar equipment requiring insulation and having removable heads or sections.

B. Exterior surfaces of chilled water system expansion tanks and chilled water pumps shall be insulated with not less than 2 inches thick expanded polystyrene or fiberglass, as specified. Fill spaces between insulation and equipment with granulated polystyrene or urethane to eliminate voids. Insulation shall be secured with metal band, and covered with one inch, 20 gage hexagon galvanized mesh and ¼ inches thick insulating cement troweled smooth. Cement surface shall then be

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covered with 0.002 inches aluminum foil applied smoothly and secured with suitable adhesive, and a layer of 6-oz. canvas.

- C. Coat joints of polyurethane insulation with neoprene based contact adhesive. Adhesives furnished shall be approved by insulation manufacturer. Fill and seal external voids and seams with non-shrinking sealant.
- D. Canvas Jacket: Cover completed insulation with canvas jacket tightly pasted to covering with lagging adhesive. Lap jacket seams a minimum of 1 ½ inches. Finish entire surface of canvas jacket with one brush coat of diluted lagging adhesive, Childers CP-50A, Foster 30-36, Mon-Eco Industries (MEI) Eco-Lag Adhesive, or equal, and heavy final coat of undiluted adhesive.

3.6 INSTALLATION OF DUCTWORK AND PLENUM INSULATION

A. External Covering:

- 1. Before installing duct insulation, sheet metal ducts shall be clean, dry, and tightly sealed at joints and seams, inspected pressure tested, and accepted by LAUSD OAR/ Inspector.
- 2. Duct exterior insulation shall be firmly wrapped around ductwork with joints lapped a minimum of 2 inches. Insulation shall be securely fastened with 18 gage copper-lined steel wire, or 16 gage soft-annealed galvanized wire spaced approximately 12 inches on centers and at loose ends, presenting a neat and workmanlike appearance. Where duct width is such that wiring will not fasten insulation firmly against duct an adhesive shall be furnished to fasten insulation to duct with wiring being installed at ends of insulation segment.
- 3. Insulation on ductwork transporting conditioned air, both supply and return, and outside air intake ducts when pre-conditioned, shall be furnished with a factory-applied, fire-resistant vapor barrier.
- 4. Exposed Ducts or Plenum:
 - a. Install insulation to ducts or plenum furnished with butt joints, without voids and with adhesive over entire surface of duct. Cover insulation with canvas jacket, fastened tightly to insulation with lagging adhesive. Install 2 finish coats of undiluted adhesive.
 - b. When installing jacket, finished covering shall be even and level, without humps, with constant diameters on round ducts maintained.

3.7 CLEANUP

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- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.8 PROTECTION

- A. Protect the Work of this Section until Substantial Completion.

END OF SECTION

SECTION 23 2013

ABOVE GROUND HVAC PIPING

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes: Above ground piping systems for heating, ventilating, and air conditioning systems. Systems include but are not limited to the following:
1. Chilled Water System.
 2. Hot Water Heating System.
 3. Low-pressure Steam.
 4. Miscellaneous Piping Required for Equipment of this Section.
 5. Connections to Exterior Utilities.
- B. Related Requirements:
1. Division 01: General Requirements.
 2. Section 23 0500: Common Work Results for HVAC.
 3. Section 23 0513: Basic HVAC Materials and Methods.
 4. Section 23 0548: HVAC Sound, Vibration and Seismic Control.
 5. Section 23 0553: HVAC Identification.
 6. Section 23 0700: HVAC Insulation.
 7. Section 23 0900: HVAC Instrumentation and Controls.
 8. Section 23 2016: Underground HVAC Piping.
 9. Section 23 2500: HVAC Water Treatment.
 10. Section 23 6416: Oil Lubricated Centrifugal Water Chillers.
 11. Section 23 6418: Oil Free Centrifugal Water Chillers.
 12. Section 23 6423: Scroll Water Chillers.

13. Section 23 6426: Rotary-Screw Water Chillers.
14. Section 23 6428: Air-Cooled Rotary Screw Chillers.
15. Section 23 6500: Cooling Towers.
16. Section 31 2323: Excavation and Fill for Utilities.

1.2 REFERENCES

A. ASTM International:

1. ASTM A47 – Standard Specification for Ferritic Malleable Iron Castings.
2. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
3. ASTM A105 - Standard Specification for Carbon Steel Forgings for Piping Applications.
4. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
5. ASTM A181 - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.
6. ASTM A234 - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
7. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength.
8. ASTM B32 - Standard Specification for Solder Metal.
9. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
10. ASTM B88 - Standard Specification for Seamless Copper Water Tube.

B. American National Standard Institute (ANSI) and The American Society for Mechanical Engineers (ASME):

1. ANSI/ASME B1.20.1 - Pipe Threads, General Purpose, Inch.
2. ANSI/ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.
3. ANSI/ASME B16.9 - Factory Made Wrought Butt-welding Fittings.

4. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

1.3 SUBMITTALS

- A. Provide submittals in accordance with Division 01, Sections 23 0500, Common Work Results for HVAC, and 23 0513, Basic HVAC Materials and Methods.
- B. Provide Shop Drawings with dimensioned piping layout and details of expansion loops, elbows, anchor points, pipe supports, building entry points and other pertinent information required to verify layout. Indicate systems, pipe material and sizes, show location of devices such as pumps, unions, joints, valves, flow measuring devices, fittings, flexible connectors, and location of hangers and supports, intent and type of materials are in accordance with this Section. Prefabricated pipe units shall be dimensioned and numbered to fit actual Work with field verified conditions prior to start of factory fabrication.
- C. Submit manufacturer's Product Data for products listed on Part 2 of this section, demonstrating conformance to specified standards and specification requirements.

1.4 QUALITY ASSURANCE

- A. Comply with applicable codes and referenced standards: ASTM, ASME/ANSI, CPC (California Plumbing Code), CMC (California Mechanical Code).
- B. Qualifications of Manufacturer: Products used in the Work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Delivery and Storage: Deliver materials to Project site in their original unopened containers with labels intact and legible at time of delivery. Store in strict accordance with manufacturer's recommendations.

1.6 COORDINATION

- A. Coordinate related and adjacent activities in accordance with Section 01 3113, Project Coordination.

PART 2 – PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Chilled Water, Heating Hot Water:

1. Pipe:
 - a. 2-inch and smaller: Standard weight, seamless copper, type L hard drawn, ASTM B88.
 - b. 2 ½-inches and larger: Schedule 40 seamless black steel, ASTM A53, grade B, type S. Pipes and fittings shall be properly marked with schedule number, ASTM number, manufacturer, etcetera, in accordance with ASTM requirements.
2. Fittings:
 - a. 2-inch and smaller: Wrought solder-type copper, in accordance with ANSI/ASME B16.22.
 - b. 2 ½-inch and larger:
 - 1) 150 pound forged steel, weld neck or slip-on, ASTM A181 and ANSI/ASME B16.5. Furnish flat faced flanges against equipment with flat faced flanges.
 - 2) Flange gaskets: Mineral fiber, 1/16 inch thick, equivalent to Garlock Style 9800, Durlon 8300, or equal.
 - 3) Bolting materials: Carbon steel heavy hex bolts and nuts, ASTM A307, type B.
3. Joints:
 - a. 2-inch and smaller: 95 percent tin and 5 percent antimony solder with non-acid flux type flux, ASTM B32, grade 95TA.
 - b. 2 ½-inch and larger: Standard weight, seamless steel; welding fittings and flanges ASTM A234 and ANSI/ASME B16.9 for fittings and ASTM A181 or ASTM A105 for flanges.
4. Unions:
 - a. 2-inch and smaller Wrought solder type, copper to copper; furnish ground joint cast bronze low lead unions, NIBCO 733, where copper connects to steel.
 - b. 2 ½-inch and larger: Refer to Section 23 0513, Basic HVAC Materials and Methods, for threaded pipe joints and welded connections.

B. Valves: Chilled Water.

1. Ball Valves, 2-inch and Smaller: Shall be 600 psi CWP, have cast brass bodies, replaceable reinforced Teflon seats, conventional port, blowout proof stems, chrome plated brass ball, and threaded or solder ends with extended solder cups.

<u>Threaded</u>	<u>Solder</u>
Stockham T-285-FB-R-70 (full port)	Stockham S-285-FB-R-70 (full port)
Crane 9301	Crane 9302
Worcester 44-11-RT-SE	Worcester 44-11-RT-TE
Jamesbury 351T	---
Apollo 70-100	Apollo 70-200
Equal	

2. Gate Valves, 2-inch and Smaller:

Class 125, body and bonnet ASTM B62. Cast bronze composition. Threaded or soldered ends. Solid disc, copper-silicon alloy stem, brass packing gland. Threaded ends: Stockham B-100 (RS) or B103 (NRS), Crane 428 or 438, Hammond IB640 (RS) or IB645 (NRS), or equal. Soldered ends: Stockham B104 (NRS) or B108 (RS), Milwaukee 115 (NRS) or 149 (RS), NIBCO S-113 (NRS) or S-111 (RS), or equal.

3. Gate Valves, 2 1/2-inch and Larger:

Class 125 iron body, bronze mounted, ASTM A126, class B cast iron, flanged ends with Teflon impregnated packing and 2-piece packing glass.

OSY RS	NRS		
Stockham	G-623	G-612	
Crane	465 1/2	461	
Powell	1793	1787	
Hammond	IR1140	IR 1138	
Equal			

4. Butterfly Valves: 150 psi tight shut-off, ASTM A126.

- a. Body: Lug type, ASTM A126iron.
- b. Disc:
 - 1) For motorized valves: 304 Stainless Steel.
 - 2) For Manual Valves: Cadmium-plated ductile, iron for chilled water (bronze, or aluminum bronze for condenser water).
- c. Stem:
 - 1) For motorized valves: 416 Stainless Steel.

- 2) For manual Valves: Solid one-piece, 304 or 316 or 410 stainless steel.
- d. Seat and O-rings: EPDM O-ring.
- e. Upper and lower stem bearings: Bronze or reinforced Teflon.
- f. Operators:
 - 1) Valves 6-inch and smaller: Bray Series 21 as basis of design or Center Line, Stockham, Crane, Belimo, Nibco or equal, with lever handle, or Electric Actuator and disc position indicator.
 - 2) Valves 8-inch and larger: Bray Series 21 as basis of design or Center Line, Stockham, Crane, Belimo, Nibco or equal, manual gear operator and disc position indicator, or Electric Actuator.
- g. Manufacturers: Bray, Milwaukee, Center Line, Stockham, Crane, DeZURIK, Belimo, Nibco or equal.

5. Check Valves, 2-inch and Smaller:

Shall be of class 125, threaded or solder ends, body and caps shall be of ASTM B62 cast bronze composition, swing type disc.

<u>Threaded</u>	<u>Solder</u>
Stockham B-319Y	Stockham B-309Y
Hammond IB 904	Hammond IB 912
Crane 37	Crane 1707S
Powell 578	Powell 1825
Equal	

- a) Class 150 valves meeting above Specifications may be furnished where pressure requires: Stockham B-321, NIBCO T-433-B, Milwaukee 515, or equal, threaded.

6. Check Valves, 2 ½-inch and Larger:

Shall be iron body, bronze mounted with body and cap conforming to ASTM A126, class B, cast iron, flanged ends, swing type disc.

Hammond	IR1124
Stockham	G-931
Crane	373
Powell	559

Equal

7. Alternative Check Valves, 2 1/2-inch and Larger:

Shall be class 125/250, iron body, bronze mounted, wafer check valves, with ends designed for flanged type connection, aluminum bronze disc, EPDM seats, 316 stainless steel torsion spring, and hinge pin.

Stockham WG-961
Center Line Series 800
Duo-Chek K12 HAP
Marlin M125 HZDSF
Equal

8. Non-Slam Check Valves (Pump Discharge):

Semi-steel body, bronze trim, top and bottom center guide, stainless steel spring and 125 pound flanged ends. Miller Manufacturing No. 162 or equivalent by Williams-Hager, Val-Matic Valve & Manufacturing Corp., or equal.

9. Air Vents: Spirotherm model Spirovent as basis of design or Amtrol, Watts, Dole, Bell and Gossett, or equal, manual type, of size for proper venting. Install at high points of systems.

C. Valves: Heating Hot Water, and Low-pressure Steam System.

1. Gate Valves, 2-inch and Smaller: Shall be of class 150 with body and union bonnet of ASTM B62 cast bronze composition, threaded or solder ends, solid disc, copper-silicon stem, brass packing gland, Teflon-impregnated packing, and malleable handwheel.

Threaded
Stockham B-120 (RS)
Hammond IB629
Crane 431UB
Powell 2714
Equal

Solder
Hammond IB648

2. Ball Valves, 2-inch and Smaller: Shall be 600 psi CWP, have cast brass bodies, replaceable reinforced Teflon seats, conventional port, blowout proof stems, chrome plated brass ball, and threaded or solder ends with extended solder cups.

<u>Threaded</u>	<u>Solder</u>
Stockham T-285-FB-R-70 (full port)	Stockham S-285-FB-R-70 (full port)
Crane 9301	Crane 9302

Worcester 44-11-RT-SE
Jamesbury 351T
Apollo 70-100
Equal

Worcester 44-11-RT-TE

Apollo 70-200

3. Gate Valves, 2 ½-inch and Larger: Shall be class 125 iron body, bronze mounted, with body and bonnet conforming to ASTM A126, class B, cast iron, flanged ends, with Teflon-impregnated packing and two-piece packing gland assembly.

	OS & Y	NRS
Stockham	G-623	G-612
Hammond	IR1140	IR1138
Crane	465 1/2	461
Powell	1793	1787
Equal		

4. Check Valves, 2-inch and Smaller: Shall be class 150 with body and cap of ASTM B62 bronze composition and threaded ends. Class 150 valves shall have lift-type non-metallic disc and union caps, and are to be furnished in lines with globe valves.

- a) For backflow prevention in lines with gate valves, Y-pattern valves with swing-type disc may be furnished.

Stockham B-322B
Crane 27TF
Equal

- b) For class 150 service, threaded ends:

Stockham B-321	Crane 137
NIBCO T-433-B	
Equal	

- c) For class 200 Service, threaded ends:

Hammond IB944	Crane 36
Stockham B-345	Powell 560
Equal	

5. Check Valves, 2 ½-inch and Larger: Shall be iron body, bronze mounted, with body and cap conforming to ASTM A126, class B, cast iron, flanged ends, and swing-type disc.

Crane 373	Hammond IR1124
Powell 559	Stockham G-931
Equal	

- a) Alternative for above listed check valves shall be class 125/250 iron body, bronze mounted, wafer check valve, with ends designed for

flanged type connection, aluminum bronze disc, EPDM seats, 316 stainless steel torsion spring, and hinge pin.

Center Line Series 800
Marlin M125 HZDSF
Stockham WG-961

Hammond IR9253
Duo-Chek G12 HAP
Equal

6. Automatic valves controlling steam to a coil in a hot water tank shall be single seated type. When these valves are installed on a gravity return system, they shall be two position type (i.e. completely open or completely closed).
 7. Valves on steam mains in boiler rooms shall be angle globe valves and be set to hold no condensate.
- D. Electric Motor Operated Valves: Belimo, Bray or equal.
- E. Valves, General:
1. Handles or hand wheels on valves shall be removable and, unless specified to be of loose key type, shall be securely fastened to their stems. Valve handwheels, except those on radiator valves, shall be of steel, brass, or cast iron.
 2. Boiler shut-off valves and valves on steam mains installed more than 6 feet above floor, shall be furnished with chain wheels and chains to within 6 feet of floor. Chains shall be free hanging and in a position to permit operation of valve from floor. When pulleys or extensions are required to locate these chains in such a position, furnish, and install said pulleys or extensions as required to provide a satisfactory operating installation. Extensions over one foot long shall be furnished with a supported outboard bearing.
 3. Furnish and install chains or wire rope with required accessories to open safety valves from boiler room floor.
 4. Radiator or convector valves shall be corner or angle type with composition handles, composition renewable discs, packing gland, union nut on tailpiece, unless otherwise specified. If exposed, they shall have a finished or plated exterior.
 5. Temperature Control Valves: Refer to Section 23 0513.
 6. Flow Control Valves: Refer to Section 23 0513.
- F. Flow Measuring Devices: Refer to Section 23 0513.
- G. Strainers: Refer to Section 23 0513.

- H. Condensate Drain Piping, from Air Handling Units: Refer to Section 22 0513.
- I. Indirect Drains, Relief Valve Discharge Piping and Air Vent Discharge Piping:
 - 1. Pipe: Type L tempered copper water tube.
 - 2. Fittings: Wrought copper. Refer to Section 23 0513. Furnish copper to threaded international pipe size adapters at threaded connections.
 - 3. Joints:
 - a. Soldered: 95/5 solder.
- J. Insulation: Refer to Section 23 0700.
- K. Pipe Anchors, Pipe Guides, Expansion and Contraction Devices:
 - 1. Piping subject to expansion or contraction shall be fastened in a manner permitting strains to be evenly distributed and alleviated by swing joints or expansion loops or joints. Seismic restraints shall be installed so as not to interfere with expansion and contraction of piping.
 - 2. Provide anchors in heating or cooling piping system, to restrain and control direction of movement for expansion or contraction in piping system.
 - 3. Provide guides at specific locations in heating or cooling piping system in conjunction with slip or bellows type expansion joint.
 - 4. When coils or unit housings are shock or vibration isolated, provide piping flexible metal connector not less than 10 inches long whether they are indicated on the Drawings or not.
- L. Flexible Metal Connectors:
 - 1. Provide vibration elimination flexible metal connectors on chilled and hot water supply and return piping where rigidly supported pipes connects to unit housing coil attachments and units are supported by vibration isolators.
 - 2. Schedule Numbers:
 - a. FMC-1: Corrugated bronze metal hose with outer bronze braid in tubular sheath of woven metal wires. Connector with female copper tube ends for copper piping. Metraflex model BBS, Unisource Style UPCB-BRSW, Microflex, or equal.
 - b. FMC-2: Corrugated stainless steel metal hose with outer stainless steel braid in tubular sheath of woven metal wires. Connector with

male pipe threads (NPT) for threaded piping. Metraflex model SST, Unisource Style UPCS-MMT, Microflex, or equal.

- c. FMC-3: Corrugated Bronze Metal Hose with outer bronze braid in tubular sheath of woven metal wires. Connector with female copper tubes ends for refrigeration piping. Metraflex model RAF, Unisource VIB, Anaconda Vibration Eliminators, or equal.

M. Refer to Sections 23 0513 for following:

- 1. Pipe Hangers and Supports.
- 2. Pipe Sleeves and Plates.
- 3. Pipe Flashings.
- 4. Relief Valves.
- 5. Thermometers.
- 6. Pressure Gages.
- 7. Pressure and Temperature Test Plugs.
- 8. Access Panels.
- 9. Dielectric Fittings.
- 10. Expansion Tanks.
- 11. Condensate Traps.

2.2 EQUIPMENT

A. Furnish centrifugal pumps capable of delivering rated capacity against total dynamic head as indicated on schedule and as specified for following:

- 1. Hot Water Pumps:
- 2. Hot Water Pumps: End suction, centrifugal, vertical split case, cast iron base mounted. Taco, Armstrong, Paco type L, Bell and Gossett, Grundfos, Weinman, or equal.

PART 3 – EXECUTION

3.1 PIPING INSTALLATION

- A. Install piping systems for chilled water, condenser water, and hot water and steam heating systems, condensate drains, and miscellaneous piping required for equipment, as indicated on Drawings and as specified in Section 23 0513.
- B. All piping and fittings size 2-1/2" and larger shall be welded – No Grooved type fitting is allowed except at chiller barrel and condenser barrel connections.

3.2 WATER PUMPS

- A. Pumps, one horsepower or larger, shall be installed with required pump connections for noise and vibration isolation and not to compensate for misalignment.

3.3 AIR AND DIRT ELIMINATION

- A. Heating and chilled water piping and steam or hot water heating and/or cooling equipment shall be installed in a manner so that air will be eliminated from lines or equipment during operation. Pitch pipe lines as specified in Section 23 0513.
- B. Manual air valve shall be installed at each high point of chilled or hot water circulating lines, on each chilled water or hot water heating unit unless unit can vent through outlet connection. Refer to valves as specified under Section 23 0513.
- C. Air vent valves shall be installed with drains to nearest floor sink or outside building.
- D. Air/Dirt separators shall be installed on all hot water heating system, chilled water system, and closed loop fluid cooler system. Units shall be furnished with internal copper coalescing medium to facilitate maximum air and dirt separation and suppress turbulence. Units shall be furnished with galvanized steel strainer and stainless steel collector tube. Provide integral high capacity float actuated air vent at top fitting of tank. Furnish cast iron float actuated air vent rated at 150 psig, threaded to the top of the fitting. Unit shall be furnished with the bottom of the vessel extended for dirt separation with the system connection nozzles equidistant from the top and bottom of the vessel and shall include a blowdown connection and valve. Refer to Air/Dirt separators as specified under Section 23 0513.
- E. Acceptable manufacturers: Spirotherm, Bell and Gossett, Wessels, or equal.

3.4 CHEMICAL POT FEEDER

- A. Provide a chemical pot feeder in each of chilled water and hot water systems as specified in Section 23 2500: HVAC Water Treatment.

3.5 CONDENSER WATER TREATMENT

- A. Provide condenser water treatment as specified in Section 23 2500: HVAC Water Treatment.

3.6 CLEANUP

- A. Remove rubbish, debris and waste material and legally dispose of off the Project site.

3.7 PROTECTION

- A. Protect the Work of this Section until Substantial Completion.

END OF SECTION

SECTION 23 8000

HEATING, VENTILATING AND AIR CONDITIONING EQUIPMENT

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes: Air conditioning and air handling equipment including but not limited to:

1. Single Packaged Air Conditioning Units.
2. Fans.

B. Related Requirements:

1. Division 01: General Requirements.
2. Section 07 6000: Flashing and Sheet Metal.
3. Section 23 0500: Common Work Results for HVAC.
4. Section 23 0513: Basic HVAC Materials and Methods.
5. Section 23 0548: HVAC Sound, Vibration and Seismic Control.
6. Section 23 0900: HVAC Instrumentation and Controls.
7. Section 23 2013: HVAC Piping.
8. Section 23 3000: Air Distribution.

1.2 DESIGN REQUIREMENTS

A. Work of this Section is based on HVAC equipment units indicated as Basis of Design in Part 2 of this Section. Products from different HVAC equipment manufacturers listed are never identical, although equivalent in capacity, performance and quality. In the cases where dimensions, weight, configuration and utility requirements differ from the products used as a basis of design, the Contractor, at no additional cost to the Owner, shall coordinate and submit, for Architect review, revisions to the design.

1.3 SUBMITTALS

A. Provide in accordance with Division 01 and Section 23 0500: Common Work Results for HVAC.

- B. For products listed that are not the basis of design, submit the following in addition to above requirements:
 - 1. Title 24 Calculations: Replace HVAC unit values in calculation files provided by the Architect and submit for review.

1.4 QUALITY ASSURANCE

- A. Provide submittals in accordance with Section 23 0500: Common Work Results for HVAC.

1.5 PROJECT RECORD DOCUMENTS

- A. Provide Owner instructions on equipment operation and maintenance procedures, as indicated in Section 23 0500: Common Work Results for HVAC.

1.6 WARRANTY

- A. Compressors shall be provided with manufacturer's five year warranty, (replacement only).
- B. Manufacturer shall warrant parts, except heat exchangers, for a period of five years.
- C. Heat exchangers shall be provided with manufacturer's ten year warranty, (replacement only).

PART 2 – PRODUCTS

2.1 EQUIPMENT

- A. Capacities of air conditioning equipment indicated on Drawings are net capacities actually required. Standard catalog ratings shall be adjusted to actual Project site environmental conditions.

2.2 AIR CONDITIONING UNITS - AC (2 Tons-25 Tons)

- A. Manufacturers: Trane, York, McQuay, Lennox, American Standard Heating & Air Conditioning, or equal.
 - 1. Basis of Design: Carrier
- B. Furnish packaged air conditioning unit with gas heating for roof top installation. Unit shall be self-contained, completely factory assembled, with complete internal wiring and controls. Unit shall also be provided with a fully piped refrigerant circuit, fully charged with an environmentally friendly refrigerant that is not scheduled for phase out. Unit shall be field configurable for down-flow or

horizontal discharge. Cooling and heating capacities, electrical characteristics, and operating conditions shall be as indicated on Drawings.

C. Quality Assurance:

1. Units shall be CSA certified for outdoor installation.
2. Cooling capacity shall be rated in accordance with current ANSI/AHRI Standard 210/240.
3. Unit shall be UL listed and designed to conform to ANSI/ASHRAE Standard 15 Safety Code for Mechanical Refrigeration and ANSI Z21.47/UL 1995 Heating and Cooling Equipment.
4. ANSI/NFPA 70: National Electrical Code.
5. Unit cooling efficiency EER/SEER ratings shall comply with CCR, Title 24, Building Energy Efficiency Standards for Residential and Nonresidential Buildings, and shall not be less than ratings indicated on drawings.
6. Unit heating efficiencies AFUE ratings shall comply with current CCR, Title 24, Building Energy Efficiency Standards for Residential and Nonresidential Buildings, and shall not be less than ratings indicated on drawings.
7. Unit shall comply with California Maximum Oxides of Nitrogen (NOX) Emission Regulations and current SCAQMD regulations.
8. The unit roof curbs shall conform to NRCA standards.
9. Insulation and adhesive shall meet NFPA 90A and 90B requirements for flame spread and smoke generation.
10. Unit casing shall be capable of withstanding ASTM B117 500-hour salt spray test.
11. Each unit shall be run tested at factory per ANSI/ASHRAE 37 and provided with a certificate indicating tested pressures, amperages, dates, and inspector.

D. Unit Cabinet:

1. Galvanized steel with baked enamel finish on external surfaces that are exposed to weather.
2. Interior surfaces exposed to conditioned and return air streams shall be insulated with a minimum ½-inch thick, 1 pound density foil-faced cleanable insulation. Insulation shall have an “R” Value of 3.70 and

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comply with material safety standards and installation requirements for duct lining as specified under Section 23 0700: HVAC Insulation.

3. Cabinet top cover shall be of one piece construction or where seams exist, shall be double hemmed and gasket sealed.
4. Cabinet panels shall be hinged access panels for filter, compressors, evaporator fan, control box and heat section areas. Each panel shall use multiple quarter-turn latches and handles. Each major external hinged access panel shall be permanently attached to rooftop unit. Panels shall also include tiebacks.
5. Return air filters shall be accessible through a hinged access panel and be on a slide-out track using standard size filters.
6. Holes shall be provided in base rails (minimum 16 gage) for rigging shackles and level travel and movement during overhead rigging operations.
7. Unit shall have a factory-installed internally sloped condensate drain pan, providing a minimum ¾-inch-14 NPT connection to prevent standing water from accumulating. Pan shall be fabricated of high impact polycarbonate material, epoxy powder coated steel or stainless steel and shall slide out for cleaning or maintenance. An alternate vertical drain (¾-inch NPT) connection shall also be available. Drain pans shall conform to ASHRAE 62 self-draining provisions.
8. Unit shall have standard thru-the-bottom power and control wiring connection capability.

E. Compressors:

1. Unit shall be furnished with single or multiple fully hermetic scroll compressors with internal vibration isolators.
2. Dual electrically and mechanically independent refrigerant circuits for 7.5 tons and above.
3. Compressors shall be provided with service access valves.
4. Compressor motors shall be cooled by refrigerant passing through motor windings.
5. Compressors shall be provided with line break thermal and current overload protection.
6. Compressors shall be provided with crankcase heaters, internal high-pressure and temperature protection.

- F. Refrigerant circuit components:
1. Thermostatic expansion valve (TXV) with removable power element.
 2. Refrigerant strainer.
 3. Service gage connections on suction, discharge, and liquid lines.
 4. Solid core refrigerant filter driers.
- G. Evaporator and Condenser Coils: Standard Evaporator and condenser coils shall be furnished with:
1. Condenser coils Type A, B, or C is acceptable
 - a. Type A: Copper-tube, aluminum-fin coil, with liquid subcooler. Internally enhanced 3/8 inch OD seamless copper tubing mechanically bonded to aluminum fins.
 - b. Type B: Spine Fin condenser coil shall be continuously wrapped, corrosion resistant aluminum with minimum brazed joints. This coil is 3/8 inch OD seamless aluminum tubing glued to a continuous aluminum fin. Coils are lab tested to withstand 2,000 pounds of pressure per square inch. The outdoor coil provides low airflow resistance and efficient heat transfer. The coil is protected on four sides by louvered panels.
 - c. Type-C: Coil shall be air-cooled Micro-Channel heat exchanger technology (MCHX) and shall have a series of flat tubes containing a series of multiple, parallel flow microchannels layered between the refrigerant manifolds. Coils shall consist of a two-pass arrangement. Coil construction shall consist of aluminum alloys for fins, tubes, and manifolds in combination with a factory applied corrosion-resistant coating.
 2. Evaporator coils
 - a. Aluminum plate fins mechanically bonded to enhanced copper tubes with joints brazed.
 - b. Tube sheet openings shall be belled to prevent tube wear.
 - c. Evaporator coil shall be of full-face active design.
 - d. Dual circuit models shall have face-split type evaporator coil.
- H. Fans and Motors:
1. Evaporator fan shall be a dynamically balanced, double width, double inlet, forward curved centrifugal type, fabricated of steel with a corrosion

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resistant finish that was tested and rated in accordance with AMCA requirements.

2. Evaporator fans shall be belt or direct-driven, as indicated on Drawings.
3. Direct drive fans shall be provided with minimum two speeds taps adjustment or ECM motor.
4. Evaporator blower and motor shall have permanently lubricated, factory-sealed ball bearings and automatic-reset thermal overload protection.
5. Belt drive shall include an adjustable-pitch motor pulley. Belt drive fans shall accommodate from 0.6 inch to 1.6-inch external static pressure without changing drives or motors.
6. Condenser fan shall be a dynamically balanced, propeller type, fabricated of aluminum blades riveted to corrosion resistant steel spiders and direct-driven by a totally enclosed motor. Condenser air shall be discharged vertically. Condenser fan motor shall be high efficiency or ECM type motor and provide cooling operation down to 25 degrees F outdoor temperature with automatic-reset thermal overload protection.

I. Heating Section:

1. Induced draft combustion type with energy saving direct spark ignition system, redundant main gas valve, and 2-stage heat.
2. The heat exchanger shall be of tubular section type fabricated of a minimum of 20 gage steel coated with a nominal 1.2 mil aluminum-silicone alloy or 20 gage type 409 stainless steel, including stainless steel tubes, vestibule plate.
3. Burners shall be of in-shot type fabricated of aluminum coated steel or stainless steel.
4. Gas piping shall enter unit cabinet at a single location.
5. Integrated Controls shall provide following:
 - a. Timed control of evaporator fan functioning and burner ignition,
 - b. Anti-cycle protection for gas heat operation (after one cycle on high temperature limit switch and one cycle on flame rollout switch).
 - c. Diagnostic information.
6. Induced draft motor shall be provided with permanently lubricated, sealed bearings and inherent automatic reset thermal overload protection.

J. Controls, Safeties and Diagnostic Points:

1. Unit Controls: Unit shall be furnished with self-contained, network capable and ready direct digital controls.
 - a. Controls shall be factory-installed.
 - b. Controls shall operate with zone control systems.
 - c. Controls shall furnish built-in diagnostics for thermostat commands for staged heating and cooling, evaporator-fan operation, and economizer operation.
 - d. Controls shall be furnished with a 5-minute time delay between modes of operation.
 - e. Control circuit shall be protected by a fuse on 24-V transformer side.
2. Compressor high temperature, high current, internal overloads, internal thermostat.
 - a. Compressor reverse rotation protection.
 - b. Loss-of-charge/low-pressure switch.
 - c. Freeze-protection thermostat, evaporator coil.
 - d. High-pressure switch. The lockout protection shall be easily disconnected at control board, if necessary.
 - e. Internal relief valve.
 - f. Anti-recycle relay, or time cycle device to prevent rapid cycling of compressor after any off cycle.
3. Heating section shall be provided with following minimum protections:
 - a. High-temperature limit switches.
 - b. Induced draft motor speed sensor.
 - c. Flame rollout switch.
 - d. Flame proving controls.
 - e. Redundant main gas valve.
 - f. Heating controls shall consist of:

- 1) 2-stage automatic combination gas valve.
 - 2) Pressure regulator.
 - 3) Electric spark intermittent ignition system or hot surface ignition system.
 - 4) Time delay fan control.
4. Operating Characteristics:
- a. Unit shall be capable of starting and operating at 125 degrees F ambient outdoor temperature, meeting maximum load criteria of AHRI Standard 210/240 or 360 at plus or minus 10 percent voltage.
 - b. Compressor with standard controls shall be capable of operation down to 25 degrees F ambient outdoor temperature.
5. EMS Diagnostic Points: Provide diagnostic points for units, including those at projects with no EMS.
- a. Supply air temperature.
 - b. Return air temperature.
 - c. Space temperature.
 - d. Outdoor air temperature.
 - e. Filter status.
 - f. Fan status.
 - g. Compressor status.
 - h. Economizer damper current position.
 - i. Other diagnostic point required by current Title 24, automated fault detection and diagnostics (FDD).

K. Filter Section:

1. Provide filter section with factory-installed low-velocity, throwaway 2-inch thick high capacity, MERV 13 Class 2, or equal, filters of commercially available sizes unless noted otherwise on the drawings.
2. Filter face velocity shall not exceed 300 fpm at nominal airflows.

3. Filter section shall allow installation of standard size air filter.
4. Return air filters shall be accessible through a hinged access panel and be on a slide-out track using standard size filters.
5. At projects with no EMS, provide clogged filter switch and options board to annunciate at the thermostat.

L. 100 Percent Outdoor Air Economizer:

1. Provide on units larger than 6.25 tons nominal capacity. Provide for smaller capacities where indicated on drawings.
2. Gear-driven integrated economizers.
3. Integrated integral-modulating type capable of simultaneous economizer and compressor operation.
4. Furnish hardware and controls to provide cooling with outdoor air.
5. Low-leakage dampers not to exceed 3 percent leakage, at one inch wg pressure differential (variable sliding economizer).
6. Barometric relief damper. Damper shall close upon unit shutoff.
7. Differential temperature and enthalpy controller unless indicated otherwise on drawings.
8. Provide units 6.25 tons and above with centrifugal power exhaust controlled by a pressure sensor in space or outdoor air measurement and tracking. The controller shall modulate VFD in centrifugal power exhaust to maintain a pressure differential of 0.05 inch of water between indoor and atmospheric pressure. The power exhaust shall be factory furnished with unit and installed in field. Furnish field wiring to power exhaust and install tubing in space. Provide other accessories as required to comply with UL or ETL requirements.
9. Base Rail: Factory installed on both horizontal and down-flow units.
10. Dampers Using Electronic Actuators:
 - a. Manufacturer: Belimo, Honeywell, Invensys, Johnson Controls, or equal.
 - b. Size for torque required for damper seal at load conditions.
 - c. Coupling: V-bolt dual nut clamp with a V-shaped, toothed cradle.

- d. Overload Protection: Electronic overload or digital rotation-sensing circuitry without the use of end switches to prevent damage to the actuator during a stall condition.
 - e. Fail-Safe Operation: Mechanical, spring-return mechanism.
 - f. Power Requirements: Maximum of 10 VA at 24 VAC or 8 W at 24 VDC.
 - g. Proportional Actuators shall be fully programmable. Control input, position feedback and running time shall be factor or field programmable by use of external computer software. Diagnostic feedback shall provide indications of hunting or oscillation, mechanical overload and mechanical travel. Programming shall be through EEPROM without the use of actuator mounted switches.
 - h. Actuators shall be listed by ISO 9001, ULC, and CSA C22.2.
- M. Furnish programmable digital thermostat with following features for single zone units that are not provided with variable volume and variable temperature type controls:
- 1. 7-day time clock.
 - 2. Heat, cool, automatic changeover.
 - 3. Occupied/unoccupied modes.
 - 4. Dry contact switch for input from an external device such as a central time clock, occupancy sensor or a telephone activated device.
 - 5. Remote sensors. School Areas that could be subject to vandalism or accidental impact damage such as Gymnasiums, Auditoriums, Multipurpose Rooms, Corridors, and Lobbies shall be provided with thermostats with remote return air duct or room sensors. Verify remote location of sensors and thermostats with Architect.
 - 6. Robertshaw, Honeywell, Johnson Controls, or equal. Refer to Section 23 0900 for areas with zone damper controls.
 - 7. Provide locking cover.
- O. Parts Availability: Submit proof in writing that majority (minimum 80 percent) of the replacements parts are commonly available and not proprietary. Also, submit proof in writing that a local parts sales and service facility exists, where replacement parts will be warehoused in quantity. Guarantee timely availability for parts that are proprietary.

PART 3 – EXECUTION

3.1 GENERAL

- A. Examine areas under which Work of this Section will be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 EQUIPMENT FOUNDATIONS

- A. Provide foundations (housekeeping pads, level platforms or curbs) for mechanical equipment whether indicated on drawings or not. Equipment foundations shall be of sufficient size and weight, and of proper design to preclude shifting of equipment under operating conditions, or under abnormal conditions imposed upon equipment.
- B. Provide foundations (housekeeping pads, level platforms or curbs) for mechanical equipment whether indicated on drawings or not. Foundations shall meet requirements of equipment manufacturer and, when required by Architect, obtain from equipment manufacturer, approval of foundation design and construction, for equipment to be installed. Equipment vibration shall be maintained within design limits, and shall be dampened and isolated. Isolators shall be bolted to a structural member so as to be readily removable.

3.3 EQUIPMENT DESIGN AND INSTALLATION

- A. Uniformity: Unless otherwise specified, equipment of same type or classification shall be product of same manufacturer.
- B. Application: Only provide equipment as reviewed by Architect.
- C. Equipment Installation: Equipment installation shall be in strict accordance with these Specifications, and installation instructions of manufacturers. Equipment installed on concrete foundations shall be grouted before piping is installed. Piping shall be installed in such a manner as not to place a strain on equipment. Flanged joints shall be adequately extended before installation. Piping shall be graded, anchored, guided and supported, without low pockets.
 - 1. Install equipment in a neat and skillful manner, properly aligned, leveled, and adjusted for satisfactory operation.
 - 2. Install so connecting and disconnecting of piping and accessories can be readily accomplished, parts are readily accessible for inspection, service and repair. Space shall be provided to readily remove filters, coils, compressors and fan wheels. Access doors shall be hinged with cam lock door handles.

3. Provide flexible connections for duct, pipe and conduit connections at moving equipment.

3.4 ROOF-TOP EQUIPMENT MOUNTING

- A. Downflow Packaged Units: Install per DSA approved drawings.

3.6 FIELD TESTS AND INSPECTION

- A. General: Perform field inspections, field tests, and trial operations as specified in Section 23 0500: Common Work Results for HVAC. Provide labor, equipment and incidentals required for testing. The Project Inspector will witness field tests and trial operations as specified in Section 23 0500: Common Work Results for HVAC.
- B. Equipment and Material: Equipment and material certified as being successfully tested by manufacturer, in accordance with referenced Specifications and standards, will not require re-testing before installation. Equipment and materials not tested at place of manufacture will be tested before or after installation, as applicable or necessary, to determine compliance with reference Specifications and standards.
- C. Start-Up and Operational Test: System shall be started up and initially operated with components operating. During this test, various strainers or filters shall be periodically cleaned until no further accumulation of foreign material occurs. Adjust safety and automatic control instruments as required to provide proper operation and control sequence. Refer to Section 23 0500: Common Work Results for HVAC.
- D. Extent of Field Tests: After installation and before completion, Work of this Section shall be subjected to required field tests, including those specified here and in Section 23 0500: Common Work Results for HVAC.
- E. Operation and Maintenance Data: Provide required operation and maintenance data as specified in Section 23 0500: Common Work Results for HVAC.

3.7 REFRIGERANT PIPING

- A. Unless otherwise indicated, main liquid and suction lines from condensing unit to evaporator coil shall be of sizes specified by manufacturer.
- B. Refrigeration piping shall be refrigeration grade copper tubing, type L hard-drawn. In instances where refrigeration lines are installed in an inaccessible location and must be snaked through conduit or a trench, that portion of tubing required to complete connections through conduit or trench may be soft drawn. Maintain entire system clean and dry during installation. Pipe shall be sealed until installed.

- C. Refrigeration piping, both hard and soft-drawn, shall be straight and free from kinks, restrictions and horizontal runs shall be sloped towards compressor one inch to 10 feet wherever possible. Vapor line oil traps shall be installed on bottom of vertical risers and inverted oil trap shall be installed on top of vertical risers.
- D. Joints shall be installed with Sil-Fos 15, Silvaloy 15, or equal, high melting point solder.
- E. Flare nuts required on suction lines shall be of short forged or frost-proof type. Other fittings shall be standard sweat-soldered type. Ells and return bends shall be long radius type. Install leak lock material.
- F. Refrigeration Piping: Joints shall be silver brazed and leak tested. Field fabricated lines shall be thoroughly flushed and cleaned before connection. Bleed nitrogen through lines during silver brazing, and cap and seal lines when not completed and connected to equipment.
- G. Sleeve penetrations of floors, walls and ceiling to allow for free motion of piping. Provide 24 gage galvanized iron pipe and chrome-plated escutcheon plates. Pack annular space between pipe and sleeve with incombustible material such as fiberglass and seal each end with mastic to provide a waterproof seal.
- H. Install insulated couplings at points of connection between dissimilar metals for cathodic protection. Insulate copper tubing from ferrous materials and hangers with 2-inch thickness of 3-inch wide strip, 10 mil polyvinyl tape wrapped around pipe.
- I. Support piping by iron hangers and supports. Hydra-Zorb cushion clamps, LSP Products Group Acousto Clamp, or equal, on non-insulated piping, and Klo-Shure coupling clamp on insulated piping, or equal.
- J. Provide saddles to protect pipe insulation.
- K. Provide connections of copper and brass pipe and tubing with Harris Products Group Safety-Silv 56, Lucas-Milhaupt, Inc., or equal, complying with ANSI/AWS A5.8 and NSF 51.
- L. Insulate refrigerant suction lines.

3.8 CLEANUP

- A. Remove rubbish, debris and waste materials and legally dispose of off Project site.

3.9 PROTECTION

- A. Protect Work of this Section until Substantial Completion.

END OF SECTION

SECTION 26 0501

ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SCOPE

- A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the drawings and/or specified herein. Work includes, but is not necessarily limited to, the following:
1. Renovation and remodel of single story Childcare learning and Daycare Center building. Examine all other sections for work related to those other sections and required to be included as work under this section.
 2. General provisions and requirements for electrical work.

1.2 SUBMITTALS

A. General

1. Review of contractors submittals is for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Any action shown is subject to the requirements of the plans and specifications. Contractor is responsible for quantities; dimensions which shall be confirmed and correlated at the job site; fabrication processes and techniques of construction; coordination of work with that of all other trades and satisfactory performance of their work.
2. The Contractor shall review each submittal in detail for compliance with the requirements of the contract documents prior to submittal to the Architect. The Contractor shall "Ink Stamp" and sign each item of the submittal with a statement "CERTIFYING THE SUBMITTAL HAS BEEN REVIEWED BY THE CONTRACTOR AND COMPLIES WITH ALL THE REQUIREMENTS OF THE CONTRACT DOCUMENTS".
3. Where the construction documents indicate specific manufacturer(s) for any given product, it shall be considered a substitution if the contractor proposes to use any manufacturer other than those specifically named. The Contractor shall clearly and specifically identify each individual

proposed substitution or proposed deviation from the requirements of the contract documents with a statement "THIS ITEM IS A SUBSTITUTION".

B. Material Lists and Shop Drawings:

1. Submit material list and equipment manufacturers for approval within 35 days of award of contract. Give name of manufacturer and where applicable, brand name, type and/or catalog number of each item. Listing of more than one manufacturer for any one item of equipment, or listing items "as specified", without both make and model or type designation, is not acceptable. Shop drawings shall not be submitted before approval of manufacturers list. The right is reserved to require submission of samples of any material whether or not particularly mentioned herein
2. Within three weeks after approval of the material and equipment manufacturers list, submit shop drawings for approval. Shop drawings shall be submitted in completed bound groups of materials (i.e., all lighting fixtures or all switchgear, etc.). Shop drawing shall be prepared by factory authorized representatives. Departure from the above procedure will result in resubmittals and delays.
3. Submittals which are intended to be reviewed as substitution or departure from the contract documents must be specifically noted as such or the requirements of the contract documents will prevail regardless of the acceptance of the submittal.
4. Shop drawings shall include dimensioned plans, elevations, details, wiring diagrams and descriptive literature of components parts where applicable.
5. The Contractor shall verify dimensions of equipment and be satisfied as to fit and that they comply with all code requirements relating to clear working space about electrical equipment prior to submitting shop drawings for approval.
6. Shop drawings shall include the manufacturer's projected days for shipment from the factory of completed equipment, after the equipment is released for production by the Contractor. It shall be the responsibility of the Contractor to insure that all material and equipment is ordered and installed in time to provide an orderly progression of the work, and to allow full occupancy and full operation of the facility at the scheduled completion date. The Contractor shall notify the Architect of any changes in delivery which would affect the project completion date.

C. The Contractor shall be responsible for incidental, direct and indirect costs resulting from the substitution of specified contract materials or work.

- D. Maintenance and Operating Manuals
1. The Contractor shall furnish three copies of typewritten maintenance and operating manuals for all electrical equipment, fire alarm equipment, sound system equipment, etc., to the District and instruct District's personnel in correct operation of all equipment at completion of project.
 2. Where these specifications indicate to provide District personnel with instructional training sessions, the Contractor shall videotape all such instructional sessions. The Contractor shall provide all equipment and personnel required to create a color VHS video and audio recording and shall turn over to the District a total of two (2) copies of each tape prepared.
 3. Maintenance and operating manuals shall be bound in three-ring, hard-cover, plastic binders and shall be delivered to the District with letter of transmittal, carbon copy to the Architect.
- E. Portable or Detachable Parts: The Contractor shall retain in his possession, and shall be responsible for all portable and detachable parts or portions of the installation such as fuses, keys, locks, adapters, locking clips, and inserts until final completion of contract work. These parts shall then be delivered to the District or his authorized representative and an itemized receipt obtained, with copies of receipt sent to the Architect.
- F. Record Drawings
1. Provide and maintain in good order at the job site a complete set of electrical contract prints. Changes to the contract to be clearly recorded on this set of prints. No pay request by the Contractor will be granted without verification that the jobsite prints are up-to-date and current with the project construction. At the end of the project, the Contractor shall transfer all changes to one set of transparencies to be delivered unfolded to the Architect. Transparency drawings shall be prepared in an organized and clearly legible fashion by persons skilled in drafting techniques.
 2. The actual location and elevation of all buried lines, boxes, monuments, vaults, stub-outs and other provisions for future connections shall be referenced to the building lines or other clearly established base lines and to approved bench marks. All measurements shall be witnessed by the job inspector who shall make his own record of the dimensions. Before the inspector signs the record drawings, he shall check his own dimensions against those on the drawings. If any necessary dimensions are omitted from the record drawings, the Contractor shall, at his own expense, do all

excavation required to expose the buried work and to establish the correct locations.

3. The Contractor shall keep the "record" prints up to date and current with all work performed.
4. A mandrel shall be pulled through each conduit upon completion of the duct bank. All mandrelling must be done in the presence of the job inspector.

1.3 GENERAL SUMMARY OF ELECTRICAL WORK

- A. The specifications and drawings are intended to cover a complete 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 additional labor and materials.
- B. Refer to the drawings and shop drawings of other trades for additional details which affect the proper installation of this work. Diagrams and symbols showing electrical connections are diagrammatic only. Wiring diagrams do not necessarily show the exact physical arrangement of the equipment.
- C. Before submitting a bid, the Contractor shall familiarize himself with all features of the building drawings and site drawings which may affect the execution of the work. No extra payment will be allowed for failure to obtain this information.
- D. If there are omissions or conflicts between the drawings and specifications, clarify these points with the Architect before submitting bid.

1.4 LOCATIONS OF EQUIPMENT

- A. The drawings indicate diagrammatically the desired locations or arrangements of conduit runs, outlets, equipment, etc., and are to be followed as closely as possible. Proper judgment must be exercised in executing the work so as to secure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structure conditions encountered.
- B. Where outlets are placed on a wall, locate symmetrically with respect to each other and other features or finishes on the wall.
- C. In the event changes in the indicated locations or arrangements are necessary, due to developed conditions in the building construction or rearrangement of furnishings or equipment, such changes made without cost, providing the change

is ordered before the conduit runs, etc., and work directly connected to same is installed and no extra materials are required.

- D. Lighting fixtures in mechanical spaces are shown in their approximate location only. Do not install light outlets or fixtures until mechanical piping and duct work is installed, then install lights in a location to provide best lighting.
- E. The locations of existing utilities, building, equipment and conduit shown on the drawings is approximate. Verify exact locations and routing of existing systems in the field. Include all costs in contract price for adjustment required to accommodate existing conditions.
- F. Coordinate and cooperate in every way with other trades in order to avoid interference and assure a satisfactory job.

1.5 AIR CONDITIONING, HEATING, PLUMBING EQUIPMENT WIRING

Provide electrical work, materials, and control components required for proper operation of the air conditioning, heating and plumbing systems.

1.6 DEMOLITION OF EXISTING ELECTRICAL

- A. Before commencing work, Contractor shall conduct a survey at the job site including all areas upon which this work is in any way dependant on for verification of existing conditions within the building and project site
- B. Provide building owner complete demolttion of existing electrical installation as required within the interior and exterior of the building.
- C. Existing main switchboard "MS" to remain in place and be re-used in this Contract for the electrical connection of new lighting, power and HVAC systems equipment.

1.7 QUALITY ASSURANCE

- A. Work and materials in full accordance with the latest rules and regulations of the California Code of Regulations Title 24, Part 3 "California Electrical Codes", Title 8 "Division of Industrial Safety" the National Life Safety Code, and other applicable Federal and State laws and regulations.
- B. All material and equipment shall be new and shall be delivered to the site in unbroken packages. All material and equipment shall be listed and labeled by Underwriters Laboratories or other recognized testing laboratories, where such listings are available. Comply with all installation requirements and restrictions pertaining to such listings.

- C. Work and material shown on the drawings and in the specifications is new and included in the contract unless specifically indicated as existing or N.I.C. (not-in-contract).
- D. Keep a copy of all applicable codes available at the job site at all times while performing work under this section. Nothing in plans or specifications shall be construed to permit work not conforming to the most stringent of codes.

1.8 CLEANING EQUIPMENT, MATERIALS, PREMISES

All parts of the equipment shall be thoroughly cleaned of dirt, rust, cement, plaster, etc., and all cracks and corners scraped out clean. Surfaces to be painted shall be carefully cleaned of grease and oil spots and left smooth, clean and in proper condition to receive paint finish.

1.9 JOB CONDITIONS - PROTECTION

Protect all work, materials and equipment from damage from any cause whatever and provide adequate and proper storage facilities during the progress of the work. All electrical equipment shall be stored in a weather-tight structure. Provide for the safety and good condition of all the work until final acceptance of the work by the District and replace all damaged or defective work, materials and equipment before requesting final acceptance.

1.10 CUTTING AND PATCHING

Perform cutting and patching of the construction work which may be required for the proper installation of the electrical work. Patching shall be of the same material, thickness, workmanship and finish as existing and accurately match surrounding work to the satisfaction of the Architect. Cutting of structural members shall not be done without notifying the Architect and obtaining DSA approval.

1.11 IDENTIFICATION

- A. Panelboards, terminal cabinets, circuit breakers, disconnect switches, starters, relays, time switches, contactors, pushbutton control stations, and other apparatus used for the operation or control of feeders, circuits, appliances, or equipment shall be properly identified by means of descriptive nameplates or tags permanently attached to the apparatus and wiring.
- B. Nameplates shall be engraved laminated phenolic. Shop drawings with dimensions and format shall be submitted to the Architect before installation. Attachment to equipment shall be with escutcheon pins, rivets, self-tapping screws or machine screws. Self-adhering or adhesive backed nameplates shall not be used.

- C. Plates: All cover and device plates shall be furnished with engraved or etched designations under any one of the following conditions:
1. Three gang or larger gang switches.
 2. Keyed and/or locking switches.
 3. Pilot light switches.
 4. Switches in locations from which the equipment or circuits controlled cannot be readily seen.
 5. Manual motor starting switches.
 6. Switches which serve other than lighting loads.
 7. Where so indicated on the drawings.
 8. As required on all control circuit switches, such as heater controls, etc.
 9. Where receptacles are other than standard duplex receptacles to indicate voltage and phase.
- D. Provide black-on-white laminated plastic nameplates engraved in minimum 1/4" high letters to correspond with the designations on the drawings. Provide other or additional information on nameplates where indicated.
- E. For equipment containing or operating on circuits of more than 240 volts nominal, provide red-on-white laminated warning signs engraved in 1/2" high letters to read: "CAUTION - 480 (or as applicable) VOLTS AUTHORIZED PERSONNEL ONLY".
- F. Wire and Cable Identification
1. Provide identification on individual wire and cable including sign systems, fire alarm, electrical power systems (each individual phase, neutral and ground), empty conduit pull ropes, and control circuit.
 2. Identification shall be provided at each termination location, splice location, pullbox, junction box and equipment enclosure.
 - a. Individual wire and cable larger than #6 AWG or 0.25 inch diameter, shall be provided with polypropylene identification tag holders, with yellow polypropylene tags interchangeable black alpha/numeric characters. Character height 0.25 inch or TECH Products-"EVERLAST" series. Attach identification tags with

plastic “tie” wraps, minimum of two for each tag. As manufactured by Almetek Industries-“EZTAG” series.

- b. Individual wire and cable #6 AWG and smaller or smaller than 0.25 inch diameter, shall be provided with water and oil resistant, flexible, pressure sensitive machine embossed plastic tags that wrap a minimum of 360 degrees around the wire/cable diameter. The entire tag shall then be covered with a clear flexible waterproof plastic cover wrapped a minimum of 540 degrees around the wire/cable diameter and completely covering the identification.
 - c. Each identification tag location shall indicate the following information: circuit number, circuit phase, source termination and destination termination equipment name (or outlet number as applicable).
 - d. Provide permanent identification tags to all underground conduit runs at pullbox and at building entrance indicating purpose and location of other end.
3. Install identification after installation/pulling of wire/cable is complete, to prevent loss or damage to the identification.
- G. Cardholders and cards shall be provided for circuit identification in panelboards. Cardholders shall consist of a metal frame retaining a clear plastic cover permanently attached to the inside of panel door. List of circuits shall be typewritten on card. Circuit description shall include name or number of circuit, area, and connected load.
 - H. Junction and pull boxes shall have covers marked with circuit numbers according to panel schedule. Data shall be lettered in a conspicuous manner with a color contrasting to finish.
 - I. Miscellaneous Electrical Equipment: Identify individually mounted starters, transformers, pullboxes, junction boxes, and related items as required by the use of such equipment with plates as for panelboards. All junction boxes shall be marked to indicate panel of origin, voltage, and circuit numbers within the box.
 - J. Auxiliary Systems, including Communications: Label to indicate function, routing and termination point of panelboard. Also, label any circuits providing power to this equipment and the panel of origin.

1.12 TESTING

- A. The Contractor shall obtain an independent NETA certified testing laboratory that will provide all instrumentation and tests on the electrical system and equipment as hereinafter described and further directed by the Architect. The test shall be performed after the completion of all electrical systems. All tests shall be recorded and documented and submitted to the Architect for review.

- B. The Testing Laboratory shall meet Federal OSHA criteria for accreditation of Testing Laboratories Title 29 Part 1907. Membership in the National Electrical Testing Association shall constitute proof of meeting aid criteria, for testing of electrical system.
 - 1. Test for Phase to Ground Condition:
 - a. Open main service disconnect.
 - b. Isolate the system neutral from ground by removing the neutral disconnect link located in the service switchboard.
 - c. Close all submain disconnects.
 - d. Close all branch feeder circuit breakers.
 - e. Measure the resistance of each phase to ground. A properly calibrated "megger" type test instrument to be used. The test voltage shall be 500 volts.
 - f. Record all readings after one minute duration and document into a complete report.
 - 2. Isolating Grounds: In the event that low resistance grounds are found in the system, they shall be isolated and located by testing each circuit individually as outlined above. Make proper corrections to restore the resistance values to an acceptable value.

- C. Method of obtaining ground resistance shall be in accordance with the latest edition of the James G. Biddle (Plymouth Meeting, Pennsylvania) manual published on this subject.
 - 1. Perform "fall-of-potential" tests on each grounding electrode of system per IEEE Standard No. 81, Section 8.2.1.5. When suitable locations for test rods are not available, a low resistance dead earth or reference ground will be utilized.

2. Perform the two-point method test per IEEE Standard No. 81, Section 8.2.1.1, to determine the ground resistance at each ground bus in distribution boards and distribution panels and transformer neutrals.
- D. All instrumentation and personnel required for testing shall be furnished by the Contractor.
- E. The testing, calibrating and setting of all ground and ground fault equipment circuit breakers, device protection relays, and meters adjustable settings shall be by an independent testing laboratory. Set as recommended by the respective manufacturer and coordination study so as to be coordinated with other protection devices within the electrical design. Four (4) bound and tabulated copies of the test and settings shall be sent to the ARCHITECT.
- F. Ampere and voltage measurements:
1. Take and record ampere and line voltage measurements under full load on all panel feeders, switchboard and switchgear feeders, motor control centers and motor circuits provided in the contract. Record measurements at the equipment tested and submit to the ARCHITECT for review.
 2. Ampere voltage readings shall be:
 - a. Phase A-B, A-C and B-C.
 - b. Phase A-Neutral, B-Neutral and C-Neutral.
 3. The ampere and voltage readings shall be not less than 20 minutes duration for each test. Record and submit the measured minimum, maximum and 20 minute average for each ampere and voltage value and test location. Voltage and ampere measurements shall occur at the connected load end of each respective feeder, not at the source of supply end of each feeder.
 4. Test equipment shall be accurate within plus or minus 1-percent.
 5. Branch circuit devices 40 ampere or less and motor boards 10 horsepower or smaller are excluded from ampere and voltage testing requirement.
- G. If, in the opinion of the Architect, the voltages and regulations are not met within acceptable limits, make arrangements with the serving utility for proper electrical service and then verify that such has been provided.

1.13 SERIES RATED EQUIPMENT

Circuit protective devices identified as "Series Rated" or "Current Limiting" (i.e., CLCB - current limiting circuit breaker; CLF - current limiting fuse; etc.) shall be

series rated and tested (UL 489 and CSA5) by the manufacturer with all equipment and circuit protective devices installed down stream of the identified series rated or current limiting devices. Provide nameplates on all equipment located down stream, including the CLCB and CLF devices, to comply with N.E.C. paragraphs 110-22 and 240-83 "CAUTION SERIES RATED SYSTEM - NEW DEVICE INSTALLATIONS AND REPLACEMENTS SHALL BE THE SAME MANUFACTURER AND MODELS."

1.14 SPARE FUSES

Provide (3) three spare fuses for each size and type to match the installed fuses where the fuses are provided as part of the contract.

1.15 WALL MOUNTED ELECTRICAL EQUIPMENT

- A. Provide multiple horizontal sections of metal "C" channels for support and attaching wall mounted equipment to walls. Channels shall provide "turned lips" at longitudinal edges to hold "lock-in" fasteners and shall comply with ANSI-1008 and ASTM-A569 latest revision. The channels shall be steel hot dip zinc galvanized. As manufactured by Unistrut or Kindorf.
- B. The "C" channels shall be positioned horizontally within 3 inches of the top and bottom of each, equipment section cabinet and located behind each equipment vertical section. Provide additional intermediate "C" channels at not less than 36 inches on center between the "top" and "bottom" "C" channel positions, located behind each equipment vertical section.
- C. The "C" channels shall be of sufficient length to provide connection to not less than two (2) vertical structural wall framing elements separated by not less than 16 inches; but in no case shall the "c" channel length be less than the width of the respective equipment section.
- D. Attach the "C" channels to the wall structural elements after the wall, finish surface, installation (including painting) is complete.
- E. Attach the "C" channels with fasteners to the building wall framing structural elements as follows: welded to steel framing; bolted to wood framing; cast in place concrete inserts for masonry and concrete construction; drilled "afterset" expansion anchors for existing masonry and concrete construction.
- F. Attach the equipment to the "C" channels with threaded and bolted fasteners to "prelocate" and lock into the channel "turned lips" and channel walls.

1.16 ELECTRICAL WORK CLOSEOUT

- A. Prepare the following items and submit to the Architect before final acceptance.

1. Two copies of all test results as required under this section.
 2. Two copies of local and/or state code enforcing authorities final inspection certificates.
 3. Copies of as-built record drawings as required under the General Conditions, pertinent Division One Sections and Electrical General Provisions.
 4. Two copies of all receipts transferring portable or detachable parts to the District when requested.
 5. Notify the Architect in writing when installation is complete and that a final inspection of this work can be performed. In the event any defect or deficiencies are found during this final inspection they shall be corrected to the satisfaction of the Architect before final acceptance can be issued.
- B. The Contractor shall complete the following work before any electrical equipment is energized:
1. All equipment shall be permanently anchored.
 2. All bus connections shall be tightened per manufacturer's instructions and witnessed by the DSA Inspector.
 3. All ground connections shall be completed and identified. Perform and successfully complete all required megger and ground resistance tests.
 4. All feeders shall be connected and identified.
 5. The interiors of all electrical enclosures including busbars and wiring terminals shall be cleaned of all loose material and debris, paint, plaster, cleaners or other abrasive's overspray removed and equipment vacuumed clean. The DSA Inspector shall observe all interiors before covers are installed.
 6. All dry wall work and painting shall be completed within the electrical rooms.
 7. All doors to electrical equipment rooms shall be provided with locks in order to restrict access to energized equipment.

8. Electrical rooms shall not be used as a storage room after power is energized.
9. The coordination study shall be complete, circuit breakers ground relays set, tested and calibrated accordingly.

END OF SECTION

SECTION 26 0515

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SCOPE

- A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
1. Examine all other sections for work related to those other sections and required to be included as work under this section.
 2. General provisions and requirements for electrical work.

1.2 SUBMITTALS (ADDITIONAL REQUIREMENTS)

- A. Submit product data sheets for all outlet boxes, floor boxes, wiring devices, device plates, relays, contactors, time switches, and disconnects fuses.
- B. Submit detailed shop drawings including dimensioned plans, elevations, details, schematic and point-to-point wiring diagrams and descriptive literature for all component parts for transformers, relays, time clocks, and photocells.
- C. Submit transformer test reports.
- D. Submit material list for outlet boxes.

PART 2 PRODUCTS

2.1 OUTLET AND JUNCTION BOXES

- A. General
1. Flush or concealed outlet and junction boxes: Pressed steel, steel thickness not less than 0.062-inch, hot-dip galvanized, knockout (KO) type with conduit entrances and quantities size to match conduits shown connecting to respective outlet box. U.L.-514 listed and labeled. Minimum required box depth is exclusive of extension-ring depth.
 2. Provide boxes of proper code size for the number of wires or conduits passing through or terminating therein, but in no case shall box be less than 4.0 inch square by 2.125 inch deep, unless specified elsewhere or noted otherwise on the drawings. 2.5 inch minimum depth for box widths exceeding 2-gang.

3. Increase the minimum outlet box size to 4.69 inches square by not less than 2.125 inches deep, where one or more of the following conditions occurs:
 - a. More than two (2) conduits connect to the outlet box. b. Conduit "homerun" connects to outlet box.
4. Provide extension rings on flush outlets to finish face of extension ring flush with finished building surfaces. Extension ring shall match outlet box construction and contain "attachment mounting-tabs" for wiring devices. Extension rings shall be "screw-attached" to respective outlet box and maintain "ground" bonding continuity.
5. Boxes installed in masonry or concrete shall be U.L. "concrete-tight" approved for installation in concrete, and shall allow the placing of conduit without displacing reinforcing bars.
6. Provide fixture-supporting device in outlet boxes for surface mounted fixtures as required.
7. Provide solid gang boxes for three or more switches, for mounting behind a common device plate.
8. Provide barriers for all 277 volt devices, between line voltage and low voltage devices and where more than one device is installed in an outlet box.
9. Individual audio/visual, telephone, computer or data outlets: 4.69 inch square by 2.125 inch deep minimum with two gang extension ring on flush boxes.
10. Combination signal/telephone/data or computer outlets: 4.69 inch square by 2.125 inch deep minimum with 2-gang wide extension ring on flush boxes.

B. Surface Outlet Boxes

1. Surface mounted outlet boxes, cast iron Type FS or FD, with threaded hubs as required. Box interior dimensions and interior volume capacity not less than required for "press steel boxes", and "sheet steel boxes". Provide plugs in all unused openings. Provide weatherproof gaskets for all exterior boxes.

C. Floor Boxes and Outlets

1. Recessed Combination Power/Signal Floor Box

- a. Floor box shall be cast iron, UL listed for concrete installation with leveling screws. Walker "Resource" RFB4-CI Series or equal.
- b. Floor box shall be listed for thru wiring.

- c. Floor box shall contain four independent, barriered wiring compartments. d. Overall dimensions shall not exceed 14 1/2" long x 11" 7/8" wide x 3 1/2" deep.
- e. Box cover shall be flush with floor and shall provide wire/cable egress points through cover notches. The trim and cover shall be of metal composition. Covers shall be hinged. Walker RAKMTR-BUFF Series or equal.
- f. Unit shall include two duplex receptacles as herein specified and two signal system outlets. Walker CIHT-D and CILT-2T.
- g. Activation assemblies shall include device mounting brackets, access plates, grommets, partitions, adjusting rings and all associated hardware.

2.2 PULL BOXES

- A. Sizes as indicated on the drawings and in no case of less size or material thickness than required by the governing code. Exercise care in locating underground pull boxes to avoid installation in drain water flow areas.
 - 1. General purpose sheet steel pull boxes: Install only in dry protected locations with removable screw covers. Manufacturer's standard baked enamel finishes.
 - 2. Weatherproof sheet steel pull boxes: Fabricate of code gauge, hot-dip galvanized steel with gasketed weathertight cover of same material. Manufacturer's standard baked exterior enamel finish.

2.3 SWITCHES

- A. Provide circuit switches totally enclosed, Bakelite or composition base, toggle type with 277 volt A.C. rating for full capacity or contacts for incandescent or fluorescent lamp loads. Switch ratings shall be 20 ampere only. Color as selected by OWNER'S REPRESENTATIVE. Switches controlling circuits connected to emergency power shall be red.
- B. Where switches are mounted in multiple gang assembly and are operating at 277 volts and/or 277 volts and 120 volts mounted in same outlet box, there shall be a barrier installed between each switch.

C. Switches – Specification Grade Commercial Series

1. Single Pole Switches		
	Toggle Type	Lock Type
<u>Make</u>	<u>20 Amps</u>	<u>20Amps</u>
Hubell	#CS1221	
	#CS1221	
	-L	

2. Double Pole Switch
Hubbell #CS1222 #CS1222-L
3. Three-Way Switches Hubell
#CS1223 #CS1223
4. Four-Way Switches
Hubbell #CS1224 #CS1224-L
5. Momentary Contact Switches- 20A at 277V 3'-Position Req. 3-Position
Lock Hubbell #1557 #1557-L
6. Maintained Contact Switches (Double Throw, Center Off), 20A at 277V
Toggle Type Lock

Make	Type		Lock	
	1-Pole	2-Pole	1-Pole	2-Pole
Hubbell	#1385	#1386-L	#1385-L	#1226-L
7. Ground Fault Circuit Interrupter (GFCI)
Hubbell GFST15I, or GFST20I
8. Pilot lights used in conjunction with circuit switches shall be neon type with red jewel, P & S #437 (120 volt) or #438 (277 volt) or approved equal.

2.4 DIMMER SWITCHES

- A. Dimmer switches shall be as indicated herein unless specifically noted otherwise on the drawings.
- B. Dimmer cover plate shall be the same color as switch cover plates in the same area.
- C. Dimmer switches shall be self-cooling and shall not require forced air cooling when individually or gang mounted. All dimmers shall be by the same manufacturer and the same appearance.
- D. Dimmers shall include "RF" filters and is voltage stabilized.

2.5 RECEPTACLES

- A. All receptacles in flush type outlet boxes shall be installed with a bonding jumper to connect the box to the receptacle ground terminal. Grounding through the receptacle mounting straps is not acceptable. The bonding jumper shall be sized in accordance with the branch circuit protective device as tabulated herein under "Grounding". Bonding jumper shall be attached at each outlet to the back of the box using drilled and tapped holes and washer head screws 6-32 or larger (except isolated ground receptacles). For receptacles in surface mounted outlet boxes direct metal-to-metal contact between receptacle mounting strap (if it

is connected to the grounding contacts) and outlet box may be used. Color as selected by OWNER'S REPRESENTATIVE. Receptacles connected to emergency power circuits shall be red.

- B. Duplex convenience receptacles shall be grounding type, 120 volt, 15 ampere, and shall have two current carrying contacts and one grounding contact which is internally connected to the frame. Outlet shall accommodate standard parallel blade cap and shall be side wired:
 - 1. Hubbell, Specification Grade Commercial Series, Ivory, or equal.
- C. Isolated ground receptacles
 - 1. The receptacle insulation barrier shall isolate the receptacle ground contact system from ground. Connect the ground plug contact to a separate dedicated insulated ground-bonding conductor. The receptacle ground plug contact shall not be grounded to the raceway or outlet box. Duplex convenience receptacle 20 amp minimum, with two current carrying contacts and one grounding contact, or as noted on the drawings.
 - 2. Identify receptacle with an orange triangle on the receptacle face and orange receptacle body. Red body for receptacles connected to emergency power.
 - a. Hubbell, Specification Grade Commercial Series, Ivory, or equal.
- D. Weatherproof receptacle: Ground fault type duplex receptacle, mounted in a flush hinged door enclosure with lock and key. Enclosure shall be a P & S #4600 with a #1591F46 receptacle. On exposed conduit runs, weatherproof ground fault type receptacle as hereinbefore specified, installed in "FS" conduit with one of the following spring door type covers:
 - 1. Hubbell, Specification Grade Commercial Series, or equal.
- E. Special outlets shall be as indicated on the drawings.

2.6 PLATES

Provide plates for every switch, receptacle, telephone, computer, television and other device outlets. All plates shall be 0.040" stainless steel, Type 302 alloy composed of 18% chromium and

8% nickel. Plates shall be manufactured by P & S, Hubbell, Leviton or General Electric only.

2.7 VANDALPROOF FASTENINGS

Provide approved vandal proof type screws, bolts, nuts where exposed to sight throughout the project. Screws for such items as switch plates, receptacle

plates, fixtures, communications equipment, fire alarm, blank covers, wall and ceiling plates to be spanner head stainless steel, tamperproof type. Provide OWNER with six (6) screwdrivers for this type.

2.8 STRUCTURAL AND MISCELLANEOUS STEEL

Structural and miscellaneous steel used in connection with electrical work and located out-of-doors or in damp locations, to be hot-dip galvanized unless otherwise specified. Included are underground pull box covers and similar electrical items. Galvanizing averages 2.0 ounce per square foot and conforms to ASTM A123.

2.9 FLASHING ASSEMBLIES

Provide Semco Fig. #1100-4 lead flashing assemblies at all roof penetrations. Seal the joint between flashing and pipe with waterproofing compound.

2.10 RELAYS, CONTACTORS, AND TIMESWITCHES

A. Individual Control Relays (HV/AC Plumbing of the Control Functions)

1. Individual control relays shall have convertible contacts rated a minimum of 10 amperes, 600 volts regardless of usage voltage. Coil voltage, number and type of contacts shall be verified and supplied to suit the specific usage as shown in the wiring diagrams and/or schedules on the electrical and mechanical drawings. Coil control circuit shall be independently fused, sized to protect coil. Relays shall be installed on pre-fabricated mounting strips. Each relay shall have a surge suppressor to limit coil transient voltages. Furnished in the NEMA Type I enclosure unless indicated otherwise.

2. The following relays are approved:

Manufacturer

IYQg

Arrow
IMP

Hart

General Electric
CR 2811

Class

I.T.E.
Class J10

Square D Co.
Type A Westinghouse
Type NH Allen Bradley

Class 8501,
Bul. 16-321,
Approved Equal

B. Contactors and/or Relays

1. Contactors and/or relays for control of lighting shall be 600 volt A.C., electrically operated, mechanically held units, open type for panel mounting with number of poles and of size as indicated on the drawings. Provide auxiliary control relay for operation of each contactor and/or relay with a two-wire control circuit.
2. Contactors and/or relays shall be mounted in panelboards in barriered section under separate hinged lockable doors or in contactor and/or relay cabinets as called for on the drawings. Contactors and/or relays shall be installed on Lord sound absorbing rubber mounts.
3. Contactors and/or relays shall be Automatic Switch Co. Bulletin #920 Series for 2 and 3 pole, Automatic Switch Co. Bulletin 917 Series with poles as indicated on drawings. Coil control circuit shall be independently fused, sized to protect coil.
4. Contactors and/or relays shall be equipped with a switch, in the proper configuration, to disconnect the control circuit controlling the coil of the respective device. Control circuit disconnect switch shall be labeled showing function of device.

C. Time switches

1. All time switches shall have synchronous motor drive for operation on 120 or 277 volts, 60 Hertz, A.C. and shall be furnished with a ten-hour, spring-driven, reserve-power motor. Contacts shall be rated 40A per pole.
 - a. Exterior lighting time switches for control of individual circuits or electrically operated relays shall have astronomic dial and shall be Tork 7000ZL Series or approved equal by Paragon or Intermatic.
 - b. Interior lighting time switches for control of individual circuits or electrically operated relays shall be Tork 7000 Series or approved equal by Paragon or Intermatic.
 - c. Time switches for control of air conditioning or plumbing equipment shall have seven day dial and shall be Tork WL Series or approved equal by Paragon or Intermatic.
2. All time switches shall be mounted in separate section in top of panelboards under separate lockable door unless otherwise indicated on drawings. Clear opening for time switch shall be a minimum of 12" x 12".

D. Contactors and/or Relays/Time switch Cabinet

1. Contactors, relays, and/or time switches not indicated to be mounted in electrical panels shall be mounted in a cabinet, size as required, with hinged lockable door keyed same as panelboards. Construction of cabinet shall be similar to terminal cabinets.

2. Each contactor, relay or time switch mounted in the contactor cabinet shall be barriered in its own compartment, and shall be installed on Lord sound absorbing mounts.
3. Contactor cabinets shall be of the same manufacturer as the panelboards.
4. Where relays and/or contactors occupy the same enclosure as time switches they shall have a clear acrylic shield installed over each relay or contactor to guard line exposed parts from accidental contact by non-authorized personnel.

2.11 DISCONNECTS (SAFETY SWITCHES)

Disconnect switches shall be rated 600 volt A.C., NEMA Type HD, quick-make, quick-break, h.p.- rated, fused Class "R", in NEMA Type I enclosure, lockable with number of poles and amperage as indicated on the drawings. Provide neutral bus and conductor landing lugs, size to match conductors shown on drawings. Where enclosure is indicated W.P. (weatherproof) switches shall be raintight NEMA Type 3R enclosure, lockable. Maximum voltage, current and horsepower rating clearly marked on the switch enclosure and switches having dual element fuses shall have rating indicated on the nameplate.

2.12 WIREWAY A. General

Unobstructed lay in type, metal wireway, fittings and connectors U.L. listed for use as wireway and auxiliary gutter. Length, elbows and "T-S" as shown on drawings. Minimum cross-section

size 4 inches X 4 inches, but not less than shown on the drawings. Suitable for mounting in any position orientation.

B. Construction

1. Minimum metal gauge shall not be less than 14 gage.
2. Cover shall be hinged entire length of cover. Cover shall be held in the closed position with bolts and nuts.
3. Provide spring nuts on all hardware fastener penetrations into the interior of the wireway to protect against wire insulation damage.
4. The inside of 90-degree corners in the wireway shall be a 45-degree bevel.
5. Grounding continuity between wireway sections and fittings shall be continuous the entire length of the wireway.

C. Finish

1. Indoor non-raintight, rust inhibitor phosphatizing base coating and baked enamel finish, manufacturer's standard color.
2. Raintight or outdoor-galvanized metal, with corrosion resistant phosphate primer and baked enamel finish, manufacturer's standard color, Nema 3R construction.
3. All hardware shall be plated to prevent corrosion.

PART 3 EXECUTION

3.1 GROUNDING (ADDITIONAL REQUIREMENTS)

- A. Grounding shall be executed in accordance with all applicable codes and regulations, both of the State of California, and local authorities having jurisdiction, and in compliance with DSA.
- B. Each pull box or any other enclosure in which several ground wires are terminated shall be equipped with a ground bus secured to the interior of the enclosure. The bus shall have a separate lug for each ground conductor. No more than one conductor shall be installed per lug.
- C. The maximum resistance to ground shall not exceed 5 ohms.

3.2 OUTLET AND JUNCTION BOXES

- A. Accurately place boxes and securely fastens to structural members. Where outlets are shown at same location but at different mounting heights, install outlets in one vertical line. Where outlets are shown at same location and mounting height, mount outlets as close together in a horizontal row as possible. Where the outlet boxes for switches and receptacles are shown at the same location and mounting height, mount in common outlet box with barriers between devices. Provide single piece multigang cover plate for close mounted outlet boxes. Where switches are shown on wall adjacent to hinge side of doors, box shall be installed to clear door when door is fully opened.
- B. Flush mounted boxes shall be attached to two studs or structure members by means of metal supports.
- C. Boxes above accessible ceilings shall be attached to structural members. Where boxes are suspended, they shall be supported independently of conduit system by means of hanger rods and/or preformed steel channels. Boxes shall be supported independently of all piping, ductwork, equipment, ceiling hanger wires and suspended ceiling grid system.
- D. Surface mounted outlets shall be attached to concrete or masonry walls by means of expansion shields.

- E. Floor boxes shall be installed level with finish floor and within adjustable limits of floor ring. Where outlets are shown at same or adjacent location, use multigang boxes.
- F. Outlet Box Horizontal and Vertical Separation: Outlet boxes and device outlet rings installed flush in walls shall be horizontally and vertically separated by not less than 24 inches (edge of box to edge of box) from device outlet boxes and rings in common wall surfaces located on the opposite (back) side of the same wall.
 - 1. Where the separation cannot be maintained, provide a solid backing behind and completely enclosing each outlet box.
 - 2. The backing shall extend the width of the wall cavity (i.e. between "studs" or masonry cells) behind the box and 12 inches above and below the outlet box centerline, completely enclosing the outlet box.
 - 3. The backing shall consist of the following:
 - a. 5/8 inch thick gypsum board anchored in place for "stud" wall construction.
 - b. Solid "mortar" to completely fill the outlet box "cell" behind the box in masonry construction.
- G. In fire rated walls and ceilings provide fire rated "box-wrap" around the outside of each outlet box placed in fire rated wall or ceiling inside the wall, to maintain the fire rating of wall with the installed outlet boxes.
- H. Plug-in type receptacle installation orientation:
 - 1. The "ground-pin" shall face "up" at the receptacle top location {double duplex) 4-plex, individual and vertically mounted individual duplex receptacles.
 - 2. The "neutral-blade" shall face "up" at the receptacle top location on horizontally mounted duplex receptacles.

3.3 DIMMER SWITCHES

- A. Do not break off dimmer cooling fins.
- B. Large dimmers shall be surface wall mounted at the location indicated on the drawings.

3.4 WIREWAY INSTALLATION

Wireway hangers shall provide clamp type, hanger rod type, direct bolted bracket type from ceiling or walls as indicated on the drawings and required for field installation locations. Supports shall be installed a minimum of 5 ft. on center.

END OF SECTION

SECTION 26 05 19

LOWVOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- B. This Section includes the following:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
 - 3. Sleeves and sleeve seals for cables.
- C. Related Sections include the following:
 - 1. Division 27 Section "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.3 DEFINITIONS

- D. EPDM: Ethylene-propylene-diene terpolymer rubber.
- E. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- F. Product Data: For each type of product indicated.
- G. Qualification Data: For testing agency.
- H. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- I. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
 - J. 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.
 - K. Comply with NFPA 70.
- 1.6 COORDINATION
- L. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Alcan Products Corporation; Alcan Cable Division.
 2. American Insulated Wire Corp.; a Leviton Company.
 3. General Cable Corporation.
 4. Senator Wire & Cable Company.
 5. Southwire Company.
 6. Or approved equal.
- B. Copper Conductors: Comply with NEMA WC 70.
- C. Conductor Insulation: Comply with NEMA WC 70 for Types THW THHN-THWN.

2.2 CONNECTORS AND SPLICES

- D. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. AFC Cable Systems, Inc.
 2. Hubbell Power Systems, Inc.

3. O-Z/Gedney; EGS Electrical Group LLC.
 4. 3M; Electrical Products Division.
 5. Tyco Electronics Corp.
 6. Or approved equal.
- E. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SLEEVES FOR CABLES

- F. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- G. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- H. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.
- I. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.4 SLEEVE SEALS

- J. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance Products & Systems, Inc.
 2. Calpico, Inc.
 3. Metraflex Co.
 4. Pipeline Seal and Insulator, Inc.
 5. Or approved equal.
- K. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 2. Pressure Plates: Plastic. Include two for each sealing element.

3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper - solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- C. Service Entrance: Type THHN-THWN, single conductors in raceway.
- D. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
- E. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway.
- F. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- G. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN, single conductors in raceway.
- H. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- I. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- J. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, and strain relief device at terminations to suit application.
- K. Class 1 Control Circuits: Type THHN-THWN in raceway.
- L. Class 2 Control Circuits: Type THHN-THWN in raceway. Power-limited cable, concealed in building finishes.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- M. Conceal conduits and cables in floor slabs, finished walls, ceilings, and floors, unless otherwise indicated.

- N. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- O. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- P. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- Q. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- R. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

- S. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- T. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- U. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- V. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- W. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- X. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- Y. Rectangular Sleeve Minimum Metal Thickness:
 1. For sleeve rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
 2. For sleeve rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.

- Z. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- AA. Cut sleeves to length for mounting flush with both wall surfaces.
- BB. Extend sleeves installed in floors 2 inches above finished floor level.
- CC. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
- DD. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- EE. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section "Joint Sealants."
- FF. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 07 Section "Penetration Firestopping."
- GG. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.
- HH. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- II. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

- JJ. Install to seal underground exterior-wall penetrations.
- KK. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

- LL. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

- MM. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- NN. Perform tests and inspections and prepare test reports.
- OO. Tests and Inspections:
1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, and conductors feeding the following critical equipment and services for compliance with requirements.
 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.
 - a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
 - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- PP. Test Reports: Prepare a written report to record the following:
1. Test procedures used.
 2. Test results that comply with requirements.
 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- QQ. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- B. This Section includes methods and materials for grounding systems and equipment, plus the following special applications:
 - 1. Underground distribution grounding.

1.3 SUBMITTALS

- C. Product Data: For each type of product indicated.
- D. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
 - 1. Test wells.
 - 2. Ground rods.
 - 3. Ground rings.
 - 4. Grounding arrangements and connections for separately derived systems.
 - 5. Grounding for sensitive electronic equipment.
- E. Qualification Data: For testing agency and testing agencies field supervisor.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:
 - 1. Instructions for periodic testing and inspection of grounding features at test wells ground rings grounding connections for separately derived systems based on NETA MTS NFPA 70B.

- a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
- b. Include recommended testing intervals.

1.4 QUALITY ASSURANCE

- H. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association to supervise on-site testing specified in Part 3.
- I. 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.
- J. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: [Copper] [or] [tinned-copper] wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 1. Solid Conductors: ASTM B 3.
 2. Stranded Conductors: ASTM B 8.
 3. Tinned Conductors: ASTM B 33.
 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, ¼ inch in diameter.
 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Bare Grounding Conductor and Conductor Protector for Wood Poles:
1. No. 4 AWG minimum, soft-drawn copper.
 2. Conductor Protector: Half-round PVC or wood molding. If wood, use pressure-treated fir or cypress or cedar.
- D. Grounding Bus: Rectangular bars of annealed copper, ¼ by 2 inches in cross section, unless otherwise indicated; with insulators.

2.2 CONNECTORS

- E. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- F. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
1. Pipe Connectors: Clamp type, sized for pipe.
- G. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

- H. Ground Rods: Copper-clad; ¾ inch by 10 feet in diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
1. Bury at least 24 inches below grade.
 2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where

visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus on insulated spacers 1 inch, minimum, from wall 6 inches above finished floor, unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus.
- E. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- F. Comply with IEEE C2 grounding requirements.
- G. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- H. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.
- I. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than

No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

3.4 EQUIPMENT GROUNDING

- J. Install insulated equipment grounding conductors with all feeders and branch circuits.
- K. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
 - 7. Armored and metal-clad cable runs.
 - 8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
 - 9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
 - 10. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.
- L. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- M. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- N. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment

grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

- O. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- P. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 - 1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.
 - 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- Q. [Metal] [and] [Wood] Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.5 INSTALLATION

- R. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- S. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- T. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
 - 2. For grounding electrode system, install at least three (3) rods spaced at least one-rod 6ft length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

- U. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Division 26 Section "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches deep, with cover.
 - 1. Test Wells: Install at least one test well for each service, unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

- V. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

- W. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

- X. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

- Y. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

- Z. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of [building] [area or item indicated].
1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
 2. Bury ground ring not less than 24 inches from building foundation.
- AA. User Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.
1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.

3.6 FIELD QUALITY CONTROL

- BB. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- CC. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
- DD. Perform the following tests and inspections and prepare test reports:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations.

Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

- EE. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity 500 kVA and less: 5 ohms.
 2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
 5. Substations and Pad-Mounted Equipment: 5 ohms.
 6. Manhole Grounds: 5 ohms.
- FF. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 26 0529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- B. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.
- C. Related Sections include the following:
 - 1. Division 26 Section “Vibration and Seismic Controls for Electrical Systems” for products and installation requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS

- D. EMT: Electrical metallic tubing.
- E. IMC: Intermediate metal conduit.
- F. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- G. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- H. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- I. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- J. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

- K. Product Data: For the following:
 - 1. Steel slotted support systems.
 - 2. Nonmetallic slotted support systems.
- L. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze hangers. Include Product Data for components.
 - 2. Steel slotted channel systems. Include Product Data for components.
 - 3. Nonmetallic slotted channel systems. Include Product Data for components.
 - 4. Equipment supports.
- M. Welding certificates.

1.6 QUALITY ASSURANCE

- N. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, “Structural Welding Code – Steel.”
- O. Comply with NFPA 70.

1.7 COORDINATION

- P. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- Q. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section “Roof Accessories.”

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.
 3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 4. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 6. Channel Dimensions: Selected for applicable load criteria.
- B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch diameter holes at a maximum of 8 inches o.c., in at least 1 surface.
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. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. Fabco Plastics Wholesale Limited.
 - d. Seasafe, Inc.
 3. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
 4. Fitting and Accessory Materials: Same as channels and angles.

5. Rated Strength: Selected to suit applicable load criteria.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened 4ortland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened 4ortland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
- 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
- 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
- 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
- 6. Toggle Bolts: All-steel springhead type.
- 7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- H. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- I. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by scheduled in NECA 1, and where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be ¼ inch in diameter.

- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with single-bolt conduit clamps or single-bolt conduit clamps using spring friction action for retention in support channel.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- E. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- F. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- G. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- H. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 - 6. To Light Steel: Sheet metal screws.
 - 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel

racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

- I. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- J. Comply with installation requirements in Division 05 Section “Metal Fabrications” for site-fabricated metal supports.
- K. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- L. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- M. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- N. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section “Cast-in- Place Concrete.”
- O. Anchor equipment to concrete base.
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer’s setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer’s written instructions.

3.5 PAINTING

- P. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- Q. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

- R. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 26 0533

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
 - 1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. EPDM: Ethylene-propylene-diene terpolymer rubber.
- D. FMC: Flexible metal conduit.
- E. IMC: Intermediate metal conduit.
- F. LFMC: Liquidtight flexible metal conduit.
- G. LFNC: Liquidtight flexible nonmetallic conduit.
- H. NBR: Acrylonitrile-butadiene rubber.
- I. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

- B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
1. Custom enclosures and cabinets.
 2. For handholes and boxes for underground wiring, including the following:
 - a. Duct entry provisions, including locations and duct sizes.
 - b. Frame and cover design.
 - c. Grounding details.
 - d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
 - e. Joint details.
- C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
1. Structural members in the paths of conduit groups with common supports.
 2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.
- D. Manufacturer Seismic Qualification Certification: Submit certification that enclosures and cabinets and their mounting provisions, including those for internal components, will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the cabinet or enclosure will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will retain its enclosure characteristics, including its interior accessibility, after the seismic event."
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- E. Qualification Data: For professional engineer and testing agency.
- F. Source quality-control test reports.

1.5 QUALITY ASSURANCE

- G. 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.
- H. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Alflex Inc.
 - 3. Allied Tube & Conduit; a Tyco International Ltd. Co.
 - 4. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 5. Electri-Flex Co.
 - 6. Manhattan/CDT/Cole-Flex.
 - 7. Maverick Tube Corporation.
 - 8. O-Z Gedney; a unit of General Signal.
 - 9. Wheatland Tube Company.
 - 10. Or approved equal.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. IMC: ANSI C80.6.
- D. EMT: ANSI C80.3.
- E. LFMC: Flexible steel conduit with PVC jacket.

- F. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
 - 2. Fittings for EMT: compression type.
 - 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch with overlapping sleeves protecting threaded joints.
- G. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 3. Arnco Corporation.
 - 4. CANTEX Inc.
 - 5. CertainTeed Corp.; Pipe & Plastics Group.
 - 6. Condux International, Inc.
 - 7. ElecSYS, Inc.
 - 8. Electri-Flex Co.
 - 9. Lamson & Sessions; Carlon Electrical Products.
 - 10. Manhattan/CDT/Cole-Flex.
 - 11. RACO; a Hubbell Company.
 - 12. Thomas & Betts Corporation.
 - 13. Or approved equal.
- B. ENT: NEMA TC 13.

- C. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.
- D. LFNC: UL 1660.
- E. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.
- F. Fittings for LFNC: UL 514B.

2.3 OPTICAL FIBER/COMMUNICATIONS CABLE RACEWAY AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Arnco Corporation.
 - 2. Endot Industries Inc.
 - 3. IPEX Inc.
 - 4. Lamson & Sessions; Carlon Electrical Products.

2.4 METAL WIREWAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman.
 - 3. Square D; Schneider Electric.
 - 4. Or approved equal.
- B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1 or 3R to suit the application, unless otherwise indicated.
- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Screw-cover type.
- E. Finish: Manufacturer's standard enamel finish.

2.5 NONMETALLIC WIREWAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hoffman.
 - 2. Lamson & Sessions; Carlon Electrical Products.
 - 3. Or approved equal.
- B. Description: Fiberglass polyester, extruded and fabricated to size and shape indicated, with no holes or knockouts. Cover is gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections are flanged, with stainless-steel screws and oil-resistant gaskets.
- C. Description: PVC plastic, extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections with plastic fasteners.
- D. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.6 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Prime coating, ready for field painting.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Thomas & Betts Corporation.
 - b. Walker Systems, Inc.; Wiremold Company (The).
 - c. Wiremold Company (The); Electrical Sales Division.
 - d. Or approved equal.

2.7 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 - 2. EGS/Appleton Electric.
 - 3. Erickson Electrical Equipment Company.

4. Hoffman.
 5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
 6. O-Z/Gedney; a unit of General Signal.
 7. RACO; a Hubbell Company.
 8. Robroy Industries, Inc.; Enclosure Division.
 9. Scott Fetzer Co.; Adalet Division.
 10. Spring City Electrical Manufacturing Company.
 11. Thomas & Betts Corporation.
 12. Walker Systems, Inc.; Wiremold Company (The).
 13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
 14. Or approved equal.
- B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
- E. Metal Floor Boxes: Cast or sheet metal, fully adjustable, rectangular.
- F. Nonmetallic Floor Boxes: Nonadjustable, round.
- G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- H. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.
- I. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
- J. Cabinets:
1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.

2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

2.8 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Description: Comply with SCTE 77.

1. Color of Frame and Cover: Gray or Green.
2. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC", "TELEPHONE", or as indicated for each service.
6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
7. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. CDR Systems Corporation.
 - d. NewBasis.
 - e. Or approved equal.

- C. Fiberglass Handholes and Boxes with Polymer-Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester-resin enclosure joined to polymer-concrete top ring or frame.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. Christy Concrete Products.
 - d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.
 - e. Or approved equal.

2.9 SLEEVES FOR RACEWAYS

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated “wall pipe,” equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section “Penetration Firestopping.”

2.10 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex Co.
 - 4. Pipeline Seal and Insulator, Inc.
 - 5. Or approved equal.
- B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: Stainless steel. Include two for each sealing element.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.11 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 1. Tests of materials shall be performed by a independent testing agency.
 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
 1. Exposed Conduit: Rigid steel conduit IMC type EPC-40-PVC and Type EPC-80-PVC.
 2. Concealed Conduit, Aboveground: Rigid steel conduit IMC or EMT.
 3. Underground Conduit: RNC, Type EPC-40 and 80-PVC, direct buried.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
 6. Application of Handholes and Boxes for Underground Wiring:

- a. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
 - b. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer-concrete units, SCTE 77, Tier 8 structural load rating.
 - c. Handholes and Pull Boxes Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf (13 345-N) vertical loading.
- B. Comply with the following indoor applications, unless otherwise indicated:
- 1. Exposed, Not Subject to Physical Damage: EMT.
 - 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 - 3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit or IMC. Includes raceways in the following locations:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 - 6. Damp or Wet Locations: Rigid steel conduit or IMC.
 - 7. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: EMT.
 - 8. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: EMT.
 - 9. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: EMT.
 - 10. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel or nonmetallic in damp or wet locations.

- C. Minimum Raceway Size: 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
 - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits in contact with concrete.

3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- H. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.

3. Change from ENT to RNC, Type EPC-40-PVC, rigid steel conduit, or IMC before rising above the floor.
- I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
 - J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
 - K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.
 - L. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:
 1. ¾-Inch Trade Size and Smaller: Install raceways in maximum lengths of 50 feet.
 2. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.
 3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
 - M. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where otherwise required by NFPA 70.
 - N. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet.
 1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:

- a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg. F of temperature change.
 3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.
- O. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- P. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.
- Q. Set metal floor boxes level and flush with finished floor surface.
- R. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
 2. Install backfill as specified in Division 31 Section "Earth Moving."
 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this

process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."

4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
 - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits, placing them 24 inches o.c. Align planks along the width and along the centerline of conduit.

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from ½-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.
- E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section “Penetration Firestopping.”
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
 - 1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
 - 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both surfaces of walls.
- G. Extend sleeves installed in floors 2 inches above finished floor level.
- H. Size pipe sleeves to provide ¼-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed or unless seismic criteria require different clearance.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section “Joint Sealants” for materials and installation.
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section “Penetration Firestopping.”
- L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.

- M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- N. Underground, Exterior-Wall Penetrations: Install cast-iron “wall pipes” for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground, exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section “Penetration Firestopping.”

3.8 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 26 0543

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks, and in single duct runs.
 - 2. Handholes and boxes.
 - 3. Manholes.

1.3 DEFINITION

- A. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Duct-bank materials, including separators and miscellaneous components.
 - 2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
 - 3. Accessories for manholes, handholes, boxes, and other utility structures.
 - 4. Warning tape.
 - 5. Warning planks.
- B. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:
 - 1. Duct entry provisions, including locations and duct sizes.

2. Reinforcement details.
 3. Frame and cover design and manhole frame support rings.
 4. Ladder Step details.
 5. Grounding details.
 6. Dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
 7. Joint details.
- C. Shop Drawings for Factory-Fabricated Handholes and Boxes Other Than Precast Concrete: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:
1. Duct entry provisions, including locations and duct sizes.
 2. Cover design.
 3. Grounding details.
 4. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
- D. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.
1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
 2. Drawings shall be signed and sealed by a qualified professional engineer.
- E. Product Certificates: For concrete and steel used in precast concrete manholes as required by ASTM C 858.
- F. Qualification Data: For professional engineer and testing agency.
- G. Source quality-control test reports.
- H. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Comply with ANSI C2.

- C. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.
- B. Store precast concrete and other factory-fabricated underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.
- C. Lift and support precast concrete units only at designated lifting or supporting points.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Architect no fewer than two days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Architect's written permission.

1.8 COORDINATION

- A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.
- B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Furnish cable-support stanchions, arms, insulators, and specialties and associated fasteners in quantities equal to 5 percent of quantity of each item installed.

PART 2 - PRODUCTS

2.1 CONDUIT

- A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.
- B. RNC: NEMA TC 2, Type EPC-80-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ARNCO Corp.
 - 2. Beck Manufacturing.
 - 3. Cantex, Inc.
 - 4. CertainTeed Corp.; Pipe & Plastics Group.
 - 5. Condux International, Inc.
 - 6. ElecSys, Inc.
 - 7. Electri-Flex Company.
 - 8. IPEX Inc.
 - 9. Lamson & Sessions; Carlon Electrical Products.
 - 10. Manhattan/CDT; a division of Cable Design Technologies.
 - 11. Spiraduct/AFC Cable Systems, Inc.
- B. Underground Plastic Utilities Duct: NEMA TC 6 & 8, Type EB-20-PVC, ASTM F 512, UL 651A, with matching fittings by the same manufacturer as the duct, complying with NEMA TC 9.
- C. Underground Plastic Utilities Duct: NEMA TC 6 & 8, Type DB-120-PVC, ASTM F 512, with matching fittings by the same manufacturer as the duct, complying with NEMA TC 9.
- D. Duct Accessories:
 - 1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.

2. Warning Tape: Underground-line warning tape specified in Division 26 Section "Identification for Electrical Systems."
3. Concrete Warning Planks: Nominal 12 by 24 by 3 inches in size, manufactured from 6000-psi concrete.
 - a. Color: Red dye added to concrete during batching.
 - b. Mark each plank with "ELECTRIC" in 2-inch- high, 3/8-inch-deep letters.

2.3 PRECAST CONCRETE HANDHOLES AND BOXES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Carder Concrete Products.
 2. Christy Concrete Products.
 3. Elmhurst-Chicago Stone Co.
 4. Oldcastle Precast Group.
 5. Riverton Concrete Products; a division of Cretex Companies, Inc.
 6. Utility Concrete Products, LLC.
 7. Utility Vault Co.
 8. Wausau Tile, Inc.
- C. Comply with ASTM C 858 for design and manufacturing processes.
- D. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.
 1. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
 2. Frame and Cover: Weatherproof steel frame, with steel cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.

3. Frame and Cover: Weatherproof steel frame, with hinged steel access door assembly with tamper-resistant, captive, cover-securing bolts.
 - a. Cover Hinges: Concealed, with hold-open ratchet assembly.
 - b. Cover Handle: Recessed.
4. Frame and Cover: Weatherproof aluminum frame with hinged aluminum access door assembly with tamper-resistant, captive, cover-securing bolts.
 - a. Cover Hinges: Concealed, with hold-open ratchet assembly.
 - b. Cover Handle: Recessed.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC." "TELEPHONE." As indicated for each service.
7. Configuration: Units shall be designed for flush burial and have [open] [closed] [integral closed] bottom, unless otherwise indicated.
8. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.
 - a. Extension shall provide increased depth of 12 inches.
 - b. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.
9. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches vertically and horizontally to accommodate alignment variations.
 - a. Windows shall be located no less than 6 inches from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
 - b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
 - c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.
10. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.

- a. Type and size shall match fittings to duct or conduit to be terminated.
 - b. Fittings shall align with elevations of approaching ducts and be located near interior corners of handholes to facilitate racking of cable.
11. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.4 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Description: Comply with SCTE 77.

1. Color: Gray.
2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC." "TELEPHONE." As indicated for each service.
6. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
7. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.

B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.

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. Armorcast Products Company.
 - b. Carson Industries LLC.

- c. CDR Systems Corporation.
 - d. NewBasis.
- C. Fiberglass Handholes and Boxes with Polymer Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.
 - 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. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. Christy Concrete Products.
 - d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.
- D. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers of cast iron.
 - 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. Carson Industries LLC.
 - b. Christy Concrete Products.
 - c. Nordic Fiberglass, Inc.
- E. High-Density Plastic Boxes: Injection molded of high-density polyethylene or copolymer-polypropylene. Cover shall be hot-dip galvanized-steel diamond plate.
 - 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. Carson Industries LLC.
 - b. Nordic Fiberglass, Inc.
 - c. PenCell Plastics.

2.5 PRECAST MANHOLES

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

1. Carder Concrete Products.
2. Christy Concrete Products.
3. Elmhurst-Chicago Stone Co.
4. Oldcastle Precast Group.
5. Riverton Concrete Products; a division of Cretex Companies, Inc.
6. Utility Concrete Products, LLC.
7. Utility Vault Co.
8. Wausau Tile, Inc.

B. Comply with ASTM C 858, with structural design loading as specified in Part 3 "Underground Enclosure Application" Article and with interlocking mating sections, complete with accessories, hardware, and features.

1. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches vertically and horizontally to accommodate alignment variations.
 - a. Windows shall be located no less than 6 inches from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.
 - b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
 - c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.
2. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
 - a. Type and size shall match fittings to duct or conduit to be terminated.
 - b. Fittings shall align with elevations of approaching ducts and be located near interior corners of manholes to facilitate racking of cable.

- C. Concrete Knockout Panels: 1-1/2 to 2 inches thick, for future conduit entrance and sleeve for ground rod.
- D. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

2.6 CAST-IN-PLACE MANHOLES

- A. Description: Underground utility structures, constructed in place, complete with accessories, hardware, and features. Include concrete knockout panels for conduit entrance and sleeve for ground rod.
- B. Materials: Comply with ASTM C 858 and with Division 03 Section “Cast-in-Place Concrete.”
- C. Structural Design Loading: As specified in Part 3 “Underground Enclosure Application” Article.

2.7 UTILITY STRUCTURE ACCESSORIES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Bilco Company (The).
 - 2. Campbell Foundry Company.
 - 3. Carder Concrete Products.
 - 4. Christy Concrete Products.
 - 5. East Jordan Iron Works, Inc.
 - 6. Elmhurst-Chicago Stone Co.
 - 7. McKinley Iron Works, Inc.
 - 8. Neenah Foundry Company.
 - 9. NewBasis.
 - 10. Oldcastle Precast Group.
 - 11. Osburn Associates, Inc.
 - 12. Pennsylvania Insert Corporation.
 - 13. Riverton Concrete Products; a division of Cretex Companies, Inc..

14. Strongwell Corporation; Lenoir City Division.
 15. Underground Devices, Inc.
 16. Utility Concrete Products, LLC.
 17. Utility Vault Co.
 18. Wausau Tile, Inc.
- B. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.
1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A 48/A 48M, Class 30B with milled cover-to-frame bearing surfaces; diameter, 26 inches or 29 inches.
 - a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.
 2. Cover Legend: Cast in. Selected to suit system.
 - a. Legend: "ELECTRIC-LV" for duct systems with power wires and cables for systems operating at 600 V and less.
 - b. Legend: "ELECTRIC-HV" for duct systems with medium-voltage cables.
 - c. Legend: "SIGNAL" for communications, data, and telephone duct systems.
 3. Manhole Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.
 - a. Mortar for Chimney Ring and Frame and Cover Joints: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. Ft. where packaged mix complying with ASTM C 387, Type M, may be used.
- C. Manhole Sump Frame and Grate: ASTM A 48/A 48M, Class 30B, gray cast iron.
- D. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch- diameter eye, and 1-by-4-inch bolt.
1. Working Load Embedded in 6-Inch, 4000-psi Concrete: 13,000-lbf minimum tension.

- E. Pulling Eyes in Nonconcrete Walls: Eyebolt with reinforced fastening, 1-1/4-inch- diameter eye, rated 2500-lbf minimum tension.
- F. Pulling-In and Lifting Irons in Concrete Floors: 7/8-inch- diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.
 - 1. Ultimate Yield Strength: 40,000-lbf shear and 60,000-lbf tension.
- G. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch ID by 2-3/4 inches deep, flared to 1-1/4 inches minimum at base.
 - 1. Tested Ultimate Pullout Strength: 12,000 lbf minimum.
- H. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch bolt, 5300-lbf rated pullout strength, and minimum 6800-lbf rated shear strength.
- I. Cable Rack Assembly: Steel, hot-rolled galvanized, except insulators.
 - 1. Stanchions: T-section or channel; 2-1/4-inch nominal size; punched with 14 holes on 1-1/2-inch centers for cable-arm attachment.
 - 2. Arms: 1-1/2 inches wide, lengths ranging from 3 inches with 450-lb minimum capacity to 18 inches with 250-lb minimum capacity. Arms shall have slots along full length for cable ties and be arranged for secure mounting in horizontal position at any vertical location on stanchions.
 - 3. Insulators: High-glaze, wet-process porcelain arranged for mounting on cable arms.
- J. Cable Rack Assembly: Nonmetallic. Components fabricated from nonconductive, fiberglass-reinforced polymer.
 - 1. Stanchions: Nominal 36 inches high by 4 inches wide, with minimum of 9 holes for arm attachment.
 - 2. Arms: Arranged for secure, drop-in attachment in horizontal position at any location on cable stanchions, and capable of being locked in position. Arms shall be available in lengths ranging from 3 inches with 450-lb minimum capacity to 20 inches with 250-lb minimum capacity. Top of arm shall be nominally 4 inches wide, and arm shall have slots along full length for cable ties.
- K. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F. Capable of withstanding temperature of 300 deg F without slump and adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete,

masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

- L. Fixed Manhole Ladders: Arranged for attachment to wall of manhole. Ladder and mounting brackets and braces shall be fabricated from hot-dip galvanized steel.
- M. Portable Manhole Ladders: UL-listed, heavy-duty fiberglass specifically designed for portable use for access to electrical manholes. Minimum length equal to distance from deepest manhole floor to grade plus 36 inches. One required.
- N. Cover Hooks: Heavy duty, designed for lifts 60 lbf and greater. Two required.

2.8 SOURCE QUALITY CONTROL

- A. Test and inspect precast concrete utility structures according to ASTM C 1037.
- B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 - 1. Tests of materials shall be performed by a independent testing agency.
 - 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or the manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 - 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 UNDERGROUND DUCT APPLICATION

- A. Ducts for Electrical Cables Over 600 V: RNC, NEMA Type EPC-80-PVC, in concrete-encased duct bank, unless otherwise indicated.
- B. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-80, EB-20-PVC, in concrete-encased duct bank, unless otherwise indicated.
- C. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-80-PVC, in direct-buried duct bank, unless otherwise indicated.
- D. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-80-PVC, in direct-buried duct bank, unless otherwise indicated.

- E. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.
- F. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40-PVC, Underground plastic utilities duct, NEMA Type DB-60-PVC, Underground plastic utilities duct, NEMA Type DB-120-PVC, installed in direct-buried concrete-encased duct bank, unless otherwise indicated.
- G. Underground Ducts for Telephone, Communications, or Data Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.
- H. Underground Ducts for Telephone, Communications, or Data Circuits: RNC, NEMA Type EB-20-PVC, in concrete-encased duct bank, unless otherwise indicated.
- I. Underground Ducts Crossing Paved Paths, Walks and Driveways: RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete.

3.2 UNDERGROUND ENCLOSURE APPLICATION

- A. Handholes and Boxes for 600 V and Less, Including Telephone, Communications, and Data Wiring:
 - 1. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20 structural load rating.
 - 2. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10 structural load rating.
 - 3. Units Subject to Light-Duty Pedestrian Traffic Only: High-density plastic, structurally tested according to SCTE 77 with 3000-lbf vertical loading.
- B. Manholes: Precast concrete.
 - 1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.
 - 2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.

3.3 EARTHWORK

- A. Excavation and Backfill: Comply with Division 31 Section "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

- B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 32 Sections “Turf and Grasses” and “Plants.”
- D. Cut and patch existing pavement in the path of underground ducts and utility structures according to Division 01 Section “Cutting and Patching.”

3.4 DUCT INSTALLATION

- A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.
- B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, 12.5 feet, 25 feet, both horizontally and vertically, at other locations, unless otherwise indicated.
- C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer’s written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.
- D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.
 - 1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line.
 - 2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
 - 3. Grout end bells into structure walls from both sides to provide watertight entrances.
- E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Division 26 Section “Common Work Results for Electrical.”

- F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
- G. Pulling Cord: Install 100-lbf- test nylon cord in ducts, including spares.
- H. Concrete-Encased Ducts: Support ducts on duct separators.
1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
 2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
 - a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
 - b. If more than one pour is necessary, terminate each pour in a vertical plane and install ¾-inch reinforcing rod dowels extending 18 inches into concrete on both sides of joint near corners of envelope.
 3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
 4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
 5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
 6. Minimum Space between Ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts.

7. Depth: Install top of duct bank at least 24 inches below finished grade in areas not subject to deliberate traffic, and at least 30 inches below finished grade in deliberate traffic paths for vehicles, unless otherwise indicated.
8. Stub-Ups: Use manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Extend concrete encasement throughout the length of the elbow.
9. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
 - b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.
10. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of the centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

I. Direct-Buried Duct Banks:

1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches between tiers.
3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Division 31 Section "Earth Moving" for pipes less than 6 inches in nominal diameter.
4. Install backfill as specified in Division 31 Section "Earth Moving."
5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final

duct connections at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."

6. Install ducts with a minimum of 3 inches between ducts for like services and 6 inches between power and signal ducts.
7. Depth: Install top of duct bank at least 36 inches below finished grade, unless otherwise indicated.
8. Set elevation of bottom of duct bank below the frost line.
9. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
10. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
 - b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
11. Warning Planks: Bury warning planks approximately 12 inches above direct-buried ducts and duct banks, placing them 24 inches o.c. Align planks along the width and along the centerline of duct bank. Provide an additional plank for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional planks 12 inches apart, horizontally.

3.5 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Cast-in-Place Manhole Installation:

1. Finish interior surfaces with a smooth-troweled finish.
2. Windows for Future Duct Connections: Form and pour concrete knockout panels 1-1/2 to 2 inches thick, arranged as indicated.
3. Cast-in-place concrete, formwork, and reinforcement are specified in Division 03 Section "Cast-in-Place Concrete."

B. Precast Concrete Handhole and Manhole Installation:

1. Comply with ASTM C 891, unless otherwise indicated.

2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
 3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevations:
1. Manhole Roof: Install with rooftop at least 15 inches below finished grade.
 2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch above finished grade.
 3. Install handholes with bottom below the frost line below grade.
 4. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch above finished grade.
 5. Where indicated, cast handhole cover frame integrally with handhole structure.
- D. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.
- E. Manhole Access: Circular opening in manhole roof; sized to match cover size.
1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
 2. Install chimney, constructed of precast concrete collars and rings to support frame and cover and to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.
- F. Waterproofing: Apply waterproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. Waterproofing materials and installation are specified in Division 07 Section "Elastomeric Sheet Waterproofing." After ducts have been connected and grouted, and before backfilling, waterproof joints and connections and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.
- G. Damp proofing: Apply damp proofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. Damp proofing materials and installation are specified in Division 07 Section "Bituminous Damp proofing." After ducts have been connected and grouted, and before backfilling,

dampproof joints and connections and touch up abrasions and scars. Dampproof exterior of manhole chimneys after mortar has cured at least three days.

- H. Hardware: Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.
- I. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.
- J. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches for manholes and 2 inches for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.
- K. Warning Sign: Install “Confined Space Hazard” warning sign on the inside surface of each manhole cover.

3.6 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from ½-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas and trafficways, set so cover surface will be flush with finished grade. Set covers of other handholes 1 inch above finished grade.
- D. Install handholes and boxes with bottom below the frost line below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.
- F. Field-cut openings for ducts and conduits according to enclosure manufacturer’s written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
- G. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.

1. Concrete: 3000 psi, 28-day strength, complying with Division 03 Section “Cast-in-Place Concrete,” with a troweled finish.
2. Dimensions: 10 inches wide by 12 inches deep.

3.7 GROUNDING

- A. Ground underground ducts and utility structures according to Division 26 Section “Grounding and Bonding for Electrical Systems.”

3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
 1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
 2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
 3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section “Grounding and Bonding for Electrical Systems.”
- B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.9 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- B. This Section includes the following:
 - 1. Identification for raceway and metal-clad cable.
 - 2. Identification for conductors and communication and control cable.
 - 3. Underground-line warning tape.
 - 4. Warning labels and signs.
 - 5. Instruction signs.
 - 6. Equipment identification labels.
 - 7. Miscellaneous identification products.

1.3 SUBMITTALS

- C. Product Data: For each electrical identification product indicated.
- D. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.
- E. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

1.4 QUALITY ASSURANCE

- F. Comply with ANSI A13.1 and ANSI C2.
- G. Comply with NFPA 70.
- H. Comply with 29 CFR 1910.145.

1.5 COORDINATION

- I. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- J. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- K. Coordinate installation of identifying devices with location of access panels and doors.
- L. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Color for Printed Legend:
 - 1. Power Circuits: Black letters on an orange field.
 - 2. Legend: Indicate system or service and voltage, if applicable.
- C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.

2.2 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

- G. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- H. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- I. Aluminum Wraparound Marker Labels: Cut from 0.014-inch- thick aluminum sheet, with stamped, embossed, or scribed legend, and fitted with tabs and matching slots for permanently securing around wire or cable jacket or around groups of conductors.
- J. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking nylon tie fastener.
- K. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.3 UNDERGROUND-LINE WARNING TAPE

- L. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.
 - 1. Not less than 6 inches wide by 4 mils thick.
 - 2. Compounded for permanent direct-burial service.
 - 3. Embedded continuous metallic strip or core.
 - 4. Printed legend shall indicate type of underground line.

2.4 WARNING LABELS AND SIGNS

- M. Comply with NFPA 70 and 29 CFR 1910.145.
- N. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
- O. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. ¼-inch grommets in corners for mounting. Nominal size, 7 by 10 inches.
- P. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inchgalvanized-steel

backing; and with colors, legend, and size required for application. ¼-inch grommets in corners for mounting. Nominal size, 10 by 14 inches.

- Q. Warning label and sign shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: “DANGER – ELECTRICAL SHOCK HAZARD – EQUIPMENT HAS MULTIPLE POWER SOURCES.”
 2. Workspace Clearance Warning: “WARNING – OSHA REGULATION – AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES.”

2.5 INSTRUCTION SIGNS

- R. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
1. Engraved legend with black letters on white face.
 2. Punched or drilled for mechanical fasteners.
 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.6 EQUIPMENT IDENTIFICATION LABELS

- S. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.
- T. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and ultraviolet-resistant seal for label.
- U. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.
- V. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.
- W. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

- X. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
1. Minimum Width: 3/16 inch.

2. Tensile Strength: 50 lb, minimum.
 3. Temperature Range: Minus 40 to plus 185 deg F.
 4. Color: Black, except where used for color-coding.
- Y. Paint: Paint materials and application requirements are specified in Division 09 painting Sections.
1. Exterior Concrete, Stucco, and Masonry (Other Than Concrete Unit Masonry):
 - a. Semigloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Exterior concrete and masonry primer.
 - 2) Finish Coats: Exterior semigloss acrylic enamel.
 2. Exterior Concrete Unit Masonry:
 - a. Semigloss Acrylic-Enamel Finish: Two finish coat(s) over a block filler.
 - 1) Block Filler: Concrete unit masonry block filler.
 - 2) Finish Coats: Exterior semigloss acrylic enamel.
 3. Exterior Ferrous Metal:
 - a. Semigloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Exterior ferrous-metal primer.
 - 2) Finish Coats: Exterior semigloss alkyd enamel.
 4. Exterior Zinc-Coated Metal (except Raceways):
 - a. Semigloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Exterior zinc-coated metal primer.
 - 2) Finish Coats: Exterior semigloss alkyd enamel.
 5. Interior Concrete and Masonry (Other Than Concrete Unit Masonry):
 - a. Semigloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Interior concrete and masonry primer.

- 2) Finish Coats: Interior semigloss alkyd enamel.
6. Interior Concrete Unit Masonry:
 - a. Semigloss Acrylic-Enamel Finish: Two finish coat(s) over a block filler.
 - 1) Block Filler: Concrete unit masonry block filler.
 - 2) Finish Coats: Interior semigloss acrylic enamel.
7. Interior Gypsum Board:
 - a. Semigloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Interior gypsum board primer.
 - 2) Finish Coats: Interior semigloss acrylic enamel.
8. Interior Ferrous Metal:
 - a. Semigloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Interior ferrous-metal primer.
 - 2) Finish Coats: Interior semigloss acrylic enamel.
9. Interior Zinc-Coated Metal (except Raceways):
 - a. Semigloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Interior zinc-coated metal primer.
 - 2) Finish Coats: Interior semigloss acrylic enamel.
- Z. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Raceways and Duct Banks More Than 600 V Concealed within Buildings: 4-inch- wide black stripes on 10-inch centers over orange background that extends full length of raceway or duct and is 12 inches wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- high black letters on

20-inch centers. Stop stripes at legends. Apply to the following finished surfaces:

1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
 2. Wall surfaces directly external to raceways concealed within wall.
 3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.
- B. Accessible Raceways and Metal-Clad Cables More Than 600 V: Identify with "DANGER-HIGH VOLTAGE" in black letters at least 2 inches high, with self-adhesive vinyl labels. Repeat legend at 10-foot maximum intervals.
- C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A: Identify with orange self-adhesive vinyl tape applied in bands.
- D. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands:
1. Fire Alarm System: Red.
 2. Fire-Suppression Supervisory and Control System: Red and yellow.
 3. Combined Fire Alarm and Security System: Red and blue.
 4. Security System: Blue and yellow.
 5. Mechanical and Electrical Supervisory System: Green and blue.
 6. Telecommunication System: Green and yellow.
 7. Control Wiring: Green and red.
- E. Power-Circuit Conductor Identification: For primary and secondary conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.
- F. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use color-coding conductor tape. Identify each ungrounded conductor according to source and circuit number.
- G. Conductors to Be Extended in the Future: Attach [write-on tags] [marker tape] to conductors and list source and circuit number.

- H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.

- I. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.

- J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
 - 1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
 - 2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.

- K. Instruction Signs:
 - 1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
 - 2. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer] [load shedding] <Insert emergency operations>.

- L. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting,

control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

- a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where 2 lines of text are required, use labels 2 inches high.
- b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
- c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

2. Equipment to Be Labeled:

- a. Panelboards, electrical cabinets, and enclosures.
- b. Access doors and panels for concealed electrical items.
- c. Electrical switchgear and switchboards.
- d. Transformers.
- e. Electrical substations.
- f. Emergency system boxes and enclosures.
- g. Motor-control centers.
- h. Disconnect switches.
- i. Enclosed circuit breakers.
- j. Motor starters.
- k. Push-button stations.
- l. Power transfer equipment.
- m. Contactors.
- n. Remote-controlled switches, dimmer modules, and control devices.
- o. Battery inverter units.
- p. Battery racks.

- q. Power-generating units.
- r. Voice and data cable terminal equipment.
- s. Master clock and program equipment.
- t. Intercommunication and call system master and staff stations.
- u. Television/audio components, racks, and controls.
- v. Fire-alarm control panel and annunciators.
- w. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
- x. Monitoring and control equipment.
- y. Uninterruptible power supply equipment.
- z. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.

3.2 INSTALLATION

- M. Verify identity of each item before installing identification products.
- N. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- O. Apply identification devices to surfaces that require finish after completing finish work.
- P. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- Q. Attach non adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- R. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- S. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.

1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 3. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- T. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- U. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
- V. Painted Identification: Prepare surface and apply paint according to Division 09 painting Sections.

END OF SECTION

SECTION 26 09 23
LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following lighting control devices:
 - 1. Time switches.
 - 2. Outdoor and indoor photoelectric switches.
 - 3. Indoor occupancy sensors.
 - 4. Lighting contactors.
 - 5. Emergency shunt relays.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
 - 1. Interconnection diagrams showing field-installed wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. 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.

1.6 COORDINATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Area Lighting Research, Inc.; Tyco Electronics.
 - 2. Grasslin Controls Corporation; a GE Industrial Systems Company.
 - 3. Intermatic, Inc.
 - 4. Leviton Mfg. Company Inc.
 - 5. Lightolier Controls; a Genlyte Company.
 - 6. Lithonia Lighting; Acuity Lighting Group, Inc.
 - 7. Paragon Electric Co.; Invensys Climate Controls.
 - 8. Square D; Schneider Electric.
 - 9. TORK.
 - 10. Touch-Plate, Inc.
 - 11. Watt Stopper (The).
 - 12. Or approved equal.
- B. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.
- C. Electromechanical-Dial Time Switches: Type complying with UL 917.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Area Lighting Research, Inc.; Tyco Electronics.
 2. Grasslin Controls Corporation; a GE Industrial Systems Company.
 3. Intermatic, Inc.
 4. Lithonia Lighting; Acuity Lighting Group, Inc.
 5. Novitas, Inc.
 6. Paragon Electric Co.; Invensys Climate Controls.
 7. Square D; Schneider Electric.
 8. TORK.
 9. Touch-Plate, Inc.
 10. Watt Stopper (The).
 11. Or approved equal.

2.3 INDOOR OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hubbell Lighting.
 2. Leviton Mfg. Company Inc.
 3. Lithonia Lighting; Acuity Lighting Group, Inc.
 4. Novitas, Inc.
 5. RAB Lighting, Inc.
 6. Sensor Switch, Inc.
 7. TORK.
 8. Watt Stopper (The).
 9. Or approved equal.

- B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.
1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
 3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, and Class 2 power source as defined by NFPA 70.
 4. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
 6. Bypass Switch: Override the on function in case of sensor failure.
 7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keep lighting off when selected lighting level is present.
- C. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.
1. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.
 2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
 3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot- high ceiling.
- D. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.

1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch- high ceiling.
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
 4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch- high ceiling.
 5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot- high ceiling in a corridor not wider than 14 feet.
- E. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
- F. Performance Requirements: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F, rated as raintight according to UL 773A.
1. Operation: Turn lights on when sensing infrared energy changes between background and moving body in area of coverage; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 2. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outdoor junction box.
 - b. Relay: Internally mounted in a standard weatherproof electrical enclosure.

- c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
- 3. Bypass Switch: Override the on function in case of sensor failure.
- 4. Automatic Light-Level Sensor: Adjustable from 1 to 20 fc; keep lighting off during daylight hours.
- G. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.
- H. Detection Coverage: Up to 35 feet, with a field of view of 90 degrees.
- I. Lighting Fixture Mounted Sensor: Suitable for switching 300 W of tungsten load at 120- or 277-V ac.
- J. Individually Mounted Sensor: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
 - 1. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, and Class 2 power source as defined by NFPA 70.
 - 2. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.

2.4 LIGHTING CONTACTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Allen-Bradley/Rockwell Automation.
 - 2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
 - 3. Eaton Electrical Inc.; Cutler-Hammer Products.
 - 4. GE Industrial Systems; Total Lighting Control.
 - 5. Grasslin Controls Corporation; a GE Industrial Systems Company.
 - 6. Hubbell Lighting.
 - 7. Lithonia Lighting; Acuity Lighting Group, Inc.
 - 8. MicroLite Lighting Control Systems.
 - 9. Square D; Schneider Electric.

10. TORK.
 11. Touch-Plate, Inc.
 12. Watt Stopper (The).
 13. Or approved equal.
- B. Description: Electrically operated and mechanically held, combination type with fusible switch, complying with NEMA ICS 2 and UL 508.
1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
 3. Enclosure: Comply with NEMA 250.
 4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

2.5 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

- A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

- A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 26 Section “Low-Voltage Electrical Power Conductors and Cables.” Minimum conduit size shall be ½ inch.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer’s written instructions.
- C. Size conductors according to lighting control device manufacturer’s written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section “Identification for Electrical Systems.”
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
 - 2. Operational Test: Verify operation of each lighting control device, and adjust time delays.
- B. Lighting control devices that fail tests and inspections are defective work.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied

conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.7 DEMONSTRATION

- A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control system specified in Division 26 Section "Network Lighting Controls."
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 26 2416

PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes distribution panelboards and lighting and appliance branch-circuit panelboards.

1.3 PERFORMANCE REQUIREMENTS

1. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
2. The term “withstand” means “the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event.”

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each panelboard and related equipment.
 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 3. Detail bus configuration, current, and voltage ratings.
 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 5. Include evidence of NRTL listing for series rating of installed devices.
 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

7. Include wiring diagrams for power, signal, and control wiring.
 8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.
- C. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section “Vibration and Seismic Controls for Electrical Systems.”
 - D. Field quality-control reports.
 - E. Panelboard schedules for installation in panelboards.
 - F. Operation and maintenance data.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA PB 1.
- C. Comply with NFPA 70.

1.6 WARRANTY

- A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section “Vibration and Seismic Controls for Electrical Systems.”
- B. Enclosures: Flush-mounted cabinets.
 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.

- b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 - 4. Directory Card: Inside panelboard door, mounted in transparent card holder.
- C. Incoming Mains Location: Top and bottom.
- D. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
- 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Main and Neutral Lugs: Mechanical type.
 - 3. Ground Lugs and Bus Configured Terminators: Mechanical type.
 - 4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 - 5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.
- G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- H. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, and listed and labeled for series-connected short-circuit rating by an NRTL.
- 1. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial – Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
 5. Or approved equal.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
- D. Mains: Circuit breaker.
1. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- E. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- F. Branch Overcurrent Protective Devices: Fused switches.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial – Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
 5. Or approved equal.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. External Control-Power Source: 120-V branch circuit.
- F. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- G. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements:
 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial – Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with series-connected rating to meet available fault currents.
 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
 - f. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
 - g. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handles in on position.
 - h. Handle Clamp: loose attachments, for holding circuit-breaker handle in on position.
- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
 1. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Division 26 Section "Fuses."

2.5 ACCESSORY COMPONENTS AND FEATURES

- A. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Receive, inspect, handle, store and install panelboards and accessories according to NECA 407.
- B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- C. Mount top of trim 90 inches above finished floor unless otherwise indicated.
 - 1. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- D. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- E. Install filler plates in unused spaces.
- F. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- G. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- H. Comply with NECA 1.

3.2 IDENTIFICATION

- I. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- J. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- K. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- L. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

- M. Perform tests and inspections.
- N. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- O. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- P. Panelboards will be considered defective if they do not pass tests and inspections.
- Q. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION

SECTION 26 2726

WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Receptacles with integral surge suppression units.
4. Wall-box motion sensors.
5. Isolated-ground receptacles.
6. Snap switches and wall-box dimmers.
7. Solid-state fan speed controls.
8. Wall-switch and exterior occupancy sensors.
9. Communications outlets.

- B. Related Sections include the following:

1. Division 27 Section "Communications Horizontal Cabling" for workstation outlets.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. 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.
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
 - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 - 3. Leviton Mfg. Company Inc. (Leviton).
 - 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).
 - 5. Or approved equal.

2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 5351 (single), 5352 (duplex).
 - b. Hubbell; HBL5351 (single), CR5352 (duplex).
 - c. Leviton; 5891 (single), 5352 (duplex).
 - d. Pass & Seymour; 5381 (single), 5352 (duplex).
- B. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; CR 5253IG.
 - b. Leviton; 5362-IG.
 - c. Pass & Seymour; IG6300.
 - 3. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.
- C. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; TR8300.

- b. Hubbell; HBL8300SG.
 - c. Leviton; 8300-SGG.
 - d. Pass & Seymour; 63H.
3. Description: Labeled to comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; GF20.
 - b. Pass & Seymour; 2084.

2.4 TWIST-LOCKING RECEPTACLES

- A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; L520R.
 - b. Hubbell; HBL2310.
 - c. Leviton; 2310.
 - d. Pass & Seymour; L520-R.
- B. Isolated-Ground, Single Convenience Receptacles, 125 V, 20 A:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; IG2310.
 - b. Leviton; 2310-IG.
3. Description: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.5 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A:
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
 - b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
 - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
 - d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).
- C. Key-Operated Switches, 120/277 V, 20 A:
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221L.
 - b. Hubbell; HBL1221L.
 - c. Leviton; 1221-2L.

- d. Pass & Seymour; PS20AC1-L.
- 3. Description: Single pole, with factory-supplied key in lieu of switch handle.
- D. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 1995.
 - b. Hubbell; HBL1557.
 - c. Leviton; 1257.
 - d. Pass & Seymour; 1251.
- E. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 1995L.
 - b. Hubbell; HBL1557L.
 - c. Leviton; 1257L.
 - d. Pass & Seymour; 1251L.

2.6 OCCUPANCY SENSORS

- A. Wall-Switch Sensors:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:

- a. Cooper; 6111 for 120 V, 6117 for 277 V.
 - b. Hubbell; WS1277.
 - c. Leviton; ODS 10-ID.
 - d. Pass & Seymour; WS3000.
 - e. Watt Stopper (The); WS-200.
3. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft.

B. Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; AT120 for 120 V, AT277 for 277 V.
 - b. Leviton; ODS 15-ID.
 - c. Wattstopper
 - d. Novitas Inc.
3. Description: Adaptive-technology type, 120/277 V, adjustable time delay up to 20 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft.

C. Long-Range Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATP1600WRP.
 - b. Leviton; ODWWV-IRW.
 - c. Watt Stopper (The); CX-100.
 - d. Novitas Inc.

3. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, with a minimum coverage area of 1200 sq. ft.

D. Long-Range Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATD1600WRP.
 - b. Leviton; ODW12-MRW.
 - c. Watt Stopper (The); DT-200.
 - d. Novitas Inc.
3. Description: Dual technology, with both passive-infrared- and ultrasonic-type sensing, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, and a minimum coverage area of 1200 sq. ft.

E. Wide-Range Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATP120HBRP.
 - b. Leviton; ODWHB-IRW.
 - c. Watt Stopper (The); CX-100-3.
 - d. Novitas Inc.
3. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 150-degree field of view, with a minimum coverage area of 1200 sq. ft.

2.7 COMMUNICATIONS OUTLETS

A. Telephone Outlet:

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

2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 3560-6.
 - b. Leviton; 40649.
3. Description: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e. Comply with UL 1863.

B. Combination TV and Power Outlet:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 3562.
 - b. Leviton; 40595.
3. Description: Single RJ-45 jack for 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e; and one Type F coaxial cable connector.

2.8 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Satin-finished stainless steel, 0.04-inch-thick.
3. Material for Unfinished Spaces: Galvanized steel, smooth, high-impact thermoplastic.
4. Material for Damp Locations: Thermoplastic and Cast aluminum with spring-loaded lift cover, and listed and labeled for use in “wet locations.”

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum and thermoplastic with lockable cover.

2.9 MULTIOUTLET ASSEMBLIES

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

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hubbell Incorporated; Wiring Device-Kellems.
 - 2. Wiremold Company (The).
- C. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- D. Raceway Material: Metal, with manufacturer's standard finish, PVC.
- E. Wire: No. 12 AWG.

2.10 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
 - 1. Wiring Devices Connected to Normal Power System: Gray, Ivory, White, As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.
 - 2. Isolated-Ground Receptacles: Orange.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
 - 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 - 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.

2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, $\frac{2}{3}$ to $\frac{3}{4}$ of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the left.

- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

- A. Comply with Division 26 Section "Identification for Electrical Systems."
 - 1. Receptacles: Identify panelboard and circuit number from which served. Engraved with panelboard name and circuit number.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
 - 2. Test Instruments: Use instruments that comply with UL 1436.
 - 3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
- B. Tests for Convenience Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION

SECTION 26 2813

FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 1.2 SUMMARY

- A. Section Includes:

1. Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed switches panelboards, switchboards, enclosed controllers and motor-control centers.
2. Plug fuses rated 125-V ac and less for use in plug-fuse-type enclosed switches, fuseholders and panelboards.
3. Plug-fuse adapters for use in Edison-base, plug-fuse sockets.
4. Spare-fuse cabinets.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.

3. Current-limitation curves for fuses with current-limiting characteristics.
 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit on translucent log-log graph paper.
 5. Coordination charts and tables and related data.
- B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Ambient temperature adjustment information.
 2. Current-limitation curves for fuses with current-limiting characteristics.
 3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit on translucent log-log graph paper.
 4. Coordination charts and tables and related data.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Comply with UL 248-11 for plug fuses.

1.5 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Cooper Bussmann, Inc.
 - 2. Edison Fuse, Inc.
 - 3. Ferraz Shawmut, Inc.
 - 4. Littelfuse, Inc.
 - 5. Or approved equal.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.3 PLUG FUSES

- A. Characteristics: UL 248-11, nonrenewable plug fuses; 125-V ac.

2.4 PLUG-FUSE ADAPTERS

- A. Characteristics: Adapters for using Type S, rejection-base plug fuses in Edison-base fuseholders or sockets; ampere ratings matching fuse ratings; irremovable once installed.

2.5 SPARE-FUSE CABINET

- A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
 - 1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
 - 2. Finish: Gray, baked enamel.
 - 3. Identification: "SPARE FUSES" in 1-1/2-inch- high letters on exterior of door.
 - 4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
 - 1. Service Entrance: Class L, fast acting Class L, time delay Class RK1, fast acting Class RK1, time delay Class J, fast acting Class J, time delay Class T, fast acting.
 - 2. Feeders: Class L, fast acting Class L, time delay Class RK1, fast acting Class RK1, time delay Class RK5, fast acting Class RK5, time delay Class J, fast acting Class J, time delay.
 - 3. Motor Branch Circuits: Class RK1 Class RK5, time delay.

4. Other Branch Circuits: Class RK1, time delay Class RK5, time delay Class J, fast acting Class J, time delay.
5. Control Circuits: Class CC, fast acting time delay.

B. Plug Fuses:

1. Motor Branch Circuits: Edison-base type, dual Edison-base type, single Type S, dual Type S, single-element time delay.
2. Other Branch Circuits: Edison-base type, single-element fast acting Edison-base type, dual-element time delay Edison-base type, single-element time delay Type S, dual-element time delay Type S, single-element time delay.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install plug-fuse adapters in Edison-base fuseholders and sockets. Ensure that adapters are irremovable once installed.
- C. Install spare-fuse cabinet(s).

3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION

SECTION 26 2816

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Receptacle switches.
 - 4. Shunt trip switches.
 - 5. Molded-case circuit breakers (MCCBs).
 - 6. Molded-case switches.
 - 7. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term “withstand” means “the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event.”

1.5 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Include evidence of NRTL listing for series rating of installed devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
 - 6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Qualification Data: For qualified testing agency.
- D. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Field quality-control reports.
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- F. Manufacturer's field service report.

- G. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - 2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NFPA 70.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 6600 feet.
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Architect no fewer than seven days in advance of proposed interruption of electric service.

2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Architect's written permission.
4. Comply with NFPA 70E.

1.8 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 2. Fuse Pullers: Two for each size and type.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements:
 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial – Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
 5. Or approved equal.
- B. Type GD, General Duty, Single Throw, 240-V ac, 800 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with cartridge fuse interiors to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Single Throw, 240-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

- D. Type HD, Heavy Duty, Six Pole, Single Throw, 240-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- E. Type HD, Heavy Duty, Double Throw, 240-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- F. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 - 5. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
 - 6. Hookstick Handle: Allows use of a hookstick to operate the handle.
 - 7. Lugs: Mechanical type, suitable for number, size, and conductor material.
 - 8. Service-Rated Switches: Labeled for use as service equipment.
 - 9. Accessory Control Power Voltage: Remote mounted and powered; 24-V ac 120-V ac.

2.2 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial – Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
 - 5. Or approved equal.

- B. Type GD, General Duty, Single Throw, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Single Throw, 240-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Type HD, Heavy Duty, Six Pole, Single Throw, 240-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- E. Type HD, Heavy Duty, Double Throw, 240-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- F. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 4. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
 - 5. Hookstick Handle: Allows use of a hookstick to operate the handle.
 - 6. Lugs: Mechanical type, suitable for number, size, and conductor material.
 - 7. Accessory Control Power Voltage: Remote mounted and powered; 24-V ac 120-V ac.

2.3 RECEPTACLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial – Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.

5. Or approved equal.
- B. Type HD, Heavy-Duty, Single-Throw Fusible Switch: 240-V ac, 30 A; UL 98 and NEMA KS 1; horsepower rated, with clips or bolt pads to accommodate specified fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
 - C. Type HD, Heavy-Duty, Single-Throw Non fusible Switch: 240 V ac, 30 A; UL 98 and NEMA KS 1; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
 - D. Interlocking Linkage: Provided between the receptacle and switch mechanism to prevent inserting or removing plug while switch is in the on position, inserting any plug other than specified and turning switch on if an incorrect plug is inserted or correct plug has not been fully inserted into the receptacle.
 - E. Receptacle: Polarized, three-phase, four-wire receptacle (fourth wire connected to enclosure ground lug).
 - F. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-Ka interrupting and short-circuit current rating when fitted with Class J fuses.
 - G. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
 - H. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.
 - I. Accessories:
 - 1. Oiltight key switch for key-to-test function.
 - 2. Oiltight green ON pilot light.
 - 3. Isolated neutral lug; 200 percent rating.
 - 4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
 - 5. Form C alarm contacts that change state when switch is tripped.
 - 6. Three-pole, double-throw, fire-safety and alarm relay; 120-V ac coil voltage.
 - 7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

2.4 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial – Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
 - 5. Or approved equal.
- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 - 1. Instantaneous trip.
 - 2. Long- and short-time pickup levels.
 - 3. Long- and short-time time adjustments.
 - 4. Ground-fault pickup level, time delay, and I^2t response.
- F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- G. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
- H. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- I. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- J. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system, specified in Division 26 Section "Electrical Power Monitoring and Control."
6. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
7. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
8. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
9. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.
10. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
11. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
12. Electrical Operator: Provide remote control for on, off, and reset operations.
13. Accessory Control Power Voltage: Integrally mounted, self-powered.

2.5 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
6. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- C. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- D. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- F. Install fuses in fusible devices.
- G. Comply with NECA 1.

3.3 IDENTIFICATION

- H. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

- I. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- J. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- K. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- L. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- M. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

- N. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- O. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- P. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- Q. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study".

END OF SECTION

SECTION 26 50 00

LIGHTING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 GENERAL INFORMATION AND DESIGN REQUIREMENTS

- A. The designs for lighting is to incorporate the most aggressive energy efficient technologies available and be installed in accordance with the State of California Title 24 energy regulation and to reduce the carbon footprints. This include reducing the electrical energy loads from the lighting – therefore innovative technologies was considered, while simultaneously be cognizant of the long term maintenance cost.
- B. Identify any or all rebate opportunities and work with the school district to apply for them in a timely and thorough manner.

1.3 SCOPE

- A. Work Included:

All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the drawings and/or specified herein. Work includes, but is not necessarily limited to the following:

1. Examine all other specification sections and drawings for related work required to be included as work under Division Sixteen.
2. General provisions and requirements for electrical work.

1.4 SUBMITTALS (ADDITIONAL REQUIREMENTS)

- A. General

1. Submit certification letter from manufacturers of Lamps and Ballasts, stating the specific lamp and ballast combination comply with manufacturer recommendation and approval for the combined use, shown on the drawings.
2. Provide complete manufacturers catalog data information for each light fixture (luminaire), ballast, LED drivers, LED lamp, materials, auxiliary equipment/devices, finishes and photometrics.

B. Performance Certification

1. Submit manufacturer's certified LED light-emitting diode source and LED or 0-10V LED dim driver tests report data showing compliance with contract document.
2. Submit manufacturer's letter of certification for each fixture type, confirming the proposed combination of specific LED light-emitting diode source, LED driver or 0-10V LED dim drivers and auxiliary components for each light fixture (luminaire) type will function together correctly and perform in compliance with the requirements of the contract documents as follows:

"The proposed LED(s), LED or LED 0-10V dim driver(s) (where, applicable), and fixture have been tested as an assembly. The proposed fixture products assembly are certified by the manufacturer to function within the required color kelvin temperature, lumen output, electrical characteristics and operational life described in the contract documents".

C. Light Fixture Samples

1. If requested by the OWNER'S Representative, provide a sample of each fixture proposed as a substitution for a specified fixture. Sample fixture shall be complete with specified lamps, 3 wire grounding "SO" cord and plug for 120-volt 60 Hz, AC plug-in operation. Sample fixtures shall be delivered to the OWNER'S Representative's office for review, the samples shall be picked up within ten (10) working days after review comments have been received; any samples left beyond this time will be discarded by the OWNER'S Representative. Decision of OWNER'S Representative regarding acceptability of any lighting fixture is final.

1.5 QUALITY ASSURANCE (ADDITIONAL REQUIREMENTS)

- A. Work and materials shall be in full accordance with the latest rules and regulations as follows. The following publications shall be included in the Contract Document requirements. If a conflict occurs between the following publications and any other part of the Contract Documents, the requirements describing the more restrictive provisions shall become the applicable contract definition:

1. U.L. – Underwriters' Laboratory
 - a. U.L. – 8750: LED Lighting Fixtures
2. NEMA-LE4
3. United States Federal Government
 - a. FCC – Part 18: EMI and RFI emissions limitations.
 - b. EPA: Energy conservation publications and waste disposal regulations.

4. Electrical installation standards, National Electrical Contractors' Association:
 - a. NEIS/NECA Recommended Practice for
& IESNA – 500: Installing Indoor Commercial Lighting Systems.
 - b. NEIS/NECA Recommended Practice for
& IESNA – 501: Installing Exterior Lighting Systems.
 - c. NEIS/NECA Recommended Practice for
& IESNA – 502: Installing Industrial Lighting Systems.

6. Illuminating Engineering Society – IES:
 - a. IES – LM41: Photometric and Reporting
 - b. IES – 587: Transient Surge Protection

7. American National Standards Institute:
 - a. ANSI – C81
 - b. ANSI – C82
 - c. ANSI – C62.41: Transient Withstand
 - d. ANSI – C78: Lamps

8. State California
Code of Regulations
Title-24: Energy Code

PART 2 - PRODUCTS

2.1 GENERAL

A. Complete Fixture

1. Provide light fixtures complete including LED light-emitting diode(s), 0-10V dimmable led driver, LED chipset board, housings, ceiling and wall trim "rings" for each ceiling type, mounting and adapter support brackets, diffusers/lenses and outlet boxes.
2. Include an allowance of \$300.00 to provide a light fixture for each lighting fixture outlet shown on drawings without a fixture type designation.

B. Specific Fixture Requirements and Fixture Schedule Information

1. The catalog numbers included in the description of the various types of lighting fixtures shall be considered to establish the type or class of the fixture with a particular manufacturer only. The fixture length, number of lamps and lamp types, component materials, accessories, mounting type, ceiling, wall and install adapters, operation voltage, and all other components required to fulfill the total description of the fixture based on all drawing information, branch circuits, voltages, specification information, and shall be included in the contract requirements regardless of whether or not the catalog number specifically includes these components.
2. Lighting fixtures shall be the types as indicated in fixture schedule on the drawings and as described in the specifications.
3. All fixtures of the same fixture type shall be the same manufacturer and of identical finish and appearance, unless indicated otherwise on drawings.

C. Manufacturer Certification of Operation

1. LED light-emitting diode(s) source and 0-10V dimming driver shall be recommended and certified by the respective manufacturer(s), to be "matched" to operate correctly together, within the published characteristics, for efficacy, CRT color kelvin, operating life hours, lumen output, power factor, power input, operating line ampere, sound intensity, and temperature.

E. Emergency Lighting

1. Light fixtures shown connected to both normal power and external emergency power branch circuits, shall be furnished with separate lamp ballasts for the normal and emergency power circuits.
2. The ballast(s) for the lamps connected to the external emergency branch circuit shall be in a separate wireway isolated and barriered from the ballast(s) for the lamps connected to the normal power branch circuits. The fixture shall be factory labeled "emergency" and "normal" on the respective wireways and ballasts.

2.2 LAMPS

A. General

1. LED light-emitting diode(s) source shall be new, of wattage and type indicated. Each fixture or lighting outlet shall be supplied with the proper LED source(s)
2. LED light-emitting diode source shall comply with the characteristics as described by the lighting manufacturer, except where indicated otherwise on the drawings.

2.3 LIGHT FIXTURES (LUMINAIRES)

A. General

1. Lighting fixtures shall have all parts, LED light-emitting diode(s) source, 0-10V dimming driver, support attachments, trim flanges and fittings necessary to complete and properly install the fixture at the indicated installation locations. All fixtures shall be provided with LED light-emitting diode(s) source and 0-10V dimming driver type specified by the lighting manufacturer, except where indicated otherwise on the drawings.
2. Ceiling and/or wall surface mounted lighting fixtures shall not have any exposed chase nipples or conduit knockouts visible to view within fixture housing. lighting fixtures mounted in continuous rows shall have chase nipples or conduit knockouts between lighting fixture housing but shall not have visible chase nipples/conduit knockouts on the visible ends of the continuous row of lighting fixtures.
3. Where fixture color is indicated to be selected by the ARCHITECT and/or OWNER'S Representative, provide two color chip samples for each color for review.
4. Recessed fixtures with attached junction box shall be provided with a junction box permanently attached to the plaster ring so that the junction box is accessible through the fixture opening when the fixture is removed. Connection between fixture and pull box shall be flexible metal conduit with not less than 16 AWG "AF" or "CF" type fixture rated copper wires, high temperature wire insulation for not less than 600 volts A.C. The flexible conduit shall be sufficient length, so that when the fixture is removed, the pullbox is readily accessible.
5. Recessed fixtures shall be Underwriters' Laboratory approved for recessed installation with plaster frame and attached pull box. Lamp enclosure, reflectors and finish wiring shall not be installed until plastering is completed. Exposed finish trim shall not be installed until finish painting of the adjacent surface is completed.
6. The fixture shall bear Underwriters' Laboratory label of approval for the wattage and installation indicated.
7. Light fixtures installed outdoors, in damp or wet locations shall be U.L. labeled for said location as "damp-location" and "wet-location" for the respective installation location.
8. Fixtures in contact with thermal/building insulation, shall be UL listed and
9. Lighting fixtures installed in masonry and/or concrete construction. The fixture housing shall be rated for "concrete-pour" installation location.
10. Provide a permanent label inside light fixture stating the following relamping information. Not less than 0.125-inch high black alphanumeric characters on white background.

B. Lens and Diffusers

1. Acrylic plastic or Plexiglas for the light fixture diffusers or fixtures lenses, shall be 100-percent virgin material.
2. Thickness of not less than 0.125-inch, as measured at the "THINIST" portion on the diffuser or lens. However, thickness shall be increased to sufficient construction and camber to prevent the lens and diffusers from having any noticeable sag over the entire normal life of the installation.
3. Diffusers shall be formed from cast sheet by a vacuum and/or pressure technique.
4. Lighting fixtures containing lamps with Dichroic reflectors and light fixtures with non-Dichroic lens/diffuser, shall be rated for high temperature lamp operations resulting from lamp heat redirected (reflected) back into the fixture.

C. Fixture/Luminaire Internal Wiring

1. Provide wiring between fluorescent LED style lamp holders and associated operating and starting equipment. Provide ballasts/transformers inside lighting fixture.
2. Where there are two or more fluorescent LED style lamps in a single luminaire, and multiple level intensity control is indicated on specifications or drawings, 0-10V dimmable driver shall be used.

G. Emergency Ballast Lighting

1. General

- a. LED Self-contained emergency back-up containing batteries, battery charger, solid-state electronic control and lamp/ballast operation, contained within a metal case, red finish case color.
- b. UL – 924, listed Emergency Lighting and Power Equipment, for installation inside and/or attached to lighting fixtures.
- c. The emergency ballast unit(s) shall be provided inside each respective emergency light fixture by the fixture manufacturer.
- d. Normal operating temperature range from 0-degrees Centigrade up to operating ambient temperature inside respective lighting fixture, but not less than 50-degrees Centigrade.
- e. Provide a permanent label inside each emergency light fixture stating as follows, not less than 0.125-inch high black alphanumeric characters on a white background:

"Warning – this fixture provides more than one electric power source. Disconnect both normal and emergency sources including battery sources prior to opening fixture. Written permanent records documenting regular (every 30 days) emergency lighting function testing results shall be kept on file by the OWNER."

f. As manufactured by Bodine Inc.; or IOTA-Engineering.

2. Operation

a. Emergency Mode

When external AC electrical power fails, the emergency ballast shall immediately and automatically switch to emergency mode. Maintain emergency lamp(s) illumination, while operating from the internal battery/electronics during the power failure for not less than 90-minutes continuous duration.

b. Normal Mode

When AC electrical power is restored, automatically switch lamp(s) operation to external AC operation and begin battery charging mode.

c. Battery Recharge Mode

The battery charger shall automatically fully recharge discharged batteries in less than 24-hours, and prevent overcharging of the batteries, while maintaining a "float-charge" on the batteries.

d. The emergency back-up unit shall operate LED light-emitting diode(s) source in the lamp light fixtures. When operating in emergency mode, the LED lumen output of each lamp shall be not less than 30-percent of the lamp normal full lumen output rating of one lamp. The lamp-lumen output shall be 100-percent of the lamp normal full lumen output rating when operating in normal mode.

e. Periodic automatic, internal self-test, simulating normal power loss and actual operation of emergency lamps on internal battery power. Auto self-test shall occur not more than 30 day intervals. Audible and visual trouble alarm display, with manual alarm reset/silence, for problems identified by auto test functions.

3. Electrical Characteristics

a. Emergency ballast shall operate on the same input AC voltage as the normally "hot" branch circuit supplying the respective light fixture. Maximum line input load shall not exceed 15-percent more than normal fixture electrical load.

b. The emergency back-up unit shall be compatible for correct operation with the specific lamp/ballast combination contained in the respective light fixture.

- c. The emergency back-up unit shall be compatible with switched (on-off), non-switched (continuously on) and dimmer controlled lighting fixtures/circuits.

4. Components

- a. Sealed nickel cadmium batteries, maintenance-free, rated for continuous operation in high ambient temperature, with 7-10 year operational life expectancy.
- b. When standing on the floor below the fixture the emergency ballast test/monitor control panel shall be visible and readily accessible when the fixture is installed. The control panel shall provide:
 - 1 Charging indicator visual annunciator to display the charger and battery status.
 - 2 Momentary test switch/pushbutton to manually simulate power failure test.

PART 3 EXECUTION

3.1 LIGHT FIXTURE INSTALLATION

A. General

- 1. The CONTRACTOR shall verify actual ceiling and wall construction types as defined on the Architectural drawings and furnish all lighting fixtures with the correct mounting devices, trim rings, brackets whether or not such variations are indicated by fixture catalog number. The CONTRACTOR shall verify depth of all recessed lighting fixtures with Architectural drawings prior to ordering fixtures. Any discrepancies that would cause recessed lighting fixtures not to fit into ceiling shall be reported to the OWNER'S Representative prior to release of order to the supplier of the fixtures.
- 2. On acoustical tile ceilings, fixture outlets shall be accurately located in the center, at the intersection of the four corners or at the center of the joints of two tiles.
- 3. The CONTRACTOR shall aim the exterior adjustable lighting fixtures after dark in the presence of, and at a time convenient to the OWNER'S Representative.
- 4. Fixtures shall be ordered and furnished to operate correctly on the branch circuit voltage connected to the respective fixture as shown on the site plan and floor plan electrical drawings. The voltages shown on the fixture schedule are for generic fixture information only.

5. Install and connect lighting fixtures to the circuits and control sequences indicated on the drawings and to comply with respective manufacturer's instructions/recommendations.
- B. Lighting fixtures installed in ceiling support grids - suspended lay-in "T-bar" and concealed spline ceilings.
1. Provide two seismic clips at opposite ends of each recessed light fixture, the clip shall connect to the ceiling grid main runners and the light fixture. The light fixture with seismic clips and ceiling grid runner connections shall resist a horizontal seismic force equal to the total weight of the light fixture assembly.
 2. Each light fixture weighing 40 pounds or less and where the respective ceiling grid system is "heavy duty" type, shall be suspended directly from the ceiling grid or shall be suspended independent of the ceiling grid support system as approved by the AHJ. Each light fixture weighing more than 40 pounds or where the ceiling grid system is not a "heavy duty" type, shall be supported independent of the ceiling grid and independent of ceiling grid support system.
 3. Each light fixture supported independent of the ceiling grid system shall be supported with a minimum of four taut independent support wires, one wire at each fixture corner.
 4. Each light fixture supported directly from the ceiling grid or ceiling grid support system shall be additionally connected with a minimum of two independent slack safety support wires. One wire at each opposite diagonal fixture corner. Each 3 ft. x 3 ft. and larger light fixture shall be supported in the same manner, except provide a minimum of four independent slack safety wires, one at each fixture corner.
 5. Light fixtures surface mounted to a suspended ceiling shall be installed with a one and one-half inch steel – "C" channel which spans across and above a minimum of two parallel main ceiling grid "runners" and concealed above the ceiling. Each channel or angle member shall be provided with a minimum of two threaded studs for attaching to the fixture housing through the lay-in ceiling tile. Two steel "C" channel members shall be installed for each four-foot (or smaller) fixture. Install the channels within six inches of each end of the light fixture to span a minimum of two ceiling grid parallel main runners. Provide two seismic clips connecting the ceiling grid main runners to each steel – "C" channel. Provide a not less than two (2) taut independent support wires connecting to each channel. Bolt the light fixtures to the threaded studs on the channels or angles, to support the light fixture tight to the ceiling surface.

C. Fixture Supports

1. The support wires for light fixture support shall be 12-gauge steel (minimum). The wires including their building and light fixture attachments shall provide support capacity of not less than four times the weight of the light fixture assembly. Provide additional light fixture support wires and building anchors to meet these requirements, as part of

the contract. The support wires shall be anchored to the building structural elements above the ceiling.

2. Suspended fixtures weighing in excess of 40 pounds shall be supported independently of the fixture outlet box. Provide "air craft" (minimum 12 gauge) steel hanger cable for suspended fixtures route cable concealed or in pendant where possible. Each cable attachments shall support four times the weight of the fixture assembly. Securely attach the cable to the building structure.
3. Surface mounted fixtures installed on drywall or plaster ceilings and weighing less than 40 pounds may be supported from outlet box. Provide structural supports above drywall or plaster ceilings for installation of fixtures weighing more than 40 pounds and secure fixture to structural supports. The use of toggle bolts is prohibited.

D. Recessed Lighting Fixtures - Fire Rated Building Surfaces

1. Lighting fixtures recessed in ceiling or wall which has a fire resistive rating of 1 hour or more shall be enclosed in a fully enclosed backbox (except over fixture lens/diffuser). The material used to fabricate the "enclosed backbox" shall have a fire rating equal to that of the respective ceiling or wall.
2. The space from the fixture to the box enclosure shall be a minimum of 3-inches.
3. The backbox shall be concealed behind the fire rated ceiling and wall finish surface. The light fixture shall be provided with lamp ballast rated for (normal light output) operation in a "high" ambient temperature.

3.2 LED light-emitting diode(s) source, 0-10V dimming driver

- A. LED light-emitting diode(s) source, 0-10V dimming driver controlled by dimming equipment shall be operated (aged) for 100 continuous hours without interruption, at 100-percent full lumen output prior to occupancy of the building by the OWNER.
- B. LED light-emitting diode(s) source, 0-10V dimming driver shall be the type and manufacturer as recommended by the dimming system or low voltage controls manufacturer.

3.3 LENS

- A. Lens, diffusers, internal reflectors shall be completely cleaned of all dust, dirt and fingerprints after the installation of the light fixtures and lamps, and after all trades have completed work and prior to occupancy of the facility by the OWNER.

3.4 COMMISSIONING LIGHTING FIXTURES (ADDITIONAL REQUIREMENTS)

- A. General
1. Verify correct lighting control configurations and operation in each room.
 2. Simulate normal source power failure by "opening" (turn off) building main service disconnect and verify connections and operation of each emergency lighting fixture.
 3. Confirm "EXIT" sign directional arrows are visible in each "EXIT" sign.
 4. Verify light fixture support-hangers, ceiling grid clips and seismic restraints comply with the Contract Documents.
 5. Remove protective shipping/installation shields on fixtures. Verify fixtures and lamps are clean and free of construction debris. Clean light fixtures found to be contaminated or dirty.
 6. Setup, program and function test lighting control systems to perform each of the indicated control functions, area/room zones and sequences.
- B. Sample spot-check in each room the following lighting fixture information:
1. Lamp type and performance data.

END OF SECTION

SECTION 26 5100

INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior solid-state luminaires that use LED technology.
 - 2. Emergency lighting units.
 - 3. Exit signs.
 - 4. Luminaires supports.

1.3 SYSTEM DESCRIPTION

- A. Catalog numbers indicated in the Luminaire Schedule are a design series reference and do not necessarily represent the exact catalog number, size, voltage, wattage, type of light bar, driver, finish trim, ceiling type, mounting hardware or special requirements as specified or as required by the installations. Provide complete luminaire to correspond with the features, accessories, number of LED's, wattage and/or size specified in the text description of each luminaire type. Additional features, accessories and options specified shall be included.
- B. Provide all frames, supplementary support structures, hangers, spacers, stems, aligner canopies, auxiliary junction boxes and other hardware as required for a complete and proper installation. Recessed luminaires shall have frames that are compatible with the ceiling systems.
- C. Luminaires voltage shall match the voltage of the circuit serving same.

1.4 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color-rendering index.
- C. IP: International Protection or Ingress Protection Rating.
- D. LED: Light-emitting diode.

- E. LER: Luminaire efficacy rating.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting fixture, including lamp, reflector, and housing.

1.5 SUBMITTALS

- A. Product Data: For each type of luminaire, arranged in order of luminaire designation. Include data on features, accessories, finishes, and the following:
 - 1. Material and physical description of luminaire including dimensions.
 - 2. Emergency lighting units including battery and charger.
 - 3. Energy-efficiency data.
 - 4. Life, output (lumens, CCT, and CRI), Kelvin temperature, and energy-efficiency data or LED light bars.
 - 5. Photometric data and adjustment factors based on laboratory test, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each luminaire type. The adjustment factors shall be for light bar, drivers, and accessories identical to those indicated for the luminaires as applied in this Project.
 - a. Testing Agency Certified Data: For indicated luminaires, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer. LM-79 and LM-80 data for solid state lighting.
 - b. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 - 6. Photometric data, certified by a qualified independent testing agency, in IESNA format, based on certified results of laboratory tests of each luminaire type, outfitted with light bars, drivers and accessories identical to those indicated for the luminaire as applied in the Project.
 - 7. Low Voltage transformers.
 - 8. LED power supplies.

9. Types of LED's, including manufacturer, wattage, and Color Rendering Index (CRI) and color temperatures in degrees Kelvin (K).
- B. Shop Drawings shall:
1. Show detail of nonstandard or custom luminaires.
 2. Indicate dimensions, weights, method of field assembly, components, features and accessories.
 3. For custom luminaires, modified luminaires or linear luminaires mounted in continuous rows, submit scaled drawings prepared by the manufacturer showing all details of constructions, lengths in runs, pendant or power feed locations, accessories, finishes and lists of materials.
 4. This Contractor shall provide the manufacturer with accurate field dimensions where required.
 5. Include wiring diagrams, power, and control wiring.
- C. Wiring diagrams shall detail wiring for luminaires and differentiate between manufacturer installed and field installed wiring.
- D. Product Certificates shall be signed by manufacturers of luminaires certifying that products comply with requirements.
- E. Dimming Driver Compatibility Certificates shall be signed by the manufacturer of driver certifying that drives are compatible with dimming systems and equipment with which they are used. Product Certificates signed by product manufacturer shall be provided for each type of driver for dimmer controlled luminaires.
- F. Maintenance Data shall be provided for luminaires and equipment to included in emergency, operation and maintenance manuals specified in specifications section describing Operations and Maintenance Data.
- G. Field quality control test reports.
- H. Special Warranties specified in the Section.
- I. Review of luminaire submittals which indicate voltage, mounting condition, or quantities shall not be approval of said voltage, mounting condition or quantities. This Contractor shall field verify voltage and actual mounting condition and method.

- J. Product samples complete with housing, trim, specified lumen package, and 8' cord with plug for 120V shall be submitted if requested.

1.6 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lighting equipment and luminaires to include in emergency, operation, and maintenance manuals.
 - 1. Provide a list of all arrays and drivers types used on project: use ANSI and manufacturer's codes.

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Glass, Plastic Diffusers and Lenses: 10% or one dozen (whichever is less) of each type and rating installed. Furnish at least one of each type.
 - 2. Globes and Guards: 5% of each type and rating installed. Furnish at least one of each type.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver luminaires individually wrapped in factory fabricated fiberboard type containers.
- B. Handle luminaires carefully to prevent breakage, denting and scouring of the luminaire finish.
- C. Store product in a clean, dry space, protected from weather.

1.9 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provide by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to the Authorities Having Jurisdiction and marked for intended use.
- C. For Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. Comply with NFPA 70.
- E. Designated manufacturers are listed to define the requirements for quality and function of the specified product.

1.10 COORDINATION

- A. Coordinate layout and installation of luminaires with ceiling system and other construction that penetrates ceilings or is supported by them including mechanical system, fire suppression, and technology and partition assemblies.
- B. Provide all frames, supplementary support structures, hangers, spacers, stems, aligner canopies, auxiliary junction boxes and other hardware as required for a complete and proper installation.
- C. Recessed luminaires shall have frames that are compatible with the ceiling system indicated on the Architectural Drawings.
- D. Coordination Meeting: This Contractor shall meet at least twice with the ceiling installer. Hold first meeting before submittal of shop drawings to coordinate each luminaire mounting condition with ceiling type. During second meeting, coordinate luminaire layout in each area. This Contractor shall meet at least twice with the mechanical systems installer prior to fabrication and installation of ductwork. Coordinate depth and location of all luminaires with ductwork, fire suppression, and technology in all areas.

1.11 WARRANTY

- A. Comply with Division 1 requirements.
- B. General Warranty: Special warranty specified in this Section shall not deprive the School District of other Rights the School District may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by this Contractor under requirements of the Contract Documents.
- C. Special Warranty for LED's and Drivers: Manufacturers standard form in which manufacturer of LED's and drivers agrees to replace components that fails in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products as listed in the Lighting Fixture Schedule or comparable products approved in writing by the School District.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES AND COMPONENTS

- A. Luminaires: Comply with UL 1598
- B. Metal Parts: Free of burrs, sharp corners, and edges. Metal work shall be free of tool marks and dents and shall have accurate angels bent as sharply as compatible

with the gauges of the required metal. Intersections and joints shall be formed true and of adequate strength and structural rigidity to prevent any distortion after assembly. All miters shall be in accurate alignment with abutting intersection members.

- C. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging. Luminaires to be painted after fabrication. Finish ferrous mounting hardware and accessories to prevent corrosion and discoloration to adjacent materials.
- D. Luminaire hardware to comply with the following material standards: For steel and aluminum luminaires, all screws, bolts, nuts, and other fastening and latching hardware shall be cadmium or equivalent plated. For stainless steel luminaires, all hardware shall be stainless steel.
- E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakages under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Safety device shall be detachable if necessary and shall not interfere with luminaire performance, maintenance, or the seating of any luminaire element. Safety device shall not be visible during normal luminaire operation and from normal viewing angles.
- F. Luminaires provided shall have means for disconnection from power source during service, as required in NEC Article 410.
- G. Reflecting Surfaces: Minimum reflectance as follows, unless indicated otherwise:
 - 1. White Surfaces: 85%
 - 2. Specular Surfaces: 90%
 - 3. Diffusing Specular Surfaces: 75%
- H. Reflector cones shall adhere to the following:
 - 1. Cones shall provide a minimum of 50 degree cutoff to source and source image.
 - 2. Plastic material shall not be used for reflector cones.
 - 3. Cones shall not be permanently fastened to the housing and shall be removable without tools. Retention devices shall not deform the cone or be visible from normal viewing angles.
 - 4. Trim shall be flush to ceiling without gaps or light leaks. Where the flange trim is separate from the cone, it shall have the same finish as the reflector cone.
 - 5. Reflector cones shall be uniform gauge, not less than 0.032" thick, high purity aluminum Alcoa 3002 alloy. Cones shall be free from spin marks or other defects.

6. Manufacture cones using the Alzak process. Refer to Luminaire Schedule for cone color and finish, i.e., specular, or diffuse requirements.
- I. Lenses, Covers, Diffusers and Globes:
 1. Acrylic Lighting Diffusers: 100% virgin acrylic plastic. UV stabilized high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
 - b. Lenses shall have uniform brightness throughout the entire visible area without LED pixilation.
 2. Glass Globes: Annealed crustal glass unless otherwise indicated.
 - J. Adjustable luminaires shall have positive locking devices to fix aiming angle. Luminaires shall be capable of being relamped without adjusting aiming angle.
 - K. Each luminaire that has any array with a beam pattern or a spread lens that defines beam orientation shall contain locking devices to insure the orientation is not disturbed during array replacement or cleaning.
 - L. All luminaires and drivers shall operate within the temperature's limits of their design and as specified by UL in the applications and mounting conditions specified.
 - M. Luminaires recessed in suspended ceilings where the space above the ceiling is either an air supply or return plenum shall conform to NEC Article 300-22.
 - N. Provide plaster frame for recessed luminaires mounted in other than T-bar ceilings. Verify mounting with architectural reflected ceiling plan before ordering luminaires.
 - O. Fixtures installed in "hard" ceilings shall have all connections accessible through the luminaire.
 - P. Provide wire guards on all open strip type luminaires in unfinished spaces.
 - Q. For weatherproof or vapor-tight installations, finishes of luminaires and accessories shall be a premium 5 stage TGIC polyester powder coat paint minimum 2.5 mils thick, applied to factory-assembled and tested luminaires

before shipping, so that the entire assembly is completely corrosion resistant for the service intended. Exterior finishes shall have an outdoor life expectancy of not less than 20 years without any visible rust or corrosion. Where aluminum parts come in contact with bronze or steel parts, apply a coating material to both surfaces to prevent corrosion.

- R. Luminaires for use outdoors or in areas designated as damp locations shall be suitable gasketed to prevent the entrance of moisture. Provide approved wire mesh screens for ventilation openings. Dissimilar metals shall be separated by non-conductive material to prevent galvanic action.
- S. Factory-Applied Labels: Comply with UL 1598. Labels shall be located where they will be readily visible to service photometric performance.
- T. Luminaires shall hold LED arrays securely against normal vibration and maintenance handling.

2.3 LUMINAIRES

- A. Housing shall be minimum code gauge steel construction painted after fabrication with high reflectance white paint unless otherwise indicated.
- B. Shielding shall adhere to the following terms:
 - 1. Flat frosted diffuser shall be 100% virgin acrylic, pattern #12 and shall have matte finish on exterior side. Diffuser shall be of sufficient density to completely obscure LED image.
 - 2. Flat clear lenses shall be injection molded 100% virgin acrylic.
 - 3. Clear patterned lenses shall be injection molded 100% virgin acrylic, pattern #12.
 - 4. Clear patterned lenses shall be polycarbonate, pattern #12.
 - 5. Minimum thickness shall not be less than 0.125" with a minimum weight of 8 ounces per square foot.
- C. Doorframes shall be supplied with concealed hinges and latches. Provide mitered corners with no gaps or light leaks.

2.4 EMERGENCY BATTERY PACK FOR LUMINAIRES

- A. Manufacturers:

1. Basis of Design Product: (Eaton) Sure-Lites.
- B. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within/top of luminaire body and compatible with driver. Comply with UL 924.
1. Indicator Light: Visible without opening luminaire or entering ceiling space. Indicator Light: LED indicates normal power on.
 2. Battery: Sealed, maintenance-free, nickel-cadmium type, sized for ninety minutes of operation.
 3. Charger: Fully automatic, solid-state.
 4. Integral Self-Test: Factory-installed electronic device automatically initiates code by an integral audible alarm and a flashing red LED.
 5. Universal Voltage input.

2.5 MESSAGE SIGNS

- A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size. Comply with Authorities Having Jurisdiction, State and Local Codes.
- B. Coordinate with Division 28 requirements.
- C. Electrical: Internally mounted, universal 120/277V transformer.
- D. Internally Lighted Signs:
1. Light bars for AC operation: LED, 70,000 hours minimum rated life.
- E. Heavy gauge steel housing and stenciled faceplate with glass or thermoplastic color shield.
1. Legend: See Luminaire Schedule.

2.6 LED LUMINAIRES AND DRIVERS

- A. All Luminaires.
1. Comply with IES LM-79-08 Approved Method for measuring lumen maintenance of LED light sources.

2. Comply with IES LM 80-08 Approved method for electrical and photometric measurement of SSL product.
3. Comply with In-Situ testing for more reliable results.
4. LEDs shall be Restriction of Hazardous Substance Directive (RoHS) compliant.
5. LED arrays shall be sealed high-performance, long-life type: minimum 70% rated output at 50,000 hours. (L70)
6. LED luminaires shall deliver a minimum of 80 lumens per watt.
 - a. LEDs shall be “Bin No. 1” quality.
7. Drivers shall be solid state and accept 120 through 277VAC at 60 Hz input.
8. The LED light source shall be fully dimmable with use of compatible dimmers switch designated for low voltage loads.
9. LED color temperatures: 3000/3500 as noted.
10. Luminaires shall have internal thermal protection.
11. Luminaires shall not draw power in the off state. Luminaires with integral occupancy, motion, photo-controls, or individually addressable luminaires with external control and intelligence are exempt from this requirement. The power draw for such luminaires shall not exceed 0.5 watts when in the off state.
12. Color spatial uniformity shall be within 0.04 of CIE 1976 diagram.
13. Color maintenance overrated life shall be within .007 of CIE 1976.
14. Indoor luminaires shall have a minimum CRI of 85.
15. Luminaire manufacturers shall adhere to device manufacturer guidelines, certification programs, and test procedures for thermal management.
16. LED packaged/modules/arrays used in qualified luminaires shall deliver a minimum 70% in initial lumens, when installed in-situ, for a minimum of 50,000 hours.
17. Luminaires shall be fully accessible from below ceiling plane for changing drivers, power supplies and arrays.

B. Power Supplies and Drivers

1. Power Factor: 0.90 or higher
2. Maximum driver case temperature not to exceed driver manufacturer recommended in-situ operation.
3. Output operating frequency: 60Hz.
4. Interference: EMI and RFI compliant with FCC 47 CFR Part 15.
5. Total Harmonic Distortion Rating: 20% Maximum.
6. Meet electrical and thermal conditions as described in LM-80 Section 5.0.
7. Fully dimmable, 0-10VDC standard.
8. Secondary Current: Confirm secondary current specified by individual luminaire manufacturers.
9. Compatibility of dimming switches: Certified by manufacturer for use with individually specified luminaire and individually specified control components.

2.7 LED ARRAYS

- A. All LEDs of the same type are to be provided by the same manufacturer.
- B. Equip each luminaire with the proper LED array of the type shown or specified in the luminaire schedule.

2.8 WIRING

- A. No internal wiring shall be visible at normal viewing angles.

2.9 LUMINAIRE SUPPORT COMPONENTS

- A. Single-Stem Hangers shall be ½-inches steel tubing with swivel ball fitting and ceiling canopy. Finish shall be the same as the luminaire.
- B. Twin-Stem Hangers shall be two, ½-inch steel tubes with single canopy arranged to mount a single fixture. Finish shall be the same as the luminaire.
- C. Rod Hangers shall be 3.16-inch minimum diameter, cadmium-plated threaded steel rod.
- D. Wires shall be ASTM A 641/A 641M, Class 3, soft temper, zinc coated steel, 12 gauge.

- E. Wires for humid spaces shall be ASTM A 580/A 580M, composition 302 or 304, annealed stainless steel, 12 gauge.
- F. Aircraft Cable Support shall use cable, anchorages, and intermediate supports recommended by luminaire manufacturer.
- G. Hangers for pendant industrial luminaires shall be heavy duty No. 8 jack chain with hangers, "S" hooks, mounting straps, and all required accessories for complete installation.

2.10 EXIT SIGNS.

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with Authorities Having Jurisdiction.
- B. LED exit sign.
 - 1. AC only or battery backup as scheduled.
 - 2. Universal mount canopy.
 - 3. Green Letters on white or black, mirror or brushed nickel field as scheduled.
 - 4. Directional chevrons as indicated; field configurable.
 - 5. LED panel, 0.25 W.
 - 6. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack with nickel hydride battery with self-diagnostics.

B. Internally Lighted Signs:

- 1. Products: Provide products as listed in the Lighting Fixture Schedule.
- 2. Steel Housing, 20-gauge, white finish.
- 3. Glass or plastic faceplate.
- 4. Red letters on white field.
- 5. Directional chevrons as indicated.
- 6. Field selectable full size arrow designations.
- 7. Light bars: LED, 70,000 hours minimum rated lamp life.

- a. Individual LED modules shall not be visible.
- 8. Maximum power consumption: 5 watts.
- 9. AC powered signs shall be 120/277 input.
- 10. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
 - a. LED, 70,000 hours minimum rated lamp life.
 - b. Battery: Two-hour capacity sealed, maintenance-free, Ni Cad type, five years manufacturer warranty.
 - c. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - d. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects light bars from battery, and battery is automatically recharged and floated on charger.
 - e. Test Push Button: Push to test type, in unit housing, simulates loss of normal power and demonstrate unit operability.
 - f. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 - g. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.11 EMERGENCY LIGHTING UNITS

- A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.
 - 1. House: 20 ga. Steel
 - 2. Flexible cord and plug connections shall not be permitted.
 - 3. Battery: Sealed, maintenance-free, lead-acid type.
 - 4. Charger: Fully automatic, solid-state type with sealed transfer relay.

5. Lamping: LED
6. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharged level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
7. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
8. Wire Guard: Heavy-chrome-plated wire guard to protect lamp heads or units in areas where subject to physical damage.
9. Integral Time-Delay Relay: Holds unit on for fixed interval 15 minutes when power is restored after an outage.
10. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.
11. Factory supplied molded plug and cord where indicated.
12. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Luminaires:
 1. Set level, plumb, and square with ceilings and walls, and secure according to manufacturers written instructions and approved submittal materials, unless otherwise indicated.
- B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, and reinstall.
- C. Remote Mounting of Drivers: Distance between the driver and fixture shall not exceed that recommended by manufacturer. Verify, with manufacturers, maximum distance between driver and luminaire.

- D. Mounting height indicated from finished floor to bottom of pendant luminaire or to the center of the outlet box for wall mounted luminaires unless otherwise noted. Verify mounting heights with Architect and Lighting Designer.
- E. Mounting height may also be indicated as the length of the pendant below finished ceiling.
- F. Lay-in Ceiling Luminaire Supports.
 - 1. Install as indicated on reflected ceiling plans or center in acoustical panel, and support luminaires independently with at least two 3/4- inch metal channels spanning and secured to ceiling tees. In addition, provide slack earthquake safety wire hangers secured diagonally from opposite luminaire corners to structural members above suspended ceiling.
- G. Suspended Luminaire Support:
 - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers.
 - 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
 - 4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.
 - 5. All power feeds shall originate from the same location/end of each run.
 - 6. Where pendants or rods are longer than 48", brace to limit luminaire swinging.
- H. Provide all necessary hanging or mounting devices and accessories for all luminaires. Verify the types needed for various ceiling conditions. Plaster rings shall be provided where required
- I. Verify weight and mounting method of all luminaires prior to ordering and provide suitable support. Coordinate with General Contractor for luminaires that require additional blocking or support. Luminaire mounting assemblies shall comply with all local seismic codes and regulations.
- J. Metal decking shall not be pierced for luminaire support.
- K. Refer to architectural reflected ceiling plans for coordination of luminaire locations with mechanical, fire protection, technology and fire safety equipment.

Where conflicts occur, coordinate with Architect, Engineer and Lighting Designer prior to installing any of the Systems.

- L. In accessible suspended ceilings, luminaire wiring connections, including equipment grounding conductor, is to be through use of 72-inch (maximum) flexible conduit from a rigidly supported junction box.
- M. Wire per requirements of branch circuit installation. Properly ground each luminaire.
- N. Luminaires located in recessed ceilings with a fire resistive rating of 1 hour or more shall be enclosed in an approved fire resistive rated box equal to that of the ceiling. Acoustical ceiling tiles are not acceptable.
- O. Install luminaires with vent holes free of air blocking obstacles.
- P. This Contractor shall be responsible for adjusting aperture flanges or rings on all recessed luminaires to be flush with the finished ceiling. Trim shall completely conceal ceiling opening. Br
- Q. Brace suspended luminaires installed near ducts or other elements so that they do not swing into obstructions.
- R. Wall mounted luminaires shall be supported from four-square outlet box plaster ring and from wall at non-feed end with two ¼-inch toggle bolts for gypsum board walls or ¼-inch bolts to pre-set inserts for concrete wall.
- S. Luminaires shall not be secured to ductwork or other Systems.
- T. Adjust variable position lampholders for proper lamp position prior to luminaire installation.
- U. Connect wiring according to Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables.11

3.2 DOWNLIGHT LUMINAIRES

- A. Recessed Type in Accessible Ceilings: Mount in frames suitable for the ceiling with the recessed portion of the luminaire securely supported from the ceiling opening by use of a metal trim ring.
- B. Recessed Type in Non-accessible Ceilings: As Specified for mounting in accessible ceilings, except provide access to wiring and driver through the ceiling opening for the luminaire.

3.3 LUMINAIRES

- A. Recessed Type: Support luminaires independent of the ceiling suspension system. Provide four integral tabs (one at each corner) which rotate into position and lock on ceiling tees after luminaire is lifted into the ceiling cavity or provide four clips similar to Caddy #535. Provide mounting frames suitable for the ceiling type. In addition, provide slack earthquake safety wire hangers secured diagonally from opposite luminaire corners to structural members above suspended ceiling.
- B. Wall Mounted Type: Support from four-square outlet box plaster ring and from wall at non-feed end with two 1/2 inch toggle bolts for gypsum board walls or 3/4 inch bolts to pre-set inserts for concrete wall.
- C. If clearance above T-bar system is too restricted to “tip-in” luminaire, coordinate with acoustic ceiling installer by leaving one cross T-bar off until the cross T-bar shall be secured into its proper place. Luminaires installed in hidden-spline-type ceilings shall have supporting channels installed by Ceiling Contractor to adequately support the luminaire without providing additional hangers from the structural ceiling above the suspended ceiling.
- D. Surface Mounted Type:
 - 1. Where mounted on accessible ceilings, support from structural members above ceiling by means of hanger rods through ceiling or as approved.
 - 2. Continuous Runs of Luminaires: Laser sight to insure luminaires are straight and true when sighting from end to end, regardless of irregularities in the ceiling. Where luminaires are so installed, omit ornamental ends between sections. All seams/ joints shall be tightly fitted.
- E. Pendant Mounted Type:
 - 1. Provide strong back channel entire luminaire length unless luminaire is designed specifically to be self-supporting.
 - 2. Where suspended below accessible ceiling, provide structural support at suspended ceiling level from structural members above ceiling. Do not run hanger rods through ceiling.
 - 3. Continuous Runs of Luminaires: Laser sight to insure luminaires are straight and true when sighting from end to end, regardless of irregularities in the ceiling. Where luminaires are so installed, omit ornamental ends between sections. All seams/joints shall be tightly fitted.
 - 4. All power feeds shall originate from the same location/end of each run.
- F. Install luminaire diffusers only after construction work, painting and clean up are completed

3.4 LED LUMINAIRES

- A. Adhere to manufacturers installation guidelines regarding proper thermal management.

3.5 LIGHTING CONTROL

- A. Provide branch circuiting in coordination with the requirements of Division 26 Wiring Device Section and as indicated.
- B. Where Quantum lighting control panels are used to sweep after hours in open areas or classrooms, provide all necessary interconnecting wiring and control modules, and local override switches for afterhours operation. Verify correct operation in presence of NU Electric Shop.

3.6 CLEANING AND ADJUSTING

- A. Remove protective plastic covers from luminaires and luminaire diffusers only after construction work, painting and clean-up are completed. Remove, clean, and reinstall all dirty reflectors and diffusers
- B. Clean luminaires internally and externally after installation. Use methods and materials recommended by manufacturer for cleaning Alzak reflectors and other surfaces.
- C. Make final adjustment of aimable luminaires and adjustable light settings under the direction of the Architect and/or Lighting Designer during a scheduled period of time prior to the completion of the Project, after normal business hours if required. Include all equipment and personnel expenses including overtime required for focusing.
- D. Luminaires, Reflectors, louvers, and accessories which are damaged, blemished, or impregnated with fingerprints shall be replaced at this Contractor's expense. All finishes shall be unmarred upon Project completion.

3.7 IDENTIFICATION

- A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."

3.8 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery/generator and retransfer to normal. Walk test and verify foot-cables levels meet Code with meter.
- B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.
- C. Inspect each installed luminaire for damage. Replace damaged luminaires and components
- D. Replace all inoperable LED arrays at the end of construction prior School District beneficial occupancy.
- E. Advance Notice: Give dates and times for field tests.
- F. Provide instruments to make and record test results.
- G. Malfunctioning Luminaires and Components: Replace or repair, then retest. Repeat procedure until units operate properly

3.9 ADJUSTING

- A. Occupancy Adjustments: Within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this Work may be required after dark.
 - 1. Adjust aimable luminaires in the presence of Architect representative.

END OF SECTION

SECTION 28 31 00

FIRE and CARBON MONOXIDE ALARM SYSTEM

PART 1 – GENERAL

1.1 SCOPE

- A. This Contractor shall furnish, install and place in operation complete automatic smoke/heat detection and Carbon Monoxide detectors addressable fire alarm system for at Childcare Learning Daycare Center. Contractor shall Sub-contract to a Certified low voltage Fire Alarm Contractor., Work Included: All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
1. Examine all other specifications sections and drawings for related work required to be included as work under Division 26 00 00, 27 00 00, 28 00 00.
 2. General provisions and requirements for electrical work.
- B. Fire Alarm System plans, manufacturer and CSFM Cut Sheets, Calculation and point to point wiring diagrams for submittals to Local City Building and Fire Department plan check /permit approval.
- C. All testing, commissioning of the fire alarm system installation.

1.2 SUBMITTALS (ADDITIONAL REQUIREMENTS)

- A. Submit eight (8) copies of the following to the Architect for approval.
1. A listing of all fire alarm components and equipment including the California State Fire Marshal (CSFM) listing numbers.
 2. CSFM listing sheets of all devices being used.
 3. Manufacturers' standard catalog data for fire alarm components.

- a. The submittal shall be arranged in the order of the Specification and shall list the specification paragraph number, the name, the proposed model and manufacturer for each item as well as a reference indicating the specific piece of data which can be easily located in the brochure.
 - b. The manufacturers' data sheets shall be marked to indicate the specific item being proposed in cases where the sheet covers several types or sizes of item. The data sheet shall completely describe the proposed item.
 - c. Where modification to the equipment is necessary to meet the operational requirements of the contract documents, the data sheets shall include complete mechanical and electrical shop drawings detailing the modification.
4. A listing of the outlet rough-in needed for every device and equipment item. The applicable symbol which illustrates that rough-in item on the job plans shall be drawn on the proposal, opposite the description of the rough-in to facilitate locating the data by field personnel.
 5. Elevation and dimensional information.

1.3 APPLICABLE STANDARDS

1. List of applicable codes:
 - a) 2022 Building Standards Administrative Code, Part 1, Title 24 C.C.R.
 - b) 2022 California Building Code (CBC), Part 2, Title 24 C.C.R. (2018 International Building Code Volumes 1-3 and 2019 California Amendments).
 - c) 2022 California Electrical Code (CEC), Part 3, Title 24 C.C.R. (2017 National Electrical Code and 2019 California Amendments)
 - d) 2022 California Mechanical Code (CMC), Part 4, Title 24 C.C.R. (2018 Uniform Mechanical Code and 2019 California Amendments).
 - e) 2022 California Plumbing Code (CPC), Part 5, Title 24 C.C.R. (2018 Uniform Plumbing code and 2019 California Amendments)

- f) 2019 California Fire Code (CFC), Part 9, Title 24, C.C.R. (2018 International Fire Code and 2019 California Amendments).
- g) 2022 California Referenced Standards Code, Part 12, Title 24, C.C.R.
- h) Title 19, C.C.R., Public Safety, State Fire Marshal Regulations.
- i) 2022 California Energy Code (CEC, Part 6, Title 24 C.C.R.

2. NFPA Standards and Guides:

- a) NFPA 72, National Fire Alarm Code, (California Amended) 2019 Edition. (Note see UL standard 1971 for "visual devices")

3. The fire alarm system shall conform to CBC Sec. 809, CFC Article 14, Article 760 of California Electrical code, NFPA 72, and the applicable Standards and Guides referenced in CBC Chapter 60.

- B. Written certification by the fire alarm equipment manufacturer shall be submitted to the Architect, stating that the system and its component parts are listed and approved by the California State Fire Marshal and the installation has been tested, is operational and conforms to the requirements as set forth in Part 3, Article 24, Title 19, California Code of Regulations.

1.4 EQUIPMENT AND INSTALLING QUALIFICATIONS

- A. The equipment shall be manufactured by Notifier or equal by Fire Lite.
- B. All equipment shall conform to all local applicable codes and ordinances, and shall be listed by Underwriters Laboratories.
- C. To qualify as an acceptable bidder, Contractor or a Sub-contractor, the system bidder or Contractor shall be qualified fire alarm Contractor and shall hold a valid C10 License issued by the Contractors State License Board of California. The system bidder or Contractor shall hereinafter be referred to as the Contractor. The Contractor shall hold all other licenses required by the legally constituted authorities having jurisdiction over the work. The Contractor shall be the factory authorized distributor for the branch of equipment offered and shall have been engaged in the business of supplying and installing the specified type of system for at least five years. The Contractor shall maintain a fully equipped service organization capable of furnishing adequate repair service to the equipment. The Contractor shall be financially able to provide a performance bond covering the work and the guarantee described. The Contractor shall provide that bond if requested.

D. Installation Certification

1. Work and material for cables, cable terminations and related components shall be performed by certified installers. The installer shall be certified by the respective product manufacturers.
2. The manufacturers of the indicated work and material, shall provide a installer education/training and certification program for the supplied products.
3. The installers performing the Contract work for the indicated products, shall have attended and successfully completed each of the respective manufacturer's installation training education programs for the specified products.
4. Submit six (6) copies of the manufacturer's certifications for each installer performing the work. The submittal shall be approved prior to initiating any related contract work.
5. Contract material installed and work performed by installers not complying with these requirements shall be removed. Removal of work and material not in compliance with these requirements shall done at the CONTRACTOR'S expense, without any additional cost to the contract and without any additional contract completion due date extensions. New material and work required to replace the non-complying removed work and material shall be provided at the CONTRACTOR'S expense, without any additional cost to the contract and without any additional contract completion due date extensions.
6. Certifications: Submit certification from the equipment manufacturer indicating the installer is an authorized representative of the equipment manufacturer in the area the new system is to be installed in and is trained on network applications.
7. Electrical Materials and equipment installed shall be new.
8. All of the equipment in this specification shall be furnished and installed by the Authorized Factory Distributor of the equipment. The Contractor shall furnish a letter from the manufacturer of al major equipment, which certifies that the installing Contractor is the Authorized Distributor and that the equipment has been installed according to factory intended practices. The Contractor shall also furnish a written guarantee from the manufacturer that they will have a service representative assigned to this area for the life of the equipment.

1.5 WARRANTY

- A. Manufacturer shall provide a 5 year material warranty. Installer shall provide a 3 year labor warranty.

- B. Complete maintenance and repair service for a fire alarm system shall be available from a factory trained authorized representative of the manufacturer for a period of 5 years after expiration of the warranty.

PART 2 - PRODUCTS

2.1 GENERAL SYSTEM OPERATION

- A. System shall be microprocessor-based, addressable, and power-limited with Class A or Class B supervised circuits.
 - 1. The microprocessor shall execute all supervisory and control programming to detect, report the failure or disconnection of any system module or peripheral device and initiate programmed control sequences. An isolated supervision "watchdog" circuit shall monitor the microprocessor and, upon failure, shall activate the system trouble circuits.
 - 2. The automatic fire detection and alarm system shall consist of sub-main control panel, transponder panel(s), notification alarm devices, remote annunciator, automatic detection devices, manual stations, printer, and CRT/keyboard, installed and wired in accordance with the drawings and shall function as specified herein.
 - 3. The system shall be programmable in the field, by a non-computer trained person. All programmed information shall be stored in non-volatile memory.
 - 4. The system shall operate both addressable and non-addressable ionization, thermal and photoelectric detecting devices, manual stations, water-flow switches, and external control modules.
 - 5. The control panel shall provide power, annunciation, supervision and control for the fire detection and alarm system. The system shall be designed such that alarm indications override trouble and control conditions.
 - 6. External circuit supervision shall not require additional wires other than the pair used for detection or alarm (only two wires shall be used from the control panel to each loop of initiating devices and two wires for the notification alarm devices). These two wires shall provide both

supervision and notification alarm signals. There shall be no loss of supervision for Class "B" wired addressable devices. Class "A" supervision may be provided by adding an additional pair of wires.

B. Alarm Conditions

1. Actuation of any manual or automatic alarm initiating device, connected to the system shall cause the following automatic functions.
 - a) All notification alarm signaling units shall activate continuously. Audible notification alarms shall sound the California State coded signal.
 - b) The respective zone alarm lamp or annunciator alpha numeric readout on the central control panel, and remote annunciator panel, shall be activated.
 - c) Activate the Digital Alarm Communicator system. System shall transmit the condition to a UL listed central station monitoring facility. Supervisory station shall be approved per 2007 CFC 1006.2.4.2.2.1.5.
2. Actuation of HV/AC air duct smoke detectors shall stop the designated fans and motors in the building's air distribution system.
3. Actuation of smoke detectors on either side of smoke doors shall energize the release mechanism on the smoke door causing the door to close.
4. Notification alarm signal duration shall be capable of continuous sounding or adjustable from three to ten minutes.
5. Perform any additional functions as specified herein or shown on the drawings.

C. Trouble Condition

1. A single open or single trouble condition in a manual or automatic fire initiating wiring circuit shall activate the respective zone trouble lamp or annunciator readout on the fire alarm control panel and sound a trouble signal at the control panel.
2. A single open or single trouble condition in the notification alarm signaling wiring circuit shall activate the trouble lamp or annunciator readout in the control panel and sound a trouble signal at the control panel.

3. 120 volt AC normal power shall be monitored with indication by a "power on" lamp. Upon normal power outage, the system shall activate a power trouble condition lamp or annunciator readout, and indicate a trouble condition.
 4. The control panel shall monitor the standby batteries and, upon a low battery condition, activate the low battery lamp or annunciator readout and indicate a trouble condition.
 5. System ground detection shall be provided for the entire system. Upon ground detection, activate the ground detection lamp or annunciator readout and indicate a trouble condition.
- D. Control panels employing alpha numeric readouts shall display the trouble condition along with a prompt to review the list chronologically. The end of the list shall be indicated.

2.2 MANUALLY ACTIVATED ALARM INITIATING DEVICES

- A. An electronic, digital multiplex, addressable module shall be incorporated into each device. The module shall communicate the status and trouble condition of each device with a unique address code. The module shall communicate with and be supervised and monitored by the fire alarm control panel.
- B. Devices shall be suitable for use on a class "B", 2-wire supervised alarm initiating circuit.
- C. Numbered screw type terminals shall be provided for "in-out" connections of the alarm circuit wiring.
- D. The face of the station shall have lettering indicating "FIRE" and operational instructions. Stations shall be tamper resistant, semi-flush mounting.
- E. Auxiliary spare switch contact shall be provided for control of remote devices rated 120 volts - 60HZ, AC - 3AMP minimum.
- F. Stations shall provide visual indication the station has been activated. A key (and/or special tool) shall be required to gain access into the station to reset the station after being activated.
- G. Stations shall be "non break-glass" type.
- H. RF and transient filtering shall be provided in the device electronics.
- I. Pull stations shall be non-coded double action, requiring two distinct manual "pulling" actions to initiate the fire alarm system.

- J. Stations installed outdoors shall be weather resistant construction, double action to activate the pull station.

2.3 AUTOMATIC ALARM INITIATING DEVICES

A. General

1. An electronic digital, multiplex, addressable module shall be incorporated into each device. The module shall communicate the status and trouble condition of each device with a unique address code. The module shall communicate with and be supervised and monitored by the fire alarm control panel.
2. Devices shall be suitable for use on a Class "B", 2-wire supervised alarm initiating circuit. Where initiating devices are shown connected to an existing system, devices shall operated on two or four wire circuits plus - 2 - wire power circuit as required by the existing equipment.
3. Numbered screw type terminals shall be provided for "in-out" connectors of the alarm circuit wiring.
4. Auxiliary double throw spare relay contact shall be provided for activation of remote rated devices 120V-60Hz, AC - 1 Ampere minimum.
5. RF and transient filtering shall be provided in the initiating device electronics.
6. Initiating devices shall be reset from the control panel and shall not require individual resetting.

B. Smoke Detector Shall be:

1. Detectors shall comply with UL standard 268, 167 and 168, and shall use solid state electronic circuits throughout.
2. The smoke detector shall operate on a total of two circuit wires. Alarm signaling and detector power shall use the same conductors. Detector sensitivity shall be factory set at 1.5%.
3. A fine mesh insect screen shall be provided on all detector openings.
4. The detector shall lock-in on alarm and shall provide a visual alarm/trouble indicator light. An electromechanical test feature shall provide functional testing of the unit without smoke.

5. The detector shall also incorporate a fixed temperature heat detector rated at 135 degrees F. The heat detector shall operate the alarm circuit and alarm/trouble light.
 - a) Photo electric type smoke detectors shall employ a light emitting diode (LED) as the detector light source, activated by the presence of combustion smoke products. Failure of the LED shall activate the alarm/trouble light on the detector.
 - b) Ionization type smoke detector shall employ the triple chamber (dual chamber) ionization principle, activated by the presence of combustion products. The ionization chamber shall be RF shielded.
 - c) Air duct smoke detector photo electric or ionization type for installation on a mechanical air ducts. Two air tubes shall extend into the air duct. The sampling tube shall extend across the entire width of the air duct. The second tube shall allow air to escape back into the duct.

C. Fire Detector – Heat Shall be:

Heat detectors shall be dual action electro-thermostatic combination rate of temperature rise and fixed temperature operation. A indicator shall be visible when detector has activated.

2. The rate of rise element shall be self restoring, after activation.
3. The fixed temperature unit shall be set at 136 degrees F (190 degrees F for high temperature areas i.e. over 110 degrees F.)

E. Carbon Monoxide detectors as required and installed per NFPA.

2.4 NOTIFICATION ALARM DEVICES

A. General

1. Notification alarm devices shall activate automatically from the control panel. Devices shall operate on a Class "B" (Style Y), 2-wire supervised alarm notification circuit. Series wired alarm devices shall not be used.
2. Numbered screw type terminals shall be provided for "in-out" connections of the alarm circuit wiring.
3. Devices shall be installed in a box, 3 1/2" deep maximum, flush mounting unless indicated otherwise on the drawings. Size as required for the alarm

indicating device and wiring connections. Provide a trim ring and metal grill cover assembly. Cover assembly shall be minimum of 1/16" minimum thick flat stainless steel or aluminum. Finish color as selected by Architect. The word "fire" shall appear on the grill minimum 1/2" letters. The grill shall be attached with screws to the box.

4. Each audible notification visual devices shall incorporate a visual alarm indicator. The visual alarm indicating device shall be an integral part of the audible alarm box assembly.
5. Audible notification device and visual notification devices shall be connected to separate notification alarm signal circuits. Do not connect these devices to the same circuit conductors.

B. Audible Alarm Horns Shall be AS SHOWN ON PLAN

1. Horns installed indoors shall be electronic type.
2. Horn shall provide a minimum sound level of 75 DB at 10 feet, when installed in the field operating conditions shown on the drawings.
3. Outdoor horns shall be electro-mechanical, weatherproof and shall be mounted in a recessed backbox with vandal resistant grille, Soundolier 193-8/VP-161 series.
4. Audible devices shall provide a minimum sound level of 10DB over the ambient level measured 48" above the floor.

C. Visual Alarm Indicator Shall be AS SHOWN ON PLAN

1. Lamp/Strobe internally illuminated projecting lens assembly, with flasher system. Unit shall flash on and off to provide visual indicating of fire alarm.
2. The word "fire" shall appear on the lens or lens plate.
3. Flash rate, one flash per second, with a flash duration of approximately 0.001 second, flash rate independent of audible device.
4. Light source, Xenon high intensity flash strobe tube white/clear color.
5. Strobe shall have a minimum output of 75 candela with a maximum flash intensity of 120 candela.
6. Strobe shall comply with NFPA requirements.

PART 3 - EXECUTION

3.1 IDENTIFICATION (ADDITIONAL REQUIREMENTS)

- A. The inside cover of alarm initiating devices shall be marked with the zone initiating number corresponding to the zone number in the control panel. Marking shall be with a felt-tip pen.
- B. Each fire alarm terminal cabinet shall be painted red.
- C. Provide nameplate: "Power to Fire Alarm Control Panel" screwed onto the branch circuit overcurrent device supplying power to the main fire alarm control panel.

3.2 WIRING (ADDITIONAL REQUIREMENTS)

- A. Review the total system point-to-point wiring layout to assure that the correct number and type of wires and conduit sizes are installed.
- B. Final connections, testing, adjusting and calibration shall be made under the direct supervision of a factory-trained technician of the system supplier.
- C. All wiring shall be in conduit.
- D. All wiring in cabinets shall be neatly formed, laced and made up on bolt and nut terminal blocks. Tag all spare conductors. All conductors shall terminate on terminal strips with spade lugs, of adequate size for all incoming and outgoing conductors. The strips shall be labeled as to their use and wiring diagram shall be placed on the cabinet door showing connections of all related equipment to these strips.
- E. Wiring requirements for shielding certain conductors shall be as recommended by the manufacturer. Provide all conduit, raceways and conductors per manufacturers recommendations and include all material and labor costs in the contract price.
- F. The conductors used for digital, multiplex communication between the fire alarm control panel and external remote initiation devices, control points and annunciators, shall be twisted, shielded, multi-conductor cable, #16 AWG copper minimum with a separate internal ground/drain conductor, UL listed for fire alarm system use. One spare pair of multiplex conductors shall be provided in all main and branch device/equipment connections for future system use. "Tees" and taps at any junction box location in the communication lines, shall be permitted by the system to additional devices without affecting proper system operation.

- G. Wire Size: Wire shall be sized to insure installed circuit voltage drop does not exceed 10% to all devices.
- H. In terminal cabinets, installer shall provide a wire index identifying the building and locations of devices.
- I. All underground wiring shall be Aquaseal suitable for outdoor use, or approved equal.

3.3 OUTLET BOXES (ADDITIONAL REQUIREMENTS)

- A. Device outlet boxes shall be flush mounted unless indicated otherwise on the drawings. Provide extension rings to finish flush with finish surface. Where the drawings indicate surface mounted devices, outlet boxes shall be cast metal with threaded hubs. Where the conduit entrances are not exposed for surface mounted devices, provide flush outlet box behind the device box and omit the conduit hubs on the device box. Size device boxes and outlet boxes per manufacturers recommendation and as required by code for wire fill.

3.4 SPECIAL INSTALLATION REQUIREMENTS

- A. Air duct smoke detectors shall be installed in the supply air ducts and return air ducts with an air flow of 2000 CFM or greater, coordinate with mechanical contractor. Sampling tube shall extend across entire duct width. Provide 3/4" conduit with 2#12 to respective motor control device to automatically shut down the respective fan motor upon detection of smoke in the air duct.
- B. Connect fire alarm control panel with security/intrusion control panel for monitoring by remote UL Listed Centrak Alarm Monitoring Company.
- F. Connect fire alarm control panel with master clock system to turn off class passing schedule, with paging system to turn off system when fire alarm system in alarm condition.
- G. Conduit with fire alarm wiring shall be painted red.
- H. Fire alarm system shall be programmed per actual building and room designation. Submit printout for review.
- I. Contractor shall thoroughly clean all work areas where work was performed at the end of each day. All areas shall be ready for the Daycare/school to occupy and conduct classes/school the next working day.
- J. Contractor shall cover all contents of the rooms in which work is being performed with suitable plastic sheeting prior to the commencement of work.

- K. In occupied campuses, Contractor shall provide for safe access for all Childrens and staff.

3.5 TESTING

- A. The entire fire alarm system shall be tested in the presence of the local Inspector and a representative of the manufacturer after the installation is complete.
 - 1. Individually activate each manual initiating station and verify correct alarm operation and control panel response.
 - 2. Individually test each automatic initiating device and verify correct alarm operation, control panel response and remote equipment operation.
 - 3. The communication loops and the notification alarm circuits shall be opened in at least two (2) locations per building to check for the presence of correct supervisory circuitry.
- B. Test the battery back-up system by disconnecting the incoming normal power and allowing this alarm system to operate 24 hours on battery power. Sound the alarm system for five minutes at the end of 24 hours on battery power.
- C. Perform all electrical and mechanical tests required by the equipment manufacturer's certification form. Measure and adjust each automatic detection detector to the maximum stable sensitivity setting. Detector tests shall be performed with the detector at its operational location and under normal operational environmental conditions in the area. Bench settings are not acceptable. An operational check-out test and report shall be performed. Submit six copies of test report results. The tests and report shall include, but not be limited to:
 - 1. A complete list of equipment installed and wired.
 - 2. Indication that all equipment is properly installed and functions and conforms with these specifications.
 - 3. Test of individual zones as applicable.
 - 4. Serial numbers, locations by zone and model number for each installed detector.
 - 5. Voltage (sensitivity) settings for each ionization and photoelectric detector as measured in place with the HVAC system operating.
 - 6. Technician's name, certificate number and date.

7. The completed manual and automatic monitoring and control system shall be tested to insure that it is operating properly. This test will consist of exposing the installed units to a standard fire test.
 8. Acceptance of the system shall also require a demonstration of the stability of the system. This shall be adequately demonstrated if the system operates for a ninety (90) day test period without any unwarranted alarms. Should an unwarranted alarm(s) occur, the contractor shall readjust or replace the equipment and detector(s) and begin another ninety (90) day test period. As required by the Architect, the contractor shall recheck the detectors using the fire test after each readjustment or replacement of detectors. This test shall not start until the District has obtained beneficial use of the building under tests.
- D. After the testing has been completed to the satisfaction of the inspectors, provide the NFPA certificate of compliance to the Building Owner Representative, the local Fire Official, and Architect.
 - E. Upon the receipt of Certificate of Compliance, the installer/supplier shall supply the Owner with a written operating, testing and maintenance instructions, point-to-point as-built drawings, and equipment specifications.
 - F. Provide a two (2) hour instructional sessions conducted by a factory-authorized technician at the job site after completion of all tests to instruct School District personnel on the use of the system. The first session shall be videotaped and conducted prior to final acceptance of the project. The second session shall be held within eleven months of final acceptance of the project, when requested by the District.
 - G. Installer shall protect all work until the Fire Alarm System has been accepted by the Inspector.

3.6. OPERATING/SERVICE MANUALS

- A. Submit 5 copies of service all manuals and all current programming software including the following:
 1. Detailed explanation of the operation of the system.
 2. Instructions for routine maintenance.
 3. Detailed instruction for repair of major components of the system.
 4. Pictorial parts list and art numbers.

5. Pictorial and schematic electrical drawings of wiring systems, including operating and safety control panels, annunciators and major components.
6. Installation instructions for system components.
7. Programming instructions and programming disk(s).
8. Programming listing.
9. Final test report.
10. A single reproducible set of record drawings reflecting the system exactly as it was installed including exact locations of components.

END OF SECTION

SECTION 31 1000

SITE CLEARING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:

1. Protection of existing trees indicated to remain.
2. Removal of trees and other vegetation.
3. Topsoil stripping and stockpiling.
4. Clearing and grubbing.
5. Removing above-grade improvements.
6. Removing below-grade improvements.
7. Storm Water Pollution Prevention Plan

- B. Related Sections:

1. "Temporary Facilities and Controls" Section for temporary utility services, construction and support facilities, and security and protection facilities.
2. "Execution" Section for field engineering and surveying.
3. "Construction Waste Management and Disposal" and "Sustainable Design Requirements" Section for additional LEED requirements.
4. "Structure Demolition" Section for demolition of buildings, structures, and site improvements.
5. "Selective Structure Demolition" Section for partial demolition of buildings or structures.

1.03

PROJECT CONDITIONS

- A. Traffic: Conduct site-clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction.
- B. Protection of Existing Improvements: Provide protections necessary to prevent damage to existing improvements indicated to remain in place.
 - 1. Protect improvements on adjoining properties and on Owner's property.
 - 2. Restore damaged improvements to their original condition, as acceptable to property owners. The full width of pavements damaged due to construction access and other construction-related activities shall be replaced with a structural section (pavement and base) at least equal to the adjacent existing section.
 - 3. Protect existing utility lines indicated to remain. Notify Owner immediately of any damage to or encounter with an unknown existing utility line. Immediately repair damage to existing utility lines.
- C. Protection of Existing Trees and Vegetation: Protect existing trees and other vegetation indicated to remain in place against unnecessary cutting, breaking or skinning of roots, ANY skinning or bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary guards to protect trees and vegetation to be left standing.
 - 1. Water trees and other vegetation to remain within limits of contract work as required to maintain their health during course of construction operations.
 - 2. Provide protection for roots over 1-1/2 inch in diameter that are cut during construction operations. Coat cut faces with an emulsified asphalt or other acceptable coating formulated to use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out; cover with earth as soon as possible.
 - 3. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations in a manner acceptable to Architect. Employ a licensed arborist to repair damage to trees and shrubs.
 - 4. Replace trees that cannot be repaired and restored to full-growth status, as determined by arborist.

- D. Improvements on Adjoining Property: Authority for performing removal and alteration work on property adjoining Owner's property will be obtained by Owner prior to award of contract.
 - 1. Extent of work on adjacent property is indicated on Drawings.
- E. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated or directed.
- F. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place. [Contractor shall abide by all conditions in the Storm Water Pollution Prevention Plan Prepared by others.]
- G. Soil stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

1.04 EXISTING SERVICES

- A. General: Indicated locations are approximate; determine exact locations before commencing Work.
- B. Arrange and pay for disconnecting, removing, capping, and plugging utility services. Notify affected utility companies in advance and obtain approval before starting this Work.
- C. Place markers to indicate location of disconnected services. Identify service lines and capping locations on Project Record Documents.

PART 2 - PRODUCTS

2.01 NONE

PART 3 - EXECUTION

3.01 SITE CLEARING

- A. General: Remove shrubs, grass, and other vegetation, improvements, or obstructions, as required, to permit installation of new construction. Remove similar items elsewhere on site or premises as specifically indicated. Removal includes digging out and off-site disposal of stumps and roots.
 - 1. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
 - 2. Unless specifically designated to remain, strip the upper two inches (minimum) of soil containing vegetation and root growth within the Limits of Work shown on the Drawings.

- B. Topsoil: Topsoil is defined as friable clay loam surface soil found in a depth of not less than 4 inches. Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones, and other objects over 2 inches in diameter, and without weeds, roots, and other objectionable material.
1. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material. Remove heavy growths of grass from areas before stripping.
 - a. Where existing trees are indicated to remain, leave existing topsoil in place within drip lines to prevent damage to root system.
 2. Stockpile topsoil in storage piles in areas indicated or directed. Construct storage piles to provide free drainage of surface water. Cover storage piles, if required, to prevent wind erosion. Limit height of stockpiles to 72 inches.
 3. Dispose of unsuitable or excess topsoil as specified for disposal of waste material.
- C. Clearing and Grubbing: Clear site of trees, shrubs, and other vegetation, except for those indicated to be left standing.
1. Completely remove stumps, roots, and other debris protruding through ground surface.
 2. Use only hand methods for grubbing inside drip line of trees indicated to remain.
 3. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
 - a. Place fill material in horizontal layers not exceeding 8 inches loose depth, and thoroughly compact each layer and compact in accordance with the requirements specified in Division 31 Section "Earth Moving" to make the new surface conform with the existing adjacent surface of the ground.
 4. Trim trees, designated to be left standing within the cleared areas, of dead branches 1-1/2 inches or more in diameter; and trim all branches to heights and in a manner as indicated. Neatly cut limbs and branches to be trimmed close to the bole of the tree or main branches. Paint cuts more than 1-1/4 inches in diameter with specified tree-wound paint.

- D. Removal of Improvements: Remove existing above-grade and below-grade improvements as indicated and as necessary to facilitate new construction.
 - 1. Abandonment or removal of certain underground pipe or conduits may be indicated on mechanical or electrical drawings. Removing abandoned underground piping or conduits interfering with construction are included under this Section.

3.02 DISPOSAL OF WASTE MATERIALS

- A. Burning on Owner's Property: Burning is not permitted on Owner's property.
- B. Removal from Owner's Property: Remove waste materials and unsuitable or excess topsoil from Owner's property.
- C. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other project work.

3.03 STORM WATER POLLUTION PREVENTION PLAN

- A. Contractor shall comply with Stormwater Pollution Prevention Plan and coordinate with the Owner to provide a Qualified SWPPP Practitioner.
- B. Prior to beginning of work, Contractor shall prepare or cause to be prepared a Storm Water Pollution Prevention Plan (SWPPP) applicable to the site conditions and project work. The SWPPP shall be submitted to the Architect for review.
 - 1. The SWPPP shall be based upon the Best Management Practices (BMPs) and shall include all sections and information as outlined in the Fact Sheet for Water Quality Order 2009-0009DWQ, found as an attachment to the State Water Resources Control Board (SWRCB) checklist for submittal of a Notice of Intent (NOI). A copy of the guidelines is available electronically at the following website: http://www.swrcb.ca.gov/water_issues/programs/stormwater/constpermits.shtml Requirements in the Construction Contractor's Guide and Specifications of the Caltrans Storm Water Quality Handbook (April 1997) and CASQA's Best Management Practice Handbook Construction (January 2011) also apply.
 - 2. The SWPPP shall include, as a minimum:

- a. Filing of a Notice of Intent (NOI), which includes submitting an online application through the SQRCB's online SMARTS system and submitting an annual payment fee to the address below:

California State Water Resources Control Board
Division of Water Quality
Storm Water Permit Unit
P.O. Box 1977
Sacramento, California 95812-1977

An NOI will be issued once payment is received.

- b. Preparing the SWPPP map and report.
 - c. Submitting the map and report through the SWRCB's online SMARTS system.
 - d. Monitoring, inspection and maintenance of the site and updating the SWPPP throughout construction.
 - e. Filing a Notice of Termination upon completion of the construction process.
- C. Contractor shall comply with Stormwater Pollution Prevention Plan and coordinate with the Owner to provide a Qualified SWPPP Practitioner.

END OF SECTION

SECTION 31 1200

DEMOLITION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Demolition and removal of buildings. Removal of trees and other vegetation.
 - 2. Demolition and removal of structures.
 - 3. Demolition and removal of site improvements.
 - 4. Disconnecting, capping or sealing, and abandoning site utilities in place.
 - 5. Disconnecting, capping or sealing, and removing site utilities.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. "Cutting and Patching" Section for cutting and patching procedures for demolition operations.
 - 2. Division 1 Section "Schedules and Reports" Section for demolition schedule requirements
 - 3. Division 1 Section "Construction Facilities and Temporary Controls" Section for temporary utilities, temporary construction and support facilities, temporary security and protection facilities, and environmental protection measures for demolition operations.
 - 4. "Contract Closeout" Section for record document requirements.
 - 5. "Selective Demolition" Section for partial demolition of a building or structure undergoing alterations and for the removal, salvage, or reuse of materials in new construction.

6. "Tree Protection and Trimming" Section for protecting trees remaining on-site.
7. "Site Clearing" Section for site clearing and removing above- and below-grade improvements.
8. "Earth Moving" Section for soil materials, excavating, backfilling, and site grading.

1.03 DEFINITIONS

- A. Remove: Remove and legally dispose of items except those indicated to be reinstalled, salvaged, or to remain the Owner's property.
- B. Remove and Salvage: Items indicated to be removed and salvaged remain the Owner's property. Remove, clean, and pack or crate items to protect against damage. Identify contents of containers and deliver to Owner's designated storage area.
- C. Remove and Reinstall: Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage. Reinstall items in locations indicated.
- D. Existing to Remain: Protect construction indicated to remain against damage and soiling during demolition. When permitted by the Architect, items may be removed to a suitable, protected storage location during demolition and then cleaned and reinstalled in their original locations.

1.04 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, salvaged, or otherwise indicated to remain the Owner's property, demolished materials shall become the Contractor's property and shall be removed from the site with further disposition at the Contractor's option.
- B. Historical items indicated remain the Owner's property. Carefully remove and salvage each item in a manner to prevent damage and deliver promptly to the Owner.
- C. Historical items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to the Owner, which may be encountered during demolition, remain the Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to the Owner.
 1. Cooperate with Owner's archaeologist or historical adviser.

1.05 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections, for information only, unless otherwise indicated.
- B. Proposed dust-control measures.
- C. Proposed noise-control measures.
- D. Schedule of demolition activities indicating the following:
 - 1. Detailed sequence of demolition and removal work, with starting and ending dates for each activity.
 - 2. Dates for shutoff, capping, and continuation of utility services.
- E. Inventory of items to be removed and salvaged.
- F. Inventory of items to be removed by Owner.
- G. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by demolition operations.
- H. Record drawings at Project closeout according to "Contract Closeout" Section.
 - 1. Identify and accurately locate capped utilities and other subsurface structural, electrical, or mechanical conditions.
- I. Landfill records for record purposes indicating receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.06 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: Engage an experienced firm that has successfully completed demolition Work similar to that indicated for this Project.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before starting demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Pre-demolition Conference: Conduct conference at Project site to comply with pre-installation conference requirements of Division 1 Section "Project Meetings."

1.07 PROJECT CONDITIONS

- A. Buildings to be demolished will be vacated and their use discontinued before start of Work.
- B. Owner assumes no responsibility for actual condition of buildings to be demolished.
 - 1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Asbestos: It is not expected that asbestos will be encountered in the course of this Contract. If any materials suspected of containing asbestos are encountered, do not disturb the materials. Immediately notify the Architect and the Owner.
 - 1. Asbestos will be removed by Owner before start of Work.
- D. Asbestos: Asbestos is present in the building or structure to be demolished. A report on the presence of asbestos is on file for review and use. Examine the report to become aware of locations where asbestos is present.
 - 1. Asbestos abatement is specified elsewhere in the Contract Documents.
 - 2. Do not disturb asbestos or any material suspected of containing asbestos except under the procedures specified elsewhere in the Contract Documents.
- E. Storage or sale of removed items or materials on-site will not be permitted.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

- A. Requirements for satisfactory soil materials are specified in "Earth Moving" Section.
 - 1. Obtain approved borrow soil materials off-site when sufficient satisfactory soil materials are not available on-site.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that utilities have been disconnected and capped.

- B. Survey existing conditions and correlate with requirements indicated to determine extent of demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. Survey the condition of the building to determine whether removing any element might result in a structural deficiency or unplanned collapse of any portion of the structure or adjacent structures during demolition.
- E. Perform surveys as the Work progresses to detect hazards resulting from demolition activities.

3.02 UTILITY SERVICES

- A. Maintain existing utilities indicated to remain in service and protect them against damage during demolition operations.
 - 1. Do not interrupt existing utilities serving occupied or operating facilities, except when authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to governing authorities.
 - a. Provide not less than 72 hours' notice to Owner if shutdown of service is required during changeover.
- B. Owner will arrange for disconnecting and sealing indicated utilities serving structures to be demolished before start of demolition work, when requested by Contractor.
- C. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services serving structures to be demolished.
 - 1. Owner will arrange to shut off indicated utilities when requested by Contractor.
 - 2. Arrange to shut off indicated utilities with utility companies.
- D. Utility Requirements: Refer to “Electrical” and “Mechanical” Sections for shutting off, disconnecting, removing, and sealing or capping utility services. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.03 PREPARATION

- A. Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with demolition operations.

- B. Employ a certified, licensed exterminator to treat building and to control rodents and vermin before and during demolition operations.
- C. Conduct demolition operations and remove debris to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
- D. Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities to remain. Ensure safe passage of people around demolition area.
 - 1. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
 - 2. Protect existing site improvements, appurtenances, and landscaping to remain.
 - 3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
- E. Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of buildings to be demolished and adjacent buildings to remain.
 - 1. Strengthen or add new supports when required during progress of demolition.

3.04 EXPLOSIVES

- A. Explosives: Use of explosives will not be permitted.
- B. Explosives: Do not bring explosives to the site or use explosives without written consent of Owner and authorities having jurisdiction. Such written consent will not relieve Contractor of total responsibility for injury to people or for damage to property due to blasting operations. Perform required blasting in compliance with governing regulations.

3.05 POLLUTION CONTROLS

- A. Use water mist, temporary enclosures, and other suitable methods to limit the spread of dust and dirt. Comply with governing environmental protection regulations.

1. Do not create hazardous or objectionable conditions, such as ice, flooding, and pollution, when using water.
- B. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
1. Do not create hazardous or objectionable conditions, such as ice, flooding, and pollution, when using water.
- C. Clean adjacent buildings and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing before start of demolition.

3.06 POLLUTION CONTROLS

- A. Building Demolition: Demolish buildings completely and remove from the site. Use methods required to complete Work within limitations of governing regulations and as follows:
1. Locate demolition equipment throughout the building and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 2. Dispose of demolished items and materials promptly. On-site storage or sale of removed items is prohibited.
 3. Small buildings may be removed intact when permitted by Architect and approved by authorities having jurisdiction.
 4. Demolish concrete and masonry in small sections.
 5. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 6. Break up and remove concrete slabs on grade, unless otherwise shown to remain.
 7. Remove air-conditioning equipment without releasing refrigerants.
- B. Below-Grade Construction: Demolish foundation walls and other below-grade construction, as follows:
1. Remove below-grade construction, including foundation walls, to at least 12 inches (300 mm) below grade.
 2. Remove below-grade construction, including foundation walls and footings, to the depths indicated.

3. Completely remove below-grade construction, including foundation walls and footings.
 4. Break up and remove below-grade concrete slabs, unless indicated to remain.
 5. Break up below-grade concrete slabs into sections no larger than 24 inches (600 mm) square and leave in place.
- C. Filling Below-Grade Areas: Completely fill below-grade areas and voids resulting from demolition of buildings and pavements with soil materials according to requirements specified in Division 2 Section "Earthwork."
- D. Damages: Promptly repair damages to adjacent facilities caused by demolition operations.

3.07 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
- B. Burning: Do not burn demolished materials.
- C. Burning: Burning of demolished materials will be permitted only at designated areas on Owner's property, providing required permits are obtained. Provide full-time monitoring for burning materials until fires are extinguished.
- D. Disposal: Dispose of demolished materials at designated spoil areas on Owner's property.
- E. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

END OF SECTION

SECTION 31 2000

EARTH MOVING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Preparing and grading sub-grades for slabs-on-grade, walks, pavements, and landscaping.
 - 2. Excavating and backfilling for buildings and structures.
 - 3. Drainage and moisture-control fill course for slabs-on-grade.
 - 4. Base course for walks and pavements.
 - 5. Subsurface drainage backfill for walls and trenches.
 - 6. Excavating and backfilling trenches within building lines.
 - 7. Excavating and backfilling for underground utilities and appurtenances outside building lines.
 - 8. Infiltration Facilities
- B. Related Sections: The following Sections contain requirements that relate to this Section.
 - 1. "Cast-in-Place Concrete" Section for concrete encasings, cradles, and appurtenances for utility systems.
 - 2. "Site Clearing" Section for site stripping, grubbing, topsoil removal, and tree protection.
 - 3. "Turf and Grasses" Section for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
 - 4. "Plants" Section for finish grading in planting areas and tree and shrub pit excavation and planting.

5. "Subdrainage" Section for drainage of foundations.

1.03 REFERENCE SPECIFICATION

- A. Perform all work in accordance with applicable provisions of "Standard Specifications for Public Works Construction", latest edition. Unless otherwise noted, mention herein of section numbers refers to sections of the Reference Specification. Where Reference Specification refers to "Agency", substitute the word "Owner". Where Reference Specification refers to "Engineer", substitute the word "Architect". Where Reference Specification is in conflict with these Specifications, these Specifications shall govern.

1.04 DEFINITIONS

- A. Excavation: Consists of the removal of material encountered to subgrade elevations and the re-use or disposal of materials removed.
- B. Subgrade: The uppermost surface of an excavation or the top surface of a fill or backfill immediately below aggregate base, drainage fill, or topsoil materials.
- C. Borrow: Soil material obtained off-site when sufficient approved soil material is not available from excavations.
- D. Base Course: The layer placed between the subgrade and surface pavement in a paving system.
- E. Drainage Fill: Course of washed granular material supporting slab-on-grade placed to cut off upward capillary flow of pore water.
- F. Unauthorized Excavation: Consists of removing materials beyond indicated subgrade elevations or dimensions without direction by the Architect. Unauthorized excavation, as well as remedial work directed by the Architect, shall be at the Contractor's expense.
- G. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below ground surface.
- H. Utilities: Include on-site underground pipes, conduits, ducts, and cables, as well as underground services within building lines.
- I. Compaction: Any method of mechanically stabilizing a material by increasing its density at a controlled moisture condition. "Degree of Compaction" is expressed as a percentage of the maximum dry density obtained by the test procedure described in ASTM D 1557 for general soil types abbreviated in this Specification as "___ percent of maximum dry density".
- J. Hard Material: Weathered rock, dense consolidated deposits or conglomerate materials which are not included in the definition of "rock" but which usually

require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

- K. Lift: A layer or course of soil placed on top of previously prepared or placed soil in a fill or embankment.
- L. Unsatisfactory Material: Soil or other material identified as having insufficient strength or stability to carry intended loads without excessive consolidation or loss of stability.

1.05 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
 - 1. Location of borrow materials.
- B. Photographs or video tape of existing adjacent structures and site improvements.

1.06 QUALITY ASSURANCE

- A. Codes and Standards: Perform earthwork complying with requirements of authorities having jurisdiction.
- B. Testing and Inspection Service: Owner will employ a qualified independent geotechnical engineering testing agency to classify proposed on-site and borrow soils to verify that soils comply with specified requirements and to perform required field and laboratory testing.
- C. Testing and Inspection Service: Employ a qualified independent geotechnical engineering testing agency to classify proposed on-site and borrow soils to verify that soils comply with specified requirements and to perform required field and laboratory testing.
- D. Pre-installation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."
 - 1. Before commencing earthwork, meet with representatives of the governing authorities, Owner, Architect, consultants, Geotechnical Engineer, independent testing agency, and other concerned entities. Review earthwork procedures and responsibilities including testing and inspection procedures and requirements. Notify participants at least 3 working days prior to convening conference. Record discussions and agreements and furnish a copy to each participant.

1.01 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the Owner or others except when permitted in writing by the Architect and then only after acceptable temporary utility services have been provided.
 - 1. Provide a minimum 48-hours' notice to the Architect and receive written notice to proceed before interrupting any utility.
- B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shutoff services if lines are active.
- C. Groundwater elevations that may be indicated are those existing at the time that subsurface investigations were made and do not necessarily represent groundwater elevations at the time of construction.
- D. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures are in place.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

- A. General: Provide approved borrow soil materials from off-site when sufficient approved soil materials are not available from excavations.
- B. Satisfactory Soil Materials: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM; free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter.
- C. Unsatisfactory Soil Materials: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT.
- D. Backfill and Fill Materials: Satisfactory soil materials.
- E. Base Material: Shall conform to crushed aggregate base or fine-gradation crushed miscellaneous base in accordance with section 200-2.2 or 200-2.4, respectively, of the Reference Specification, and compacted to at least 95% of the maximum dry density as determined by ASTM Test Method D 1557.
- F. Engineered Fill: Well graded granular soil with an expansion index less than 20 and free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter.
- G. Bedding Material: Shall be base materials with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve; or clean sand classified in accordance with ASTM D 2487.

- H. Drainage Fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, ASTM D 448, coarse aggregate grading size 57, with 100 percent passing a 1-1/2-inch sieve and not more than 5 percent passing a No. 8 sieve.
- I. Filtering Material: Evenly graded mixture of natural or crushed gravel or crushed stone and natural sand, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 50 sieve.
- J. Sand: ASTM C33, fine aggregate.
- K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.02 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility.
- B. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick minimum, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 2'-6" deep.
 - 1. Tape Colors: Provide tape colors to utilities as follows:
 - a. Red: Electric.
 - b. Yellow: Gas, oil, steam, and dangerous materials.
 - c. Orange: Telephone and other communications.
 - d. Blue: Water systems.
 - e. Green: Sewer systems, incl. storm drain.
 - f. White: Steam systems.
- C. Filter Fabric: Manufacturer's standard non-woven pervious geotextile fabric of polypropylene, nylon or polyester fibers, or a combination.
 - 1. Provide filter fabrics that meet or exceed the listed minimum physical properties determined according to ASTM D 4759 and the referenced standard test method in parentheses:
 - a. Grab Tensile Strength (ASTM D 4632): 120 lb.

- b. Apparent Opening Size (ASTM D 4751): #70 U.S. Standard sieve.
 - c. Permeability (ASTM D 4491): 150 gallons per minute per sq. ft.
- D. Filter Fabric for Infiltration Trenches
- 1. A Class “C” geotextile or better shall interface between the trench side walls and between the stone reservoir gravel filter layers. A partial list of non-woven filter fabrics that meet the lass “C” criteria follows. Any alternative filter fabric must be approved by the Architect.
 - a. Mirafi 180-N
 - b. Amoco 4552
 - c. Webtec N70
 - d. Geolon N70
 - e. Carthage FX-80S
- E. Subsurface Drainage Geotextile: Manufacturer's standard non-woven needle punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters, with elongation greater than 50 percent, complying with AASHTO M 288 and the following, measured per test methods referenced:
- 1. Survivability: Class 2, AASHTO M 288.
 - 2. Apparent Opening Size: [No. 40 (0.425-mm)] [No. 60 (0.250-mm)] [No. 70 (0.212-mm)] sieve maximum, ASTM D 4751.
 - 3. Permittivity: [0.5] [0.2] [0.1] per second minimum, ASTM D 4491.
 - 4. UV Stability: 50 percent after 500 hours' exposure, ASTM D 4355.
- F. Separation Geotextile: Manufacturer's standard woven geotextile, manufactured for separation applications, made from polyolefins or polyesters, with elongation less than 50 percent, complying with AASHTO M 288 and the following, measured per test methods referenced:
- 1. Survivability: Class 2, AASHTO M 288.
 - 2. Apparent Opening Size: No. 60 (0.250-mm) sieve maximum, ASTM D 4751.
 - 3. Permittivity: 0.02 per second minimum, ASTM D 4491.
 - 4. UV Stability: 50 percent after 500 hours' exposure, ASTM D 4355.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Provide erosion control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Tree protection is specified in the "Site Clearing" Section.
- D. Prepare subgrade and place base materials in accordance with sections 301-1.2 and 301-2, respectively, of the Reference Specification.

3.02 DEWATERING

- A. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

3.03 EXCAVATION

- A. General: Shall be to the contours and dimensions indicated. Keep excavations free from water and debris while construction is in progress. Notify the Owner immediately in writing where it becomes necessary to remove hard, soft, weak, or wet material to a depth greater than indicated. Unless otherwise indicated, concrete placed below grade will be formed and excavations shall allow for placement and removal of forms. Side cuts shall be cribbed and shored as required.
- B. Explosives: Do not use explosives.
- C. Unclassified Excavation: Excavation is unclassified and includes excavation to required subgrade elevations regardless of the character of materials and obstructions encountered.

3.04 STABILITY OF EXCAVATIONS

- A. Comply with local codes, ordinances, and requirements of authorities having jurisdiction to maintain stable excavations.
- B. Unshored Temporary Excavations: Unshored temporary excavations may be sloped back at 1 to 1 (horizontal to vertical) or flatter. Where sloped

embankments are used, the tops of the slopes should be barricaded to prevent vehicles and storage loads within seven feet of the tops of the slopes. If the temporary construction slopes will be maintained during the rainy season, construct berms along the tops of the slopes where necessary to prevent run-off water from entering the excavation and eroding the slope faces.

3.05 EXCAVATION FOR STRUCTURES

A. Excavation Limits: Shall be to a tolerance of plus-or-minus 0.10 foot and shall extend at least five feet laterally beyond the building limits at the excavation level. The excavation side slopes shall not exceed a slope ratio of 1 to 1, horizontal to vertical, unless they are positively retained by shoring or other approved methods. Over-excavation side slopes may be vertical, as long as they are no higher than allowed by the State of California Construction Safety Orders, in which case they shall be no steeper than 1 to 1. If cut below depths indicated, excavations shall be filled with concrete when the foundations or footings are placed.

1. Excavations for Footings and Foundations:

a. Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

b. Excavations shall be such that all footings be founded on at least [] feet of properly compacted soil. This [] feet shall consist of compacted fill; or, in cases where the footing bottom would otherwise be in cut, may consist of as little as [one][] feet of over-excavation, with [one] [] foot of scarified and compacted existing soil beneath the excavation (i.e. the total over-excavation may only need to be [] feet). This determination shall be made in the field by the geotechnical engineer.

2. Pile Foundations: Stop excavations [] inches above bottom of the supported foundations before piles are placed. After piles have been placed, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.

3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Appurtenances: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 0.10 foot. Do not disturb bottom of excavations intended for bearing surface.

3.06 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavations shall be such that all walks and pavements are founded on at least [2] [] feet of properly compacted soil. This determination shall be made in the field by the geotechnical engineer.

3.07

EXCAVATION FOR UTILITY TRENCHES

- A. Excavation made with power-driven equipment is not permitted within two feet of any known utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, use hand or light equipment excavation. Start hand or light equipment excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines and other existing work affected by the excavation work of this Section until approval for backfill is granted by the geotechnical engineer. Immediately report damage to utility lines or subsurface construction to the Owner.
- B. Where unidentified existing utilities are encountered, determine whether these are active or abandoned. Remove interfering portions of abandoned utilities and cap or plug open ends of pipe to remain. The cap or plug must seal the opening in such a manner that would permit remaining portions of the utility to be reactivated. Notify Owner for instructions on utilities which are determined to be active. Do not proceed without instructions, except to correct an immediate hazard or emergency condition. Relocation work performed on an active utility without obtaining prior approval from Owner shall be done at the Contractor's expense and liability.
- C. In areas where compacted backfill has been placed, additional consolidation may occur after completion due to changes in moisture content and surcharge. Utility connections crossing this backfill, and improvements adjoining the building at the backfill line shall be installed taking into account this additional consolidation, or sufficient time shall be scheduled between backfilling operations and such improvements to allow this consolidation to take place. Damage to utilities or other improvements due to Contractor's negligence in regard to this paragraph shall be repaired at the Contractor's expense.
- D. Protect newly backfilled areas and adjacent structures, slopes, or grades from traffic, erosion settlement, and any other damage. Repair and re-establish damaged or eroded grades and slopes and restore surface construction prior to acceptance.
- E. Cutting Pavement, Curbs, and Gutters: Saw cut with neat, parallel, straight lines one foot wider than trench width on each side of trenches and one foot beyond each edge of pits. If an existing pavement joint or cracked area is within two feet outside of a designated sawcut line shown on the Drawings, removal and resurfacing shall be to that joint, and/or shall include the crack or cracked area, unless otherwise approved by Architect.
- F. Contractor shall pothole at all identifiable crossings of existing utilities prior to any trenching operations and provide Architect with a survey of the top elevations (and bottom elevations, if applicable), of possible interferences so that an evaluation of necessary adjustments to the current profile or alignment may be

made. Additionally, Architect shall be given the opportunity to view possible conflicts in the field prior to providing revised designs.

- G. Provide a minimum cover from grade of 3 feet for water mains and gas mains. Storm drains and sewers shall be to the depths indicated. Where settlements greater than the tolerance allowed herein for grading occur in trenches and pits due to improper compaction, excavate to the depth necessary to rectify the problem, then backfill and compact the excavation as specified herein and restore the surface to the required elevation.
- H. Keep excavations free from water while construction is in progress.
- I. Notify the Owner immediately in writing if it becomes necessary to remove rock or hard, unstable, or otherwise unsatisfactory material to a depth greater than indicated. Excavate large rock, boulders, and other unyielding material to an overdepth at least 6 inches below the bottom of the pipe, conduit, duct and appurtenances, unless otherwise indicated or specified. Over-excavate soft, weak, or wet excavations to an overdepth at least 12 inches below the bottom of the pipe, conduit, duct or appurtenances unless otherwise indicated or specified.
- J. Excavate trenches to indicated slopes, lines, depths, and invert elevations.
 - 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- K. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, except where sloping of sides is allowed. Sides of trenches shall not be sloped from the bottom of the trench up to the elevation of the top of the pipe. See plans for detail.
- L. At the option of the Contractor, the excavations may be cut to an overdepth of not less than 4 inches and refilled to required grade as specified.
- M. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove stones and sharp objects to avoid point loading.
 - 1. For pipes or conduit less than 6 inches in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
 - 2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
 - 3. Dig bell holes and depressions for joints after trench has been graded. Dimension of bell holes shall be as required for properly making the

particular type of joint to ensure that the bell does not bear on the bottom of the excavation.

3.08 APPROVAL OF SUBGRADE

- A. Notify Architect when excavations have reached required subgrade.
- B. When Architect determines that unforeseen unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
 - 1. Unforeseen additional excavation and replacement material will be paid according to the Contract provisions for changes in Work.
- C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Architect.

3.09 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending indicated bottom elevation of concrete foundation or footing to excavation bottom, without altering required top elevation. Lean concrete fill with 28-day compressive strength of 2500 psi (17.2 MPa), may be used to bring elevations to proper position when acceptable to the Architect.
 - 1. Fill unauthorized excavations under other construction as directed by the Architect.
- B. Where indicated widths of utility trenches are exceeded, provide stronger pipe, or special installation procedures, as required by the Architect.

3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile excavated materials acceptable for backfill and fill soil materials, including acceptable borrow materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent wind-blown dust.
 - 1. Stockpile soil materials away from edge of excavations a minimum distance of 7 feet or depth of excavation, whichever is greater. Do not store within drip line of remaining trees.

3.11 BACKFILL

- A. Backfill excavations promptly, but not before completing the following:
 - 1. Acceptance of construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
 - 2. Surveying locations of underground utilities for record documents.

3. Testing, inspecting, and approval of underground utilities.
4. Concrete formwork removal.
5. Removal of trash and debris from excavation.
6. Removal of temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

3.12 UTILITY TRENCH BACKFILL AND COMPACTION

- A. Backfilling of exterior utility trenches shall not be undertaken until geotechnical engineer has received 24-hours notice, until required tests and inspections have been completed, and until as-built location notes have been furnished. Remove uninspected backfill in accordance with requirements of this specification. Use hand-operated, plate-type, vibratory, or other suitable hand tampers in areas not accessible to larger rollers or compactors. Avoid damaging pipes and protective pipe coatings.
- B. Place backfill material in accordance with Section 306-1.3.2 of the Reference Specifications and achieve at least 90% of the maximum density per ASTM D 1557. The top 12 inches of backfill in the building or paved areas shall be compacted to 95% of maximum density per ASTM D 1557.
- C. Compaction by ponding or flooding will not be permitted.
- D. Place and compact bedding course on rock and other unyielding bearing surfaces and to fill unauthorized excavations. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- E. Concrete backfill trenches that carry below or pass under footings and that are excavated within 18 inches of footings. Place concrete to level of bottom of footings.
- F. Provide 4-inch-thick concrete base slab support for piping or conduit with less than 2'-6" of cover below finish surface of roadways. After installation and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway base.
- G. Place and compact initial backfill of satisfactory soil material or aggregate base material, free of particles larger than 1 inch, to a height of 12 inches over the utility pipe or conduit.
 1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.

- H. Coordinate backfilling with utilities testing.
- I. Fill voids with approved backfill materials as shoring and bracing, and sheeting is removed.
- J. Place and compact final backfill of satisfactory soil material to final subgrade.
- K. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.
- L. Manholes and other appurtenances: Provide at least 12 inches clear from outer surfaces to the embankment or shoring. Remove rock as specified herein. Remove unstable soil that is incapable of supporting the structure to an over-depth of one foot and refill with gravel or sand to the proper elevation and compact to 95% percent of maximum density.

3.13 FILL

- A. Preparation: Remove vegetation, topsoil, debris, wet, and unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placing fills.
 - 1. Plow strip, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing surface.
- B. When subgrade or existing ground surface to receive fill has a density less than that required for fill, break up ground surface to depth required, pulverize, moisture-condition or aerate soil and re-compact to required density.
- C. Place fill material in layers to required elevations for each location listed below.
 - 1. Under grass, use satisfactory excavated or borrow soil material.
 - 2. Under walks and pavements, use base material or satisfactory excavated or borrow soil material.
 - 3. Under steps and ramps, use base material.
 - 4. Under building slabs, use drainage fill material.
 - 5. Under footings and foundations, use engineered fill.

3.14 MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to minimum 2 percent above optimum moisture content for cohesive soils and to near optimum for cohesionless soils.

1. Do not place backfill or fill material on surfaces that are muddy, frozen or contain frost or ice.
2. Remove and replace, or scarify and air-dry satisfactory soil material that is too wet to compact to specified density.
 - a. Stockpile or spread and dry removed wet satisfactory soil material.

3.15 COMPACTION

- A. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill materials evenly on all sides of structures to required elevations. Place backfill and fill uniformly along the full length of each structure. Keep rollers and other heavy equipment at least 18 inches from footings, foundations, piers and walls of buildings and accessory construction. Use mechanical and hand tampers weighing at least 90 pounds with a maximum face area of 48 inches square to compact backfill within 18 inches of construction and where access is restricted.
- C. Percentage of Maximum Dry Density Requirements: Compact soil to not less than the following percentages of maximum dry density according to ASTM D 1557:
 1. For general site fills, compact each layer of backfill or fill material at 90 percent maximum dry density.
 2. Under structures, building slabs, steps, and pavements, scarify and compact the top 12 inches below subgrade at 95 percent maximum dry density.
 3. Under walkways, scarify and compact the top 6 inches below subgrade at 90 percent maximum dry density.
 4. Under lawn or unpaved areas, compact the top 6 inches below subgrade at 85 percent maximum dry density.

3.16 GRADING

- A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 1. Provide a smooth transition between existing adjacent grades and new grades.
 2. Cut out soft spots, fill low spots, and trim high spots to conform to required surface tolerances.

3. All hillside grading or construction of fill slopes shall conform to the minimum standards listed in Chapter 70 of the UBC.
 4. Fill slopes shall be keyed and benched into firm, natural ground when the existing slope to receive the fill is 5:1 or steeper (horizontal to vertical). Keys shall be tilted into the slope, shall be a minimum of one equipment width wide and shall be a minimum of three [] feet deep at the outside edge.
 5. If necessary, the Contractor's selected equipment and construction procedure shall be altered, changed or modified in order to meet the specified compaction requirements. Flooding and water jetting is prohibited.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
1. Lawn or Unpaved Areas: Plus or minus 0.10 foot, unless otherwise indicated.
 2. Concrete Walks: Plus or minus 0.05 foot.
 3. Pavements:
 - a. Concrete: 0.02 foot minus, with no high spots.
 - b. Asphalt: 0.05 foot minus, with no high spots.
- C. Grading Inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.17 BASE COURSE

- A. Under pavements and walks, place base course material on prepared subgrades to pavements.
1. Compact base courses at optimum moisture content to required grades, lines, cross sections and thickness to not less than 95 percent relative compaction in accordance with ASTM D 1557 and ASTM D 4718.
 2. Shape base to required crown elevations and cross-slope grades.
 3. When thickness of compacted base course is 6 inches or less, place materials in a single layer.
 4. When thickness of compacted base course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.

3.18 DECOMPOSED GRANITE

- A. Install decomposed granite (DG) area[s] to [depth of ----- inches] [depths indicated].
- B. All DG shall be treated with “Stabilizer” soil additive (source: Santa Barbara Stone - Telephone (805) 963-5891) at a rate of one pound per ten square feet.
- C. Mix stabilizer thoroughly throughout total depth of DG with ‘rototiller’ or similar equipment. Grade and smooth surface of DG to desired finish and to the elevations shown. Apply water until moisture penetrates total depth of tilled area. Compact with small riding roller or vibrating plate tamp.

3.19 RIP-RAP CONSTRUCTION

- A. Construct rip-rap [on bedding material] [on filter fabric] [with grout] [in accordance with [____]]in the areas indicated.
- B. Penetration: Trim and dress indicated areas to conform to cross sections, lines and grades shown within a tolerance of 0.1 foot.
- C. Bedding Placement: Spread [filter fabric] bedding material uniformly to a thickness of at least [3] [__] inches on prepared subgrade as indicated. [Compaction of the bedding will not be required. Finish bedding to present even surface free from mounds and windrows.]
- D. Stone Placement: Place rock for rip-rap on the prepared bedding material to produce a well graded mass with the minimum practicable percentage of voids in conformance with lines and grades indicated. Distribute larger rock fragments (with dimensions extending the full depth of the rip-rap) throughout the entire mass and eliminate "pockets" of small rock fragments. Re-arrange individual pieces by mechanical equipment or by hand as necessary to obtain the distribution of fragment sizes specified above. [For grouted rip-rap, hand-place surface rock with open joints to facilitate grouting and do not fill smaller spaces between surface rock with finer material. Provide at least one "weep hole" through grouted rip-rap for every 50 square feet of finished surface. Weep holes shall consist of columns of bedding material, [4] inches in diameter, extending up to the surface of the rip-rap without grout.]
- E. Grouting: [Prior to grouting, wet all surfaces of the rip-rap. Grout the rip-rap in successive longitudinal strips, approximately 10 feet in width, commencing at the lowest strip and working up the slope. Distribute grout to place of final deposit and work into place between stones with brooms, spades, trowels, or vibrating equipment. Take adequate precautions to prevent grout from penetrating the bedding layer. Protect and cure the surface for a minimum of 7 days.

3.20 PAVEMENT REPAIR

- A. Repair or patch asphalt pavement as specified in Asphalt Paving Section. Repair or patch concrete pavement, curbs and gutters as specified in Concrete Paving Section. Do not repair pavement until trench has been backfilled and compacted as herein specified. [Provide a temporary road surface of [gravel] [crushed stone] over the backfill portion until permanent pavement is repaired. Remove and dispose of temporary road surface material when permanent pavement is placed. As a minimum, maintain one-way traffic on roads and streets crossed by trenches; roads and streets shall be fully opened to traffic within [____] days.]

3.21 FIELD QUALITY CONTROL

- A. Testing Agency Services: Allow testing agency to inspect and test each subgrade and each fill or backfill layer. Do not proceed until test results for previously completed work verify compliance with requirements.
 - 1. Perform field in-place density tests according to ASTM D 1556 (sand cone method), ASTM D 2167 (rubber balloon method), or ASTM D 2937 (drive cylinder method), as applicable.
 - a. Field in-place density tests may also be performed by the nuclear method according to ASTM D 6938, provided that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D 1556. With each density calibration check, check the calibration curves furnished with the moisture gages according to ASTM D 6938.
 - b. When field in-place density tests are performed using nuclear methods, make calibration checks of both density and moisture gages at beginning of work, on each different type of material encountered, and at intervals as directed by the Architect.
 - 2. Footing Subgrade: At footing subgrades, perform at least one test of each soil stratum to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of each subgrade with related tested strata when acceptable to the Architect.
 - 3. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, perform at least one field in-place density test for every 2,000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
 - 4. Foundation Wall Backfill: In each compacted backfill layer, perform at least one field in-place density test for each 100 feet or less of wall length, but no fewer than two tests along a wall face.
 - 5. Trench Backfill: In each compacted initial and final backfill layer, perform at least one field in-place density test for each 150 feet or less of trench, but no fewer than two tests.

- B. When testing agency reports that subgrades, fills, or backfills are below specified density, scarify and moisten or aerate, or remove and replace soil to the depth required. Re-compact and retest until required density is obtained.

3.22 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and re-establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace material to depth directed by the Architect; reshape and re-compact at optimum moisture content to the required density.
- C. Settling: Where settling occurs during the Project correction period, remove finished surfacing, backfill with additional approved material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.23 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off the Owner's property.

3.24 INFILTRATION FACILITIES

- A. Infiltration Trenches
 - 1. The infiltration trench systems shall not receive run-off until the entire contributing drainage area to the infiltration system has received final stabilization.
 - 2. Heavy equipment and traffic shall be restricted from traveling over the infiltration trench to minimize compaction of the soil.
 - 3. Excavate the infiltration trench to the design dimensions. Excavated materials shall be placed away from the trench sides to enhance trench wall stability. Large tree roots must be trimmed flush with the trench sides in order to prevent fabric puncturing or tearing of the filter fabric during subsequent installation procedures. The side walls of the trench shall be roughened where sheared and sealed by heavy equipment.

4. The width of the geotextile must include sufficient material to conform to trench perimeter irregularities and for a 6-inch minimum top overlap. The filter fabric shall be tucked under the sand layer on the bottom of the infiltration trench for a distance of 6 to 12 inches. Stones or other anchoring objects should be placed on the fabric at the edge of the trench to keep the trench open during windy periods. When overlaps are required between rolls, the uphill roll should lap a minimum of 2 feet over the downhill roll in order to provide a shingled effect
5. A 6-inch sand filter layer may be placed on the bottom of the infiltration trench in lieu of filter fabric, and shall be compacted using plate compactors. The sand for the infiltration trench shall be washed and meet AASHTO Std. M-43, Size No. 9 or No. 10. Any alternative sand gradation must be approved by the Engineer or the reviewing agency.
6. The stone aggregate shall be placed in lifts and compacted using plate compactors. A maximum loose lift thickness of 12 inches is recommended. The gravel (Rounded "Bank Run" gravel is preferred) for the infiltration trench shall be washed and meet one of the following AASHTO Std. M-43; Size No. 2 or No. 3.
7. Following the stone aggregate placement, the filter fabric shall be folded over the stone aggregate to form a 6-inch minimum longitudinal lap. The desired fill soil or stone aggregate shall be placed over the lap at sufficient intervals to maintain the lap during subsequent backfilling.
8. Care shall be exercised to prevent natural or fill soils from intermixing with the stone aggregate. All contaminated stone aggregate shall be removed and replaced with uncontaminated stone aggregate.
9. Voids between the fabric and the excavation sides shall be avoided.
10. Perforated pipes shall terminate and be capped 1 foot short of the infiltration trench wall.
11. The observation well is to consist of 6-inch diameter PVC Schedule 40 pipe (ASTM Std. D 1784) with a cap set 6 inches above ground level and is to be located near the longitudinal center of the infiltration trench. The pipe shall have a plastic collar with ribs to prevent rotation when removing cap. The screw top lid shall be a "Panella" type cleanout with a locking mechanism or special bolt to discourage vandalism. A perforated (1/2 inch in diameter) PVC Schedule 40 pipe shall be provided and placed vertically within the gravel portion of the infiltration trench and a cap provided at the bottom of the pipe. The bottom of the cap shall rest on the infiltration trench bottom.
12. If a distribution structure with a wet well is used, a 4-inch PVC drain pipe shall be provided at opposite ends of the infiltration trench distribution

structure. Two (2) cubic feet of porous backfill meeting AASHTO Std. M-43 Size No. 57 shall be provided at each drain.

13. If a distribution structure is used, the manhole cover shall be bolted to the frame.

B. Infiltration Basins

1. The sequence of various phases of basin construction shall be coordinated with the overall project construction schedule. The partially excavated basin, however, **shall not** serve as a temporary sedimentation basin.
2. Initial basin excavation shall be carried to within 1 foot of the final elevation of the basin floor. Final excavation to the finished grade shall be deferred until all disturbed areas on the watershed have been stabilized or protected. The final phase excavation shall remove all accumulated sediment. Relatively light tracked equipment is recommended for this operation to avoid compaction of the basin floor. After the final grading is completed in the basin, provide a well-aerated, highly porous surface texture.
3. Heavy equipment and traffic shall be restricted from traveling over the infiltration trench to minimize compaction of the soil.
4. The stone aggregate shall be placed in lifts and compacted using plate compactors. A maximum loose lift thickness of 12 inches is recommended. The gravel (Rounded "Bank Run" gravel is preferred) for the infiltration trench shall be washed and meet one of the following AASHTO Std. M-43; Size No. 2 or No. 3.
5. Following the stone aggregate placement, the filter fabric shall be folded over the stone aggregate to form a 6-inch minimum longitudinal lap. The desired fill soil or stone aggregate shall be placed over the lap at sufficient intervals to maintain the lap during subsequent backfilling.

END OF SECTION

SECTION 32 1216

ASPHALT PAVING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:

1. Hot-mix asphalt paving.
2. Hot-mix asphalt patching.
3. Asphalt surface treatments:
 - a. Fog seals.
 - b. Slurries.
4. Wheel stops.
5. Subgrade preparation.
6. Pervious bituminous base course and paving.

- B. Related Sections include the following:

1. "Earth Moving" Section for aggregate base courses and aggregate pavement shoulders.
2. "Concrete Paving Joint Sealants" Section for joint sealants and fillers at paving terminations.
3. "Pavement Marking" Section for pavement marking requirements.

1.03 SYSTEM DESCRIPTION

- A. Provide hot-mix asphalt pavement and/or pervious asphalt paving according to the materials, workmanship, and other applicable requirements of the following standard specifications:

1. Reference Specification: Perform all work in accordance with applicable provisions of "Standard Specifications for Public Works Construction", latest edition. Unless otherwise noted, mention herein of section numbers refers to sections of the Reference Specification. Where Reference Specification refers to "Agency", substitute the word "Owner". Where Reference Specification refers to "Engineer", substitute the word "Architect". Where Reference Specification is in conflict with these Specifications, these Specifications shall govern.
2. Measurement and payment provisions and safety program submittals included in Reference Specifications do not apply to this Section.
3. The latest edition of the Asphalt Institute's publication "The Asphalt Handbook".
4. Standard Specifications, July 1999 or latest edition; California Department of Transportation (Caltrans).
5. California Test Methods, latest edition; California Department of Transportation (Caltrans) Transportation Laboratory.
6. Standards of the American Association of State Highway and Transportation Officials (AASHTO), 1998 or latest edition. Standards of the American Association of State Highway and Transportation Officials (AASHTO), 1998 or latest edition.

1.04 SUBMITTALS

- A. Product Data: For each product specified. Include technical data and tested physical and performance properties.
- B. Job-Mix Designs: For each job mix proposed for the Work.
- C. Material Certificates: Certificates signed by manufacturers certifying that each material complies with requirements.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed hot-mix asphalt paving similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Manufacturer Qualifications: Engage a firm experienced in manufacturing hot-mix asphalt similar to that indicated for this Project and with a record of successful in-service performance.
- C. Regulatory Requirements: Conform to applicable standards of authorities having jurisdiction for asphalt paving work on public property.

- E. Asphalt-Paving Publication: Comply with Asphalt Institute's "The Asphalt Handbook," except where more stringent requirements are indicated.
- F. Pre-installation Conference: Conduct conference at Project site to comply with requirements of Division 01 Section "Project Management and Coordination" Review methods and procedures related to asphalt paving including, but not limited to, the following:
 - 1. Review condition of substrate and preparatory work performed by other trades.
 - 2. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
 - 3. Review and finalize construction schedule for paving and related work. Verify availability of materials, paving Installer's personnel, and equipment required to execute the Work without delays.
 - 4. Review inspection and testing requirements, governing regulations, and proposed installation procedures.
 - 5. Review forecasted weather conditions and procedures for coping with unfavorable conditions.

1.06 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if substrate is wet or excessively damp or if the following conditions are not met:
 - 1. Prime and Tack Coats: Minimum surface temperature of 60 deg F (15.6 deg C).
 - 2. Slurry Coat: Comply with weather limitations of ASTM D 3910.
 - 3. Asphalt Base Course: Minimum surface temperature of 40 deg F (4.4 deg C) and rising at time of placement.
 - 4. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.6 deg C) at time of placement.
 - 5. Pervious Bituminous Paving Mixtures: Minimum surface temperature of 55 deg. F (12.5 deg. C) at time of placement.

PART 2 - PRODUCTS

2.01 ASPHALT PAVEMENT MATERIALS

Note to Engineer: Performance Grades shall be selected based upon the area of California in which the project is located, as follow: PG 64-10 for the Central Coast, Inland Valley and South Coast; 64-16 for the North Coast, Low Mountains and South Mountains; 64-28 for the High Desert and High Mountains; and 70-10 for the Desert.

- A. Asphalt Pavement Leveling Course: Conform to Performance Grade [B-PG 64-10] [B-PG 64-16] [B-PG 64-28] or [B-PG 70-10] in section 203-1.2 and section 203-6 of the Reference Specification.
- B. Asphalt Pavement Wearing (Surface) Course : Conform to Performance Grade [III C2-PG 64-10] [III C3-PG 64-10] [III C2-PG 64-16] [III C3-PG 64-16] [III C2-PG 64-28] [III C3-PG 64-28] [C1-PG 70-10] [C2-PG 70-10] [C1-PG 64-28] [C2-PG 64-28] [] in section 203-1.2 and section 203-6
[and section 400-4 *to be used with Class III asphalt*] of the Reference Specification.]
- C. Full Depth Asphalt: When asphalt is to be laid in one lift, conform to Asphalt Concrete Leveling Course.

Note to Engineer: The above method shall NOT be used for parking lots or where any pedestrian traffic is expected. Leveling courses may always be laid in one lift.

- D. Prime Coat: Grade SC-70 liquid asphalt conforming to section 203-2 of the Reference Specification.
- E. Tack Coat: Emulsified asphalt grade SS-1h conforming to section 203-3 of the Reference Specification.
- F. Asphalt Paint: conform to ASTM D41 or D43 per Section 203-8 of the Reference Specification.

Note to Engineer: Slurries shall NOT be used on new pavements. Obtain manufacturer's recommendation for minimum waiting period.

- G. Slurry Seal: Emulsified asphalt grade [SS-1h] [CSS-1h] and aggregate conforming to section 203.5 of the Reference Specification.
- H. Fog Seal: ASTM D 977, emulsified asphalt or ASTM D 2397, cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.
- I. Water: Potable.
- J. Pervious Bituminous Asphalt:
 - 1. Bituminous surface course for pervious paving shall be three (3.0) inches thick with a bituminous mix of 5.5% to 6% by weight dry aggregate. In accordance with ASTM D6390, draindown of the binder shall be no

greater than 0.3%. If more absorptive aggregates, such as limestone, are used in the mix then the amount of bitumen is to be based on the testing procedures outlined in the National Asphalt Pavement Association's Information Series 115 – "Design, Construction, and Maintenance of Open-Graded Asphalt Friction Courses" (2002) or Caltrans equivalent (California Test 368).

2. Use neat asphalt binder modified with an elastomeric polymer to produce a binder meeting the requirements of PG 76-10. The elastomeric polymer shall be styrene-butadiene-styrene (SBS), or approved equal, applied at a rate of 3% by total weight of the binder. The composite materials shall be thoroughly blended at the asphalt refinery or terminal prior to being loaded into the transport vehicle. The polymer modified asphalt binder shall be heat and storage stable.

The Contractor shall submit a certification letter from the polymer-modified asphalt supplier to the Engineer before the mix is placed on the project. The certification letter from the supplier will include the following:

- a. Type of elastomer polymer used to modify the asphalt.
- b. Quality control sampling and testing procedures used to certify the polymer modified asphalt prior to shipping to the Contractor's asphalt plant.
- c. Information on the storage and stability of the polymer modified asphalt.
- d. Recommended mixing and compaction temperatures.
- e. A statement saying that the polymer modified asphalt will comply with these specifications.

3. Aggregate grading in the asphalt mix shall be:

U.S. Stand ard Sieve Size	Percent P a s s i n g
½" (12.5 mm)	100
3/8" (9.5m m)	92-98
4 (4.75mm)	32-38
8 (2.36mm)	12-18
16	7-13

(1.18 mm)	
30 (600 µm)	0-5
200 (75 µm)	0-3

4. Add hydrated lime at a dosage rate of 1.0% by weight of the total dry aggregate to mixes containing granite. Hydrated lime shall meet the requirements of ASTM C 977. The additive must be able to prevent the separation of the asphalt binder from the aggregate and achieve a required tensile strength ratio (TSR) of at least 80% on the asphalt mix when tested in accordance with California Test 371. The asphaltic mix shall be tested for its resistance to stripping by water in accordance with ASTM D-3625 or California Test 302. If the estimated coating area is not above 95 percent, anti-stripping agents shall be added to the asphalt.

2.02 AUXILIARY MATERIALS

- A. Herbicide Treatment: Commercial chemical for weed control, registered by Environmental Protection Agency (EPA). Provide granular, liquid, or wettable powder form.
- B. Sand: ASTM D 1073, Grade Nos. 2 or 3.
- C. Wheel Stops: Pre-cast, air-entrained concrete, 2500-psi (17.2-MPa) minimum compressive strength, approximately 6 inches (150 mm) high, 9 inches (225 mm) wide, and length as shown, reinforced with two No. 3 deformed steel bars. Provide chamfered corners and drainage slots on underside, and provide holes for anchoring to substrate.
 1. Dowels: Galvanized steel, diameter 3/4 inch (19 mm), minimum length 10 inches (254 mm).

PART 3 – EXECUTION (HOT-MIX ASPHALT)

3.01 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads.
- B. Subgrade and Base:
 1. Proof-roll [subgrade] [base course] using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.

- C. Notify Architect in writing of any unsatisfactory conditions. Do not begin paving installation until these conditions have been satisfactorily corrected.

3.02 COLD MILLING

- A. Cold mill existing asphalt concrete pavement in accordance with section 302-5.2 of the Reference Specification.

3.03 PATCHING AND REPAIRS

- A. Patching: Saw cut perimeter of patch and excavate existing pavement section to sound base. Re-compact new subgrade. Excavate rectangular or trapezoidal patches, extending 12 inches (300 mm) into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically.
 - 1. Tack coat faces of excavation and allow to cure before paving.
 - 2. Fill excavation with dense-graded, hot-mix asphalt base mix and, while still hot, compact flush with adjacent surface.
 - 3. Partially fill excavation with dense-graded, hot-mix asphalt base mix and compact while still hot. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.
- B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.
 - 1. Pump hot undersealing asphalt under rocking slabs until slab is stabilized or, if necessary, crack slab into pieces and roll to re-seat pieces firmly.
 - 2. Remove disintegrated or badly broken pavement. Prepare and patch with hot-mix asphalt.
- C. Leveling Course: Install and compact leveling course consisting of dense-graded, hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch (25 mm) in existing pavements.
 - 1. Install leveling wedges in compacted lifts not exceeding 3 inches (75 mm) thick.
- D. Crack and Joint Filling: Remove existing filler material from cracks or joints to a depth of 1/4 inch (6 mm). Refill with asphalt joint-filling material to restore watertight condition. Remove excess filler that has accumulated near cracks or joints.
- E. Asphalt paint: Apply uniformly to existing surfaces of previously constructed asphalt or Portland cement concrete paving and to surfaces abutting or projecting into new, hot-mix asphalt pavement. Apply at a uniform rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m) of surface.

1. Allow asphalt paint to cure undisturbed before paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.04 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
 1. Sweep loose granular particles from surface of unbound aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.
- B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
 1. Mix herbicide with prime coat when formulated by manufacturer for that purpose.
- C. Prime Coat: Comply with section 302-5.3 of the Reference Specification. Apply primer at a rate of between 0.20 and 0.25 gallons per square yard to top surface of base course prior to asphalt placement.
- D. Tack Coat: If a leveling course has been used for construction traffic, apply tack coat to all leveling course surfaces in accordance with section 302-5.4 of the Reference Specification at a rate of 0.10 gallons per square yard.
- E. Asphalt Paint: Apply uniformly to existing surfaces of previously constructed asphalt or Portland cement concrete paving and to surfaces abutting or projecting into new, hot-mix asphalt pavement. Apply at a uniform rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m) of surface.
 1. Allow asphalt paint to cure undisturbed before paving.
 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.05 GEOTEXTILE INSTALLATION

- A. Apply bond coat, consisting of asphalt cement, uniformly to existing surfaces at a rate of 0.20 to 0.30 gal./sq. yd. (0.8 to 1.2 L/sq. m).
- B. Place paving geotextile promptly according to manufacturer's written instructions. Broom or roll geotextile smooth and free of wrinkles and folds. Overlap longitudinal joints 4 inches (100 mm) and transverse joints 6 inches (150 mm).

1. Protect paving geotextile from traffic and other damage and place overlay paving the same day.

3.06 HOT-MIX ASPHALT PLACING

- A. The asphalt pavement shall be completed in phases; the leveling course during construction for temporary construction traffic and storage of materials and; the wearing (surface) course just prior to turnover to Owner; unless the entire paving operation is completed just prior to turnover to the Owner. If this method is chosen, then no construction traffic or storage of materials shall be allowed on the finished pavement surface after its completion. Contractor shall schedule final surface course paving operations so that the required waiting period specified in the "Pavement Marking" Section will allow project completion within the specified time.
- B. Construct asphalt pavement in accordance with section 302-5 of the Reference Specification and as shown on the Drawings.
- C. Two Layer Method: The leveling course shall be installed to elevations which will allow the future placement of a wearing (surface) course no thinner than 1-1/2 inches. Prior to placing the wearing (surface) course, repair all areas damaged during construction use, thoroughly clean the leveling course of all loose material and place a tack coat pursuant to paragraph 3.4.D. herein.

Contractor is further cautioned that the use of this two-layer method will result in construction traffic using pavements which are thinner than designed for the traffic expected for the completed project, and that damage due to wheel loads and materials storage during construction is probable. Any such damage shall be repaired to the satisfaction of the Architect and the Owner prior to placement of the surface course.

3.07 JOINTS

- A. Construct joints to ensure continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course.
 1. Clean contact surfaces and apply tack coat.
 2. Offset longitudinal joints in successive courses a minimum of 6 inches (150 mm).
 3. Offset transverse joints in successive courses a minimum of 24 inches (600 mm).
 4. Construct transverse joints by bulkhead method or sawed vertical face method as described in AI's "The Asphalt Handbook."

5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.08 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.
 1. Complete compaction before mix temperature cools to 185 deg F (85 deg C).
- B. Breakdown Rolling: Accomplish breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Repair surfaces by loosening displaced material, filling with hot-mix asphalt, and re-rolling to required elevations.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling, while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
 1. Average Density: 96 percent of reference laboratory density according to ASTM D 1559, but not less than 94 percent nor greater than 100 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while still hot, with back of rake or smooth iron. Compact thoroughly using tamper or other satisfactory method.
- F. Repairs: Remove paved areas that are defective, pond water or are contaminated with foreign materials. Remove paving course over area affected and replace with fresh, hot-mix asphalt, with a thickness one inch greater than the existing, and to match existing finish surface grades such that no local ponding of water will result. Compact by rolling to specified density and surface smoothness. Note that no application of seal coats of any kind will be allowed for any reason on pavements newer than one year. This is to allow for proper curing of the newly placed asphalt pavement, as recommended by The Asphalt Institute.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.09 INSTALLATION TOLERANCES

- A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:
 - 1. Leveling Course: Plus or minus 1/2 inch (13 mm).
 - 2. Surface Course: Plus 1/4 inch (6 mm), no minus.
- B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:
 - 1. Leveling Course: 1/4 inch (6 mm).
 - 2. Surface Course: 1/8 inch (3 mm).
 - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch (6 mm).

3.10 ASPHALT CURBS

- A. Construct hot-mix asphalt curbs over compacted pavement surfaces. Apply a light tack coat, unless pavement surface is still tacky and free from dust. Spread mix at minimum temperature of 250 deg F (121 deg C).
 - 1. Asphalt Mix: Same as pavement surface-course mix.
- B. Place hot-mix asphalt to curb cross section indicated or, if not indicated, to local standard shapes, by machine or by hand in wood or metal forms. Tamp hand-placed materials and screed to smooth finish. Remove forms after hot-mix asphalt has cooled.

3.11 SURFACE TREATMENTS

- A. Fog Seals: Apply fog seal at a rate of 0.10 to 0.15 gal./sq. yd. (0.45 to 0.70 L/sq. m) to existing asphalt pavement and allow to cure. Lightly dust areas receiving excess fog seal with a fine sand.
- B. Slurry seals: Apply in accordance with section 302-4 of the Reference Specification.
 - 1. Roll slurry seal to smooth ridges and provide a uniform, smooth surface.

3.12 WHEEL STOPS

- A. Allow new pavement surfaces to cure for a period of not less than 30 days before installation of wheel stops.
- B. Install in the locations shown on the Drawings, and in an even alignment.
- C. Install wheel stops over clean and dry surfaces.
- D. Securely attach wheel stops into pavement with not less than 2 galvanized steel dowels embedded in precast concrete at one-third points. Firmly bond each dowel to wheel stop and to pavement.
 - 1. Extend upper portion of dowel 5 inches (125 mm) into wheel stop and lower portion a minimum of 5 inches (125 mm) into pavement.

3.13 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing agency to perform field inspections and tests and to prepare test reports.
 - 1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from specified requirements.
- B. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.
- C. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
- D. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- E. Finish Grade: Completed pavement surface shall be tested for proper drainage through flood testing. Contractor shall schedule a flood test to be held in the presence of the Architect and the Owner to assure that the finished pavement surfaces are consistent with the intent of the Grading Plans with respect to surface drainage, and that drainage devices function properly. It is suggested that a water truck or fire hose be used for the flooding; garden hoses will not be acceptable. Pavements not deemed acceptable subsequent to this test shall be removed and replaced pursuant to paragraph 3.3 herein. Overlays with thicknesses less than 1-1/2 inches will not be acceptable for these repairs.
- F. In-Place Density: Samples of uncompacted paving mixtures and compacted pavement will be secured by testing agency according to ASTM D 979.
 - 1. Reference laboratory density will be determined by averaging results from 4 samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 1559, and compacted according to job-mix specifications.

2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
 - a. One core sample will be taken for every 1000 sq. yd. (836 sq. m) or less of installed pavement, but in no case will fewer than 3 cores be taken.
 - b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
- G. Replace and compact hot-mix asphalt where core tests were taken.
- H. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

PART 4 – EXECUTION (PERVIOUS ASPHALT)

4.01 INSTALLATION

A. Pervious Bituminous Asphalt

1. Transporting Material

- a. Transporting of mix to the site shall be in vehicles with smooth, clean dump beds that have been sprayed with a non-petroleum release agent.
- b. The mix shall be covered during transport to control cooling.

2. Pervious bituminous asphalt shall not be stored in excess of 90 minutes before placement.

3. Asphalt Placement

- a. The pervious bituminous surface course shall be laid in one lift directly over the storage bed and stone base course to a 3.0-inch finished thickness.
- b. The laying temperature of the bituminous mix shall be between 300 degrees Fahrenheit and 350 degrees Fahrenheit (based on recommendations of the asphalt supplier).
- c. Installation shall take place when ambient temperatures are 55 degrees Fahrenheit or above, when measured in the shade away from artificial heat.
- d. The use of a remixing material transfer device between the trucks and the paver is highly recommended to eliminate cold lumps in the mix.

- e. The polymer-modified asphalt is very difficult to rake, a well-heated screed should be used to minimize the need for raking.
 - f. Compaction of the surface course shall take place when the surface is cool enough to resist a 10-ton roller. One or two passes is all that is required for proper compaction. More rolling could cause a reduction in the surface porosity which is unacceptable.
- 4. After final rolling, no vehicular traffic of any kind shall be permitted on the surface until cooling and hardening has taken place, and in no case within the first 48 hours. Provide barriers as necessary at no extra cost to the Owner to prevent vehicular use; remove at the discretion of the Engineer.
 - 5. Work shall be done expertly throughout, without staining or injury to other work.

Transition to adjacent impervious bituminous paving shall be merged neatly with flush, clean line. Finished paving shall be even, without pockets, and graded to elevations shown on drawing.

- 6. Pervious pavement beds shall not be used for equipment or materials storage during construction, and under no circumstances shall vehicles be allowed to deposit soil on paved pervious surfaces.
- 7. Repair of Damaged Paving
 - a. Any existing paving on or adjacent to the site that has been damaged as a result of construction work shall be repaired to the satisfaction of the Owner without additional cost to the Owner.
- 8. Field Quality Control
 - a. The full permeability of the pavement surface shall be tested by application of clean water at the rate of at least 5 gpm over the surface, using a hose or other distribution device. Water used for the test shall be clean, free of suspended solids and deleterious liquids and will be provided at no extra cost to the Owner. All applied water shall infiltrate directly without puddle formation or surface runoff, and shall be observed by the Engineer and Owner.
 - b. Testing and Inspection: Employ at Contractor's expense an inspection firm acceptable to the Engineer and Owner to perform soil inspection services, staking and layout control, and testing and inspection of site grading and pavement work. Inspection and list of tests shall be reviewed and approved in writing by the Engineer prior to starting construction. All test reports must be signed by a licensed Engineer.

- c. Test in-place base and surface course for compliance with requirements for thickness and surface smoothness. Repair or remove and replace unacceptable work as directed by the Owner.
- d. Surface Smoothness: Test finished surface for smoothness and even drainage, using a ten-foot to centerline of paved area. Surface will not be accepted if gaps or ridges exceed 3/16 of an inch.

9. Grade Control

- a. Establish and maintain required lines and elevations. The Engineer shall be notified for review and approval of final stake lines for the work before construction work is to begin. Finished surfaces shall be true to grade and even, free of roller marks and free of low spots to form puddles. All areas must drain.
- b. If, in the opinion of the Owner, based upon reports of the testing service and inspection, the quality of the work

4.02 DISPOSAL

- A. Except for material indicated to be recycled, remove excavated materials from the Project site and legally dispose of them in an Environmental Protection Agency (EPA)-approved landfill.
 - 1. Do not allow milled materials to accumulate on-site.

END OF SECTION

SECTION 32 1313

CONCRETE PAVING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes exterior Portland cement concrete paving for the following:
 - 1. Roadways.
 - 2. Curbs and gutters.
 - 3. Walkways.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. "Earth Moving" Section for subgrade preparation, grading and base course.
 - 2. "Cast-in-Place Concrete" Section for general building applications of concrete.
 - 3. "Concrete Paving Joint Sealants" Section for joint fillers and sealants within concrete paving and at joints with adjacent construction.
 - 4. "Pavement Marking" Section for pavement marking requirements.

1.03 SYSTEM DESCRIPTION

- A. Provide concrete pavement according to the materials, workmanship, and other applicable requirements of the following standard specifications:
 - 1. Reference Specification: Perform all work in accordance with applicable provisions of "Standard Specifications for Public Works Construction", latest edition. Unless otherwise noted, mention herein of section numbers refers to sections of the Reference Specification. Where Reference Specification refers to "Agency", substitute the word "Owner". Where Reference Specification refers to "Engineer", substitute the word

"Architect". Where Reference Specification is in conflict with these Specifications, these Specifications shall govern.

2. Measurement and payment provisions and safety program submittals included in Reference Specifications do not apply to this Section.

1.04 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Design mixes for each class of concrete. Include revised mix proportions when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Product data for integral colored concrete pigments. Include manufacturer's instructions for mixing, placement, curing, and sealing.
- D. Minutes of pre-installation conference.
- E. LEED Submittals
 1. Submit proof that the solar reflectance index of the hard surface paving is at least SRI 29.
 2. Submit product data indicating percentage by weight of pre-consumer and post-consumer recycled content for each product having recycled content.
 3. Submit a statement or vendor's invoice indicating costs for each product having recycled content. Indicate relative dollar value of recycled content product to total dollar value of products included in the project.
 4. Submit cut sheets or manufacturer's technical data sheet indicating levels of recycled content for each material having recycled content.
 5. Submit statement of cost on a line-item basis and statement that the distance from place of extraction, harvest, recovery and manufacture to project site is within 500 miles and indicate relative dollar value of regional material product to total dollar value of products included in the project.
 6. Submit cut sheets or manufacturer's statement indicating location of extraction, harvest, recovery and manufacture.

1.05 QUALITY ASSURANCE

- A. Concrete Standards : Comply with provisions of the following standards, except where more stringent requirements are indicated.

1. American Concrete Institute (ACI)
 - a. 211.1, Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
 - b. 301, Specifications for Structural Concrete
 - c. 305.1, Specification for Hot Weather Concreting
 - d. 306.1, Standard Specification for Cold Weather Concreting
 - e. 318, Building Code Requirements for Structural Concrete and Commentary

2. American Society for Testing and Materials International (ASTM)
 - a. A 307, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength
 - b. A 615, Standard Specification for Deformed and Plain Carbon-Steel Bars
 - c. A 1064, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
 - d. C 31, Standard Specification for Making and Curing Concrete Test Specimens in the Field
 - e. C 33, Standard Specification for Concrete Aggregates
 - f. C 39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens for Concrete Reinforcement
 - g. C 42, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
 - h. C 94, Standard Specification for Ready-Mixed Concrete
 - i. C 143, Standard Test Method for Slump of Hydraulic-Cement Concrete
 - j. C 150, Standard Specification for Portland Cement
 - k. C 171, Standard Specification for Sheet Materials for Curing Concrete
 - l. C 172, Standard Practice for Sampling Freshly Mixed Concrete

- m. C 231, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
 - n. C 309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
 - o. C 881, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
 - p. C 979, Standard Specification for Pigments for Integrally Colored Concrete
 - q. C 1028, Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method
 - r. C 1059, Standard Specification for Latex Agents for Bonding Fresh To Hardened Concrete
 - s. C 1602, Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
 - t. D 2047, Standard Test Method for Static Coefficient of Friction of Polish- Coated Flooring Surfaces as Measured by the James Machine
3. American State Highway and Transportation Officials (AASHTO)
- a. M 182, Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats
- B. Concrete Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
- C. Concrete Testing Service: Engage a qualified independent testing agency to perform materials evaluation tests and to design concrete mixes.
- D. Field-Constructed Mockup: Cast mockup of size required (but not less than 10 feet by 10 feet) to demonstrate typical joints, surface finishes, textures, color, and standard of workmanship for------. One mockup per each broom finish, sack finish, and/or exposed aggregate finish shall be created.
- 1. Notify Architect a minimum of 4 days in advance prior to applying sandblast finish to mock-up. Apply sandblast finish in the presence of the Architect and adjust finish as required by the Architect.
 - 2. When Architect determines that mockup does not meet requirements, demolish and remove it from the site and cast another until the mockup is accepted.

3. Keep accepted mockup undisturbed during construction as a standard for judging completed paving. Undamaged mockup may be incorporated into the Work.
 4. Demolish accepted mockup and remove from site when directed by Architect.
- E. Pre-installation Conference: Conduct conference at Project site to comply with requirements of Section "Project Management and Coordination" and the following:
1. Before installing Portland cement concrete paving, meet with representatives of authorities having jurisdiction, Owner, Architect, consultants, independent testing agency, and other concerned entities to review requirements. Notify participants at least 3 working days before conference.

1.06 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.01 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other acceptable panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
1. Use flexible or curved forms for curves of a 100-foot or less radius.
- B. Form Release Agent: Provide commercial formulation form-release agent with a maximum of 350 g/L volatile organic compounds (VOCs) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Debond Form Coating, L & M Construction Chemicals.
 - b. Crete-Lease 880 VOC, Cresset Chemical Company.
 - c. MasterFinish Series, BASF Corporation

2.02 REINFORCING MATERIALS

- A. Reinforcing Bars and Tie Bars: ASTM A 615, Grade 40 for #3 bars and Grade 60 for bars larger than #3, deformed.
- B. Plain, Cold-Drawn Steel Wire: ASTM A 1064.
- C. Joint Dowel Bars: Plain steel bars, ASTM A 615, Grade 60. Cut bars true to length with ends square and free of burrs.
- D. Dowel Sleeves: Speed Dowel, Aztec Concrete Accessories, Inc.
- E. Hook Bolts: ASTM A 307, Grade A bolts, internally and externally threaded. Design hook bolt joint assembly to hold coupling against pavement form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- F. Supports for Reinforcement: Chairs, spacers, dowel bar supports and other devices for spacing, supporting, and fastening reinforcing bars, welded wire fabric, and dowels in place. Use wire bar-type supports complying with CRSI specifications.
 - 1. Use supports with sand plates or horizontal runners where base material will not support chair legs.

2.03 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type II, low alkali.
 - 1. Use one brand of cement throughout Project. Coordinate with Section "Cast-In-Place Concrete."
 - 2. Provide white cement when required to achieve specified color in integral colored concrete.
- B. Normal-Weight Aggregates: ASTM C 33, Class 4M non-reactive, and as follows. Provide aggregates from a single source.
 - 1. Maximum Aggregate Size: 1-inch.
 - 2. Do not use fine or coarse aggregates that contain substances that cause spalling.
 - 3. Local aggregates not complying with ASTM C 33 that have been shown to produce concrete of adequate strength and durability by special tests or actual service may be used when acceptable to Architect.
- C. Water: ASTM 1602, Potable.
- D. Admixtures: Comply with requirements specified in Section "Cast-In-Place Concrete."

1. Integral Colored Concrete: Use admixtures only as approved by the color pigment manufacturer. Do not use admixtures that will alter the color of integral colored concrete.
 2. Do not use admixtures containing calcium chloride or chloride ions.
- E. Aggregate for Integral Colored Concrete: ASTM C 33, Class 4M, non-reactive, and as follows: Provide aggregates from a single source.
1. Maximum Aggregate Size and Type: 3/8-inch (range from 1/4-inch to 3/8-inch), pea gravel.
 2. Do not use fine or coarse aggregates that contain substances that cause spalling.
 3. Percentage of Fine Aggregate to Pea Gravel: 60 percent fines to 40 percent coarse aggregate.
 4. Local aggregates not complying with ASTM C 33 that have been shown to produce concrete of adequate strength and durability by special tests or actual service may be used when acceptable to Architect.

2.04 CURING MATERIALS

- A. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 3.
- B. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.
1. Waterproof paper.
 2. Polyethylene film.
 3. White burlap-polyethylene sheet.
- C. Liquid Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B. Moisture loss not more than 0.55 kg./sq. meter in 72 hours when applied at a rate of 200 sq. ft./gal.
1. Provide material that has a maximum volatile organic compound (VOC) rating of 350 g/L.
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. L & M Cure R, L & M Construction Chemicals, Inc.
 - b. 1100-Clear, W.R. Meadows, Inc.

- c. MasterKure CC 180WB (formerly Kure-N-Seal), BASF Corporation
 - 3. Do not use sodium silicate type curing agents.
 - 4. For integral colored concrete plaza and stair pavement, provide curing compound meeting the specified requirements and approved by the manufacturer of the integral color pigments for use on integral colored concrete paving. Coordinate with manufacturer of integral colored concrete pigments and determine compatibility of the curing compound with integral color pigment. Curing compound manufactured by the pigment manufacturer that also meets the requirements of this Section is acceptable.
 - a. Do not use curing compound that will alter the color of integral colored concrete.
- D. Evaporation Control: Monomolecular film-forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Eucobar; Euclid Chemical Co.
 - b. E-Con; L&M Construction Chemicals, Inc.
 - c. MasterKure ER 50 (formerly Confilm), BASF Corporation,
- E. Surface Retarder (Exposed Seeded Surfaces): Sika 'Rugaslo B', Sovig 'Top Surface Conreveal', BASF Corporation 'MasterFinish' Series, or approved equal.
- F. Non-Shrink Grout: Suereisen No. F-100, Upco 'Upcon,' 5-Star, BASF Corporation 'Masterflo 713', or approved equal, non-metallic, non-staining, premixed grout.
- G. Sealant Bead (this applies only when referenced by paving conditions on the Drawings.): Polysulfide composition, equal to THIOKOL or "TREMCO SPECTRUM". Color to match adjacent paving.
- H. Aggregate (this applies only when referenced on the Drawings.): (Exposed Aggregate Concrete) "_____" and "_____" aggregate, 3/8 inches in diameter washed stones. Submit a half-pound sample of each to Landscape Architect for approval prior to making jobsite sample.

2.05 RELATED MATERIALS

- A Bonding Agent: Acrylic or styrene butadiene, complying with ASTM C 1059, Type II.

- B. Epoxy Adhesive: ASTM C 881, two-component material suitable for dry or damp surfaces. Provide material type, grade, and class to suit requirements.
- C. Products: Subject to compliance with requirements, provide one of the following:
1. Bonding Agent:
 - a. SBR Latex; Euclid Chemical Co.
 - b. Daraweld C; W.R. Grace & Co.
 - c. Everbond; L&M Construction Chemicals, Inc.
 2. Epoxy Adhesive:
 - a. MasterEmaco ADH Series (formerly Concessive Series); BASF Corporation
 - b. Rezi-Weld 1000; W.R. Meadows, Inc.
- D. Concrete Sealer: Water-based, deep penetrating, non-staining, non-darkening silane micro emulsion.
1. Positive chloride-ion screening, prevents water intrusion, minimizes rebar corrosion and potential concrete spalling, and protects against damaging effects of alkalis and other contaminants.
 2. Provide material that has a maximum volatile organic compound (VOC) rating of 350 g/L.
 3. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Pentane WB, L & M Construction Chemicals, Inc. This product is intended to establish the characteristics and level of quality intended for this Project.
 - b. MasterProtect H 1000 (formerly Hydrozo 100), BASF Corporation
 4. For integral colored concrete plaza and stair pavement, provide sealer meeting the specified requirements and approved by the manufacturer of the integral color pigments for use on integral colored concrete paving. Coordinate with manufacturer of integral colored concrete pigments and determine compatibility of the sealer with integral color pigment. Sealer manufactured by the pigment manufacturer that also meets the requirements of this Section is acceptable.

- a. Do not use sealer that will alter the color of integral colored concrete.
- E. Color Pigments/Coloring Admixtures: ASTM C 979. For integral colored concrete use coloring pigments that are finely ground non-fading mineral oxides of synthetic or natural varieties and do not contain fillers, adulterants, or admixtures that will affect the characteristics or performance of the concrete mix design.
1. Color: Match Architect's sample which is based on []. ***Note to Engineer: Obtain this color from the Architect or the Landscape Architect for the project.***
 2. Products:
 - a. Davis Colors, Davis Colors Co.
 - b. Chromix Admixtures, L. M. Scofield Co.
 - c. MasterColor, BASF Corporation
 - d. Approved equal

2.06 CONCRETE MIX

- A. Prepare design mixes for each type and strength of normal-weight concrete by either laboratory trial batch or field experience methods as specified in ACI 301. For the trial batch method, use a qualified independent testing agency for preparing and reporting proposed mix designs.
1. Do not use the Owner's field quality-control testing agency as the independent testing agency.
 2. Prepare mixes for integral colored concrete in accordance with color pigment manufacturer's instructions.
 - a. Maximum Pigment Dosage Rate: 10 percent of the weight of cement.
 - b. Use the same aggregate, brand and type of cement for all integral colored concrete.
- B. Proportion mixes according to ACI 211.1 and ACI 301 to provide normal-weight concrete with the following properties:
1. Compressive Strength (28-Day): 4000 psi, for walks.
 2. Compressive Strength (28-Day): 3500 psi, for curbs and gutters.
 3. Compressive Strength (28-Day): 3000 psi, for all other site concrete.

4. Minimum cement content: shall be 5-1/4 sacks per cubic yard.
 5. Maximum concrete slump: shall be 3 inches, plus or minus 1/2 inch, for all walks; and 4 inches, plus or minus 1 inch for all other Portland cement concrete paving, except for integral colored concrete paving maintain a slump of 3 inches.
 6. Water/Cement Ratio: shall be less than or equal to 0.5.
- C. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, project conditions, weather, test results, or other circumstances warrant.
- D. Admixtures: Comply with requirements specified in Section "Cast-In-Place Concrete".

2.07 CONCRETE MIXING

- A. Ready-Mixed Concrete: Comply with requirements and with ASTM C 94.
1. When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

2.08 HERBICIDE TREATMENT

- A. Commercial chemical for weed control, registered by Environmental Protection Agency. Provide granular, liquid, or wettable powder form.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:
 - a. Dow Chemical U.S.A.
 - b. E.I. Du Pont de Nemours & Co., Inc.
 - c. FMC Corp.
 - d. U.S. Borax and Chemical Corp.

2.09 SOURCE QUALITY CONTROL

- A. Color Control for Integral Colored Concrete: Arrange for the services of a qualified technical representative of the color pigment manufacturer, equipped with wet-batch color control test devices, at the ready-mix plant to ensure concrete of uniform color and matching Architect's sample for the mock-up and after mock-up is approved, matching mock-up with final concrete.

2.10 LEED PRODUCT REQUIREMENTS

- A. Provide materials with the highest levels of post-consumer and pre-consumer recycled content.
- B. Provide materials extracted, harvested, recovered and manufactured within 500 miles of the project site.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

- A. Proof-roll subgrade or base surface prepared by others to check for unstable areas and verify need for additional compaction. Do not begin paving work until such conditions have been corrected and are ready to receive paving.
- B. Remove loose material from compacted subbase surface immediately before placing concrete.
- C. Herbicide Treatment: Apply chemical weed control agent in strict compliance with manufacturer's recommended dosages and application instructions. Apply to compacted, dry subbase prior to application of prime coat.

3.02 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for paving to required lines, grades, and elevations. Install forms to allow continuous progress of work and so that forms can remain in place at least 24 hours after concrete placement.
- B. Check completed formwork and screeds for grade and alignment to following tolerances:
 - 1. Top of Forms: Not more than 1/8 inch in 10 feet.
 - 2. Vertical Face on Longitudinal Axis: Not more than 1/4 inch in 10 feet.
- C. Clean forms after each use and coat with form release agent as required to ensure separation from concrete without damage.

3.03 PLACING REINFORCEMENT

- A. General: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars" for placing and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities or replace units as required before placement. Set mats for a minimum 2-inch overlap to adjacent mats.

3.04 JOINTS

- A. General: Construct contraction, construction, and isolation joints true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to the centerline, unless indicated otherwise.
 - 1. When joining existing paving, place transverse joints to align with previously placed joints, unless indicated otherwise.
 - 2. Make joints, including sawed joints, full depth required and from edge to edge of paving.
- B. Contraction Joints: Provide weakened-plane contraction joints, sectioning concrete into areas approximately 10 feet square, unless otherwise shown on Drawings. Construct contraction joints for a depth equal to at least 1/4 of the concrete thickness, as follows:
 - 1. Tooled Joints: Form contraction joints in fresh concrete by grooving and finishing each edge of joint with a radiused jointer tool.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into hardened concrete when cutting action will not tear, abrade, or otherwise damage surface and before development of random contraction cracks.
 - 3. Inserts: Form contraction joints by inserting pre-molded plastic, hardboard, or fiberboard strips into fresh concrete until top surface of strip is flush with paving surface. Radius each joint edge with a jointer tool. Carefully remove strips or caps of two-piece assemblies after concrete has hardened. Clean groove of loose debris.
- C. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than 1/2 hour, unless paving terminates at isolation joints.
 - 1. Continue reinforcement across construction joints unless indicated otherwise. Do not continue reinforcement through sides of strip paving unless indicated.
 - 2. Provide tie bars at sides of paving strips where indicated.

3. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.
 4. Locate construction joints to correspond with a planned contraction joint or score line as shown on the drawings.
- D. Isolation Joints:
1. Isolation-Type Joints: Form isolation joints of preformed joint filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, and other fixed objects.
 2. Extend joint fillers full width and depth of joint, not less than 1/2 inch or more than 1 inch below finished surface where joint sealant is indicated. Place top of joint filler flush with finished concrete surface when no joint sealant is required.
 3. Furnish joint fillers in one-piece lengths for full width being placed wherever possible. Where more than one length is required, lace or clip joint filler sections together.
 4. Protect top edge of joint filler during concrete placement with a metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint
- E. Installation of joint fillers and sealants is specified in Division 03 Section "Cast-in-Place Concrete".
- F. Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt-coat one half of dowel length to prevent concrete bonding to one side of joint.
- G. Where plastic "zip strips" are used to construct concrete joints, cut and remove, as a minimum, the top 1/4 inch of these strips after concrete has cured, and coordinate installation of joint filler, if shown on the Drawings.

3.05 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. Moisten subgrade or base to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.
- C. Comply with requirements and with ACI 301 for measuring, mixing, transporting, and placing concrete.
- D. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

- E. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- F. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures to consolidate concrete complying with ACI 301.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocating reinforcing, dowels, and joint devices.
- G. Screed paved surfaces with a straightedge and strike off. Use bull floats or darbies to form a smooth surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces prior to beginning finishing operations.
- H. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete.
- I. Cold-Weather Placement: Comply with provisions of ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.
 - 4. Do not place concrete on surfaces that are frozen.
- J. Hot-Weather Placement: Place concrete complying with ACI 305.1 and as specified when hot weather conditions exist.
 - 1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 deg F (32 deg C). Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.
3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.06 CONCRETE FINISHING

- A. Float Finish: Begin floating when bleed water sheen has disappeared and the concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Finish surfaces to true planes within a tolerance of 1/4 inch in 10 feet as determined by a 10-foot-long straightedge placed anywhere on the surface in any direction. Cut down high spots and fill low spots. Refloat surface immediately to a uniform granular texture.
 1. Burlap Finish: Drag a seamless strip of damp burlap across concrete, perpendicular to line of traffic, to provide a uniform gritty texture finish.
 2. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across concrete surface perpendicular to line of traffic to provide a uniform fine line texture finish.
 3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating surface 1/16 inch to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.
 4. Do not use troweling machines within 12 inches of electrical junction and outlet boxes which are set to finish flush with concrete slabs. Float and trowel such areas by hand with wood floats and steel trowels, taking care to see that concrete is finished flush with box cover and matches adjacent surfaces.
- B. Finishing formed surfaces:
 1. Curb forms shall leave a smooth face.
 2. Remove all fins.
- C. Provide steel trowel finish on tops of curbs and flow lines of curbs, gutters and integral curb and gutters.
- D. Final Tooling: Tool edges of paving, gutters, curbs, and joints formed in fresh concrete with a jointing tool to the following radius. Repeat tooling of edges and joints after applying surface finishes. Eliminate tool marks on concrete surfaces.
 1. Radius: 1/4 inch.

2. Radius: 3/8 inch.
- E. Finish surfaces to produce a uniform appearance throughout area involved and throughout adjacent areas with the same treatment.
 - F. Where concrete finishing occurs adjacent to finished metal or other surfaces, particularly where serrated or indented surfaces occur, remove all traces of cement film before allowing to harden.
 - G. Apply integral wood float and broom finish to the all concrete pavements and walkways, unless otherwise shown on the Drawings.
 1. After screeding and compacting, finish with a wood float using a circular motion to produce a uniform texture and finish throughout.
 2. For vehicular traffic areas, the finish shall be coarse enough to provide a non-slip surface with a minimum static friction coefficient of 0.6.
 3. For pedestrian traffic areas, finish shall be a non-slip surface with a minimum static coefficient of friction of 0.6.
 - a. For ramps, the static coefficient of friction shall be a minimum of 0.8. Ramps are defined as any sloping path of travel with a slope in the direction of travel of 5.0%, or greater.
 4. Tests for coefficient of friction shall be either ASTM C-1028 (field test) or ASTM D-2047 (laboratory test).

3.07 SPECIAL FINISHES

- A. Integral Colored Concrete Finish: Apply a float finish as described in "Concrete Finishing" Article. After float finish, apply textured finishes as follows:
 1. Where indicated, apply a medium-to-coarse-textured broom finish as described for pedestrian traffic areas in the "Concrete Finishing" Article.
 2. Where indicated, apply a sandblast finish as follows:
 - a. Sandblast surfaces uniformly, at the same age, using the same equipment and operators. Match approved mock-up for texture and color.
 - b. Medium Sandblast Finish: Expose coarse aggregate with maximum reveal of 1/4-inch. Make color uniform.
 3. Cure concrete with the specified curing compound in accordance with pigment manufacturer's curing instructions. Apply the curing compound immediately after final finishing. Do not use any other curing method unless specifically approved in writing by the pigment manufacturer and the Architect.

3.08 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with the recommendations of ACI 306.1 for cold weather protection and ACI 305.1 for hot weather protection during curing.
- B. Evaporation Control: In hot, dry, and windy weather, protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply according to manufacturer's instructions after screeding and bull floating, but before floating.
- C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- D. Curing Methods: Cure integral colored concrete by curing compound as approved by the manufacturer of the color pigments used in the concrete mix. Cure other concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than 7 days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with a 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
- E. Spray-apply concrete sealer to all concrete pavement. Comply with sealer manufacturer's application instructions.
- F. Integral Colored Concrete: Comply with recommendations of color pigment manufacturer for curing, sealing, and protecting integral colored concrete to provide color retention and uniformity.

3.09 FIELD QUALITY CONTROL TESTING

- A. The Owner will employ a qualified testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include the following:
1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
 - a. Slump: ASTM C 143; one test at point of placement for each compressive-strength test but no less than one test for each day's pour of each type of concrete. Additional tests will be required when concrete consistency changes.
 - b. Air Content: ASTM C 231, pressure method; one test for each compressive-strength test but no less than one test for each day's pour of each type of air-entrained concrete.
 - c. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each set of compressive-strength specimens.
 - d. Compression Test Specimens: ASTM C 31; one set of four standard cylinders for each compressive-strength test, unless directed otherwise. Mold and store cylinders for laboratory-cured test specimens except when field-cured test specimens are required.
 - e. Compressive-Strength Tests: ASTM C 39; Frequency as specified in ACI 301.
 2. When frequency of testing will provide fewer than five strength tests for a given class of concrete, conduct testing from at least five randomly selected batches or from each batch if fewer than five are used.
 3. When total quantity of a given class of concrete is less than 50 cu. yd., Architect may waive strength testing if adequate evidence of satisfactory strength is provided.
 4. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
 5. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 500 psi.

- B. Test results will be reported in writing to Architect, concrete manufacturer, and Contractor within 24 hours of testing. Reports of compressive strength tests shall contain the Project identification name and number, date of concrete placement, name of concrete testing agency, concrete type and class, location of concrete batch in paving, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day and 28-day tests.
- C. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.
- D. Additional Tests: The testing agency will make additional tests of the concrete when test results indicate slump, air entrainment, concrete strengths, or other requirements have not been met, as directed by Architect. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.
- E. Manufacturer's Field Service: When placing integral colored concrete, arrange for the services of a qualified technical representative of the color pigment manufacturer, equipped with wet-batch color control test devices to ensure concrete of uniform color and matching approved mock-up.

3.10 REPAIRS AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective, or does not meet the requirements of this Section. Concrete which is not true to line and plane, which is not thoroughly troweled and properly surfaced as required, which varies in excess of 1/4-inch along a 10-foot straight edge, which is scuffed or has a rough top surface, except where required, or which does not connect properly to adjoining work, does not slope as required for drainage or is not properly cured, will be deemed defective.
 - 1. General: Patch defective areas immediately following form removal. Remove defective concrete to a width and depth necessary for proper patching, but in no case less than 1 inch deep. Make the walls of the cut area perpendicular to the surface and do not feather out the edge. Dampen the patch area and the adjacent area 6 inches around the patch area.
 - 2. Exposed concrete: Prepare a patching mortar of one part Portland cement, adjusted to match the color of the surrounding concrete, and 2-1/2 parts sand with the least water required to produce a workable mass. Re-work this mortar until it is the stiffest consistency that will permit placing. Brush the patch area with a bond of neat cement and water paste and apply patching mortar when the water sheen is off the bond. Strike off the mortar slightly higher than the surrounding surface, let set for 1 hour and finish flush with the surrounding surface.

- B. Drill test cores where directed by Architect when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with Portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep concrete paving not more than 2 days prior to date scheduled for Substantial Completion inspections.
- E. Comply with pigment manufacturer's instructions for patching integral colored concrete.

END OF SECTION

SECTION 32 13 73
CONCRETE JOINT SEALANTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Cold-applied joint sealants.
2. Cold-applied, jet-fuel-resistant joint sealants.
3. Hot-applied joint sealants.
4. Hot-applied, jet-fuel-resistant joint sealants.

1.02 PRECONSTRUCTION TESTING

- A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, **[eight]**, Samples of materials that will contact or affect joint sealants. Use **[ASTM C 1087]** **[manufacturer's standard test method]** to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

1.03 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples: For each kind and color of joint sealant required.
- C. Pavement-Joint-Sealant Schedule: Include the following information:
1. Joint-sealant application, joint location, and designation.
 2. Joint-sealant manufacturer and product name.
 3. Joint-sealant formulation.
 4. Joint-sealant color.
- D. Product certificates.
- E. Product test reports.
- F. Preconstruction compatibility and adhesion test reports.

1.04 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021.
- B. Preinstallation Conference: Conduct conference at **[Project site]** <Insert location>.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.
- B. Colors of Exposed Joint Sealants: [As indicated by manufacturer's designations] [Match Architect's samples] [As selected by Architect from manufacturer's full range] <Insert color>.

2.02 COLD-APPLIED JOINT SEALANTS

- A. Single-Component, Nonsag, Silicone Joint Sealant for Concrete: ASTM D 5893, Type NS.
 - 1. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. Crafcoc Inc., an ERGON company; RoadSaver Silicone.
 - b. Dow Corning Corporation; 888.
 - c. Pecora Corporation; 301 NS.
 - d. <Insert manufacturer's name; product name or designation>.
- B. Single-Component, Self-Leveling, Silicone Joint Sealant for Concrete: ASTM D 5893, Type SL.
 - 1. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. Crafcoc Inc., an ERGON company; RoadSaver Silicone SL.

- b. Dow Corning Corporation; 890-SL.
 - c. Pecora Corporation; 300 SL.
 - d. <Insert manufacturer's name; product name or designation>.
- C. Multicomponent, Pourable, Traffic-Grade, Urethane Joint Sealant for Concrete: ASTM C 920, Type M, Grade P, Class 25, for Use T.
- 1. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. Pecora Corporation; Urexpan NR-200.
 - b. <Insert manufacturer's name; product name or designation>.

2.03 COLD-APPLIED, JET-FUEL-RESISTANT JOINT SEALANTS

- A. Jet-Fuel-Resistant, Single-Component, Pourable, Traffic-Grade, Modified-Urethane Joint Sealant for Concrete: ASTM C 920, Type S, Grade P, Class 25, for Use T.
- 1. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. BASF Building Systems; Sonomeric 1.
 - b. <Insert manufacturer's name; product name or designation>.
- B. Jet-Fuel-Resistant, Multicomponent, Pourable, Traffic-Grade, Modified-Urethane Joint Sealant for Concrete: ASTM C 920, Type M, Grade P, Class 12-1/2, for Use T.
- 1. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. Pecora Corporation; Urexpan NR-300.
 - b. <Insert manufacturer's name; product name or designation>.
- C. Jet-Fuel-Resistant, Multicomponent, Pourable, Traffic-Grade, Modified-Urethane Joint Sealant for Concrete: ASTM C 920, Type M, Grade P, Class 25, for Use T.

1. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. Meadows, W. R., Inc.; Sealtight Gardox.
 - b. <Insert manufacturer's name; product name or designation>.

2.04 HOT-APPLIED JOINT SEALANTS

- A. Hot-Applied, Single-Component Joint Sealant for Concrete: ASTM D 3406.
 1. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. <Insert manufacturer's name; product name or designation>.
- B. Hot-Applied, Single-Component Joint Sealant for Concrete and Asphalt: ASTM D 6690, Types I, II, and III.
 1. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. Meadows, W. R., Inc.; [Sealtight Hi-Spec] [Sealtight 3405].
 - b. Right Pointe; D-3405 Hot Applied Sealant.
 - c. <Insert manufacturer's name; product name or designation>.

2.05 HOT-APPLIED, JET-FUEL-RESISTANT JOINT SEALANTS

- A. Hot-Applied, Jet-Fuel-Resistant, Single-Component Joint Sealant for Concrete: ASTM D 7116, Type I.
 1. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. Crafcoc Inc., an ERGON company; Superseal 444/777.
 - b. <Insert manufacturer's name; product name or designation>.
- B. Hot-Applied, Jet-Fuel-Resistant, Single-Component Joint Sealant for Concrete and Tar Concrete: Single-component formulation complying with ASTM D 3581.

1. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. Crafcoc Inc., an ERGON company; Superseal 1614A.
 - b. <Insert manufacturer's name; product name or designation>.

2.06 JOINT-SEALANT BACKER MATERIALS

- A. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.
- B. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D 5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.
- C. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D 5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.07 PRIMERS

- A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
 - a.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
- B. Cleaning of Joints: Clean out joints immediately before installing joint sealants.
- C. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- D. Install joint-sealant backings of kind indicated to support joint sealants during application and at position required to produce cross-sectional shapes and depths of

installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of joint-sealant backings.
 2. Do not stretch, twist, puncture, or tear joint-sealant backings.
 3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.
- E. Install joint sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place joint sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:
1. Remove excess joint sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- G. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.
- H. Clean off excess joint sealant or sealant smears adjacent to joints as the Work progresses, by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

END OF SECTION

SECTION 32 8413

POTABLE WATER IRRIGATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Potable water irrigation system.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 01 4524 - Environmental Import/Export Materials Testing.
3. Division 22 - Plumbing.
4. Division 26 - Electrical.
5. Section 31 2313 - Excavation and Fill.
6. Section 31 2323 - Excavation and Fill (Utilities).
7. Section 32 8416 - Irrigation Controls.
8. Section 32 8426 - Reclaimed Water Irrigation.
9. Section 32 9000 - Planting.

1.02 SUBMITTALS

- A. Materials List: Provide manufacturer's name and description of items to be furnished.
- B. Product Data: Provide catalog cuts, technical data, and manufacturer's specifications.
- C. Shop Drawings: Provide Shop Drawings indicating proposed system layout, locations of controllers, valves, backflow devices, flow sensors, master valves, quick couplers, heads and point of connections. Include details for sleeves, yard boxes, backflow devices, and controller installations.

D. Provide proof of purchase for energy saving devices to the OWNER. OWNER will receive rebates as part of energy savings program.

E. Record Documents:

1. Before Contract Completion, provide project record documents as follows:

a. Indicate the location of each numbered sprinkler controlled valves and quick coupling valves with legible dimensions from two permanent points of reference such as building corners or sidewalks.

2. Closeout Submittals-As Built:

a. Submit three copies of as-built including complete list of materials, manufacturer's name, and product installation literatures.

b. Record drawings: Submit dimensioned drawings and details, before Contract Completion.

c. Record Drawings shall contain the following:

1) As-Built shall be computer generated (AutoCad).

2) Print shall show the locations of the numbered remote control valves, manual control valves, locations and size of supply and lateral lines, location and type of sprinkler heads, quick coupling valves, gate valves, backflow devices, point of connections, controllers and other related equipment.

3) Dimensions shall be legible from two permanent points of reference such as buildings and sidewalks.

4) Shall be 24-inch by 36-inch minimum size.

d. Proof of Backflow Registration:

1) CONTRACTOR to provide proof of registration with the jurisdictional authority.

2) Backflow test results shall be acceptable to the jurisdictional authority.

3. Operation and Maintenance Manuals:

- a. Provide complete operating and maintenance instruction manuals for equipment.
- b. This service shall be performed by a certified water auditor and paid by the CONTRACTOR. This report shall identify designed controller setting for water discharge and actual installed discharged tested. The audit report shall also include the status of items indicated in paragraph 1.07.C based on final inspection and testing.

1.03 REFERENCES

A. ASTM International (ASTM):

1. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM B88 – Standard Specification for Seamless Copper Water Tube.
3. ASTM D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
4. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
5. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

B. American Society of Mechanical Engineers International (ASME):

1. B36.10M - Welded and Seamless Wrought Steel Pipe.

C. Federal Specifications:

1. FS WW-P-460 - Pipe Fittings; Brass or Bronze (Threaded) Classes 125 and 250 Pound.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with local, municipal and state laws, rules, and regulations governing or relating to this Work. Wiring shall conform to National Electrical Code.

2. Conform to California Code of Regulations, Title 23, Division 2, Chapter 2.7, Model Water Efficient Landscape Ordinance.
- B. Manufacturer Instructions: The manufacturer's instructions and detailed drawings shall be followed where the manufacturers of products and/or materials furnish installation details not indicated in the Drawings and Specifications.
 - C. Qualifications: Work shall be performed by skilled workers with a minimum of five years experience in work of similar scope and complexity.

1.05 PRODUCT HANDLING

- A. Do not damage materials during handling, loading, unloading, and storage of pipe and fittings. Store materials under cover, protect from direct sunlight. Transport materials in a manner to avoid undue stress on piping and other materials.
- B. Do not install damaged materials or products into the Work.

1.06 PROJECT CONDITIONS

- A. Before excavation, contact DigAlert for information on buried utilities and pipelines.

1.07 TESTING AND INSPECTION

- A. Notify the Project Inspector 24 hours in advance of the pressure side piping inspection.
 1. Pressure Side Piping: After welded joints have cured for at least 24 hours, lines flushed and outlets are capped, the system shall be tested under normal street water pressure for a minimum of 4 hours. Joints shall remain exposed for inspection during the pressure test. Center loading of piping with small loads of sand backfill to prevent arching or slipping under pressure is permitted.
 2. Correct defective Work and repeat tests until the entire system is tested watertight.
- B. Submit a request for a final inspection 48 hours in advance. Perform a coverage test to determine if the coverage of water to turf and planting areas is complete and adequate meeting Title 23 Model Water Efficient Landscape Ordinance.

C. Final Inspection: The following items shall be considered part of the final inspection:

1. Specified products and materials.
2. Irrigation coverage test, providing 100% head to head coverage.
3. Soils compacted in trenches and around sprinkler heads, level with existing grades.
4. Controller and cabinet installation.
5. Sprinkler control valves and boxes.
6. Backflow devices, pressure regulators, pumps.
7. Automatic sensors.
8. Final site review shall include operating each system in its entirety in the presence of the Landscape ARCHITECT or Project Inspector.
9. Provide any required adjustments and correct defective Work as required.

1.08 MAINTENANCE

A. Extra Materials, Tools and Accessories:

1. Spare Sprinkler Heads: Furnish twelve spare sprinkler heads, with inserts for each type, size and series installed.
2. Keys and Wrenches:
 - a. Keys: Furnish two tagged pin tumbler type keys.
 - b. Wrenches: Furnish two sets for each type of sprinkler head or nozzle.
 - c. Coupler: Furnish a minimum of one quick coupler key (quill) and an additional key for every three quick-coupler valves installed.

B. Training:

1. Before substantial completion provide at least 4 hours of training, by an authorized representative of the controller manufacturer, for each type of irrigation controller installed.

2. Instruct designated OWNER personnel on operation and programming of the irrigation controller and hand held controller, demonstrating program features.
3. Review "As-Built" plans with OWNER's personnel and explain the following features: master valve, flow sensor, rain sensors, pump, backflow devices and locations of critical valves.
4. Provide an attendance sheet to the OWNER listing personnel trained.

1.09 WARRANTY

- A. Provide a five year manufacturer's warranty for controller units.
- B. Provide a one year warranty for materials, fabrication, and installation, including restoration of planted or paved areas due to settlement of trenches.

PART 2 - PRODUCTS

2.01 IRRIGATION SYSTEM

- A. Systems shall be automatic with electrically operated control valves.
- B. Provide 100 percent head to head triangulated coverage or other required 100 percent configuration.
- C. Point of connection (POC) for irrigation systems:
 1. Provide a single POC on a designated irrigation meter, with flow monitoring, unless otherwise indicated on the Drawings.
- D. Football Fields: Install remote valves grouped in above grade caged areas when not restricted by Project site limitations.
- E. Athletic Fields: Install remote valves grouped along the perimeter of the field.
- F. No PVC piping of any kind will be permitted for above grade pressure lines.
- G. Drip irrigation is not permitted.
- H. Full meter protection is required for irrigation systems by installing reduced pressure principle backflow prevention devices.

- I. Install isolation valves in order to avoid a total system shutdown for maintenance and repairs. Include valves to isolate loop system and major branch lines.
- J. Irrigation System shall incorporate the following requirements:
 - 1. The flow velocity shall not exceed five feet per second for pressure/lateral lines based on industry standard friction pressure loss values.
 - 2. Pressure line pipe size shall be sufficient to support a minimum of two control valves operating at the same time, one valve opening while another is closing.
 - 3. Gallons per minute demand and sprinkler head coverage shall follow the manufacturer's requirements.
 - 4. Remote valves shall be sized no smaller than the piping it serves unless piping is increased in size to reduce friction loss. Remote valves shall then be sized no less than one pipe size smaller than the piping it serves.
 - 5. Minimum pipe size shall be 3/4 inch.

2.02 MATERIALS

- A. Provide only new materials, of brands and types noted on Drawings and in the Specifications.
- B. Plastic Pipe and Fittings:
 - 1. Pipe shall be Schedule 40, extruded from 100 percent Virgin PVC 1120 compounds meeting the requirements of Cell Classification 12454 as defined in ASTM D1784.
 - a. Plastic pipe shall be continuously and permanently marked with the following information: Manufacturer's name, nominal pipe size, Schedule or Class, SDR (Standard Dimension Ratio, or pressure rating in psi) National Sanitation Foundation (NSF).
 - 2. Plastic fittings: Schedule 40 molded from PVC Type I Compound, conforming to the requirements of specification ASTM D2466.
 - a. Plastic Nipples: PVC schedule 80 conforming to ASTM D2467.

- b. PVC Male Threaded Nipples: Schedule 80 only.
 - 3. PVC primer and solvent for chemical weld of pipe and fittings shall be as recommended by pipe manufacturer. Containers for solvent and primer shall be clearly marked with manufacturer's data. Solvent and primer shall not be more than one year old. Blue or red hot glue is not permitted.
 - a. IPS Weld On P-70 primer.
 - b. IPS Weld On 2711 (gray) cement.
- C. Pipe and Fittings:
 - 1. Steel Pipe and Steel Fittings: (where occurs at existing sites only): Pipe and fittings shall be ASA Schedule 40 ASTM A53 galvanized mild steel screwed pipe and beaded galvanized malleable iron screwed fittings, including couplings. Thread on pipe and fittings shall be taper type. Above grade fittings shall comply with ASME B36.10M and ASTM. A53.
 - a. Unions 2 inch and smaller shall be ground joint pattern.
 - b. Unions larger than 2 inch shall be flanged unions.
 - c. Steel pipe or fittings shall not be installed below grade.
 - d. Connection between steel pipe and copper pipe or tube shall be provided with a 6 inch brass nipple.
 - 2. Connection between any female threaded fitting and plastic pipe shall be bridged with a Schedule 80 PVC nipple.
 - 3. Brass Pipe: Seamless, 85 percent red brass, iron pipe sized, threaded.
 - 4. Brass Fittings: Brass fittings shall be 250psi rated, threaded FS WW-P-460.
 - 5. Copper pipe, fittings, ASTM B88:
 - a. Pipe: Type K rigid.
 - b. Fittings: Wrought copper, solder joint type.
- D. Valves: (PVC Valves are not permitted):

1. Gate valves 2 inch or smaller shall be bronze, non-rising stem, threaded, with cross handle:
 - a. Nibco T113K, or equal.
 2. Quick coupler valves shall be brass, 1 inch, with lock top and resilient cap.
 - a. Rainbird 44LRC, or equal.
 - b. Quills shall be the same manufacturer as quick coupler valve, cast bronze, machine shank, stainless steel or bronze lugs.
 3. Coupler keys (quills) shall be from the same manufacturer as quick coupler valve; cast bronze with stainless steel or bronze lugs.
 4. Electric remote control valves shall be 24 volt normally closed solenoid actuated valve, capable of operating on 14 gage UF wire; either bronze or brass, globe or angle pattern, and diaphragm actuated:
 - a. Hunter ICV Series, or equal.
 5. Manual sprinkler control valves are not allowed.
 6. Master Control Valves:
 - a. Shall be a normally open solenoid actuated valve. Valve shall have a NPT inlet and outlet, and shall be capable of working pressures up to 150 psi. Superior 3100, Hunter IBV Series, or equal.
 - b. Shall meet requirements for Automatic Valves, except for those indicated on article “a” above.
 - c. Shall be installed with separate power and common wires.
- E. Back Flow Protection Device:
1. To operate on a reduced pressure principle furnished with a full port shut off valve up stream and down stream of the backflow device. Provide and install enclosure to house backflow device.
 2. Wye strainers at back flow device shall be 125 pounds class customer brass with 40 mesh Monel screen.
 3. Provide and install permanent enclosure to house backflow device

4. On Backflow Devices 2" and smaller. Enclosures shall be stainless steel "Strong Box- SMOOTH TOUCH" manufactured by V. I. T. Products. Inc or Equal.
- F. Tracer Wires: A No. 14, Green, Type TW plastic-coated copper tracer wire shall be installed with non-metallic irrigation main lines.
- G. Control Wires to Control Valves: Control wires to electrically operated solenoid valves shall be direct burial type UF#14 AWG copper, 3/64 inch thick PVC coating. UL approved for Class 2 wiring for 24 volts, 60 cycle AC, use UL recognized waterproof connectors to connect control wires to solenoids.
1. Use UL recognized waterproof connectors to connect control wires to solenoids.
 - a. Spears Drysplice DS400 or Equal.
- H. Valve Boxes:
1. Rectangular valve boxes shall be green plastic 12-inch wide, 18 inch long, and 12-inch deep (outside dimensions) or larger as may be required to provide specified clearances.
 - a. NDS #314BCB or Equal.
 2. Round valve boxes shall be green, 7-inch diameter by 10-inch high with locking cover.
 - a. NDS #312BCB or Equal.
 3. Covers on valve boxes shall be vandal resistant, locking, and marked "Water". Tops of boxes shall be set flush with finished turf grade or 2-inch above grade in shrubbery or groundcover areas.
 - a. The cover shall be identified with 3-inch high stenciled letters "RCV (with Station No.) GV for Gate Valve, or QC for Quick Coupler.
 - b. Dura Boxes are not allowed.

PART 3 - EXECUTION

3.01 CONNECTIONS TO SUPPLY

- A. Source of water supply shall be as indicated on the Drawings.

- B. Connection to piping shall be provided with proper fittings:
1. When connecting to point of connection (POC) above grade pipes shall be copper with required fittings unless otherwise indicated.
 2. POC from above to below grade transition shall be copper pipe to a depth of 18 inches from top of pipe.
 3. No steel pipe or fitting shall be installed below grade.
 4. When connecting plastic pipe to copper below grade, provide a schedule 80 PVC nipple.
 5. Exposed copper or brass material above grade shall be painted green in color.
 6. Connect steel and copper pipe or tube with a 6-inch brass nipple.

3.02 PIPE INSTALLATION

- A. Excavate trenches deep enough to provide earth coverage of 12 inches for non-pressure lines and 24 inches for pressure lines, from finished grades to top of pipe. Bottom of trenches shall be free of rocks, clods and other sharp-edged objects. Below grade piping shall be installed on a firm sand bed for its entire length.
- B. Plastic pipe and fittings shall be solvent welded. PVC pipe ends shall be cut ninety (90) degrees and cleaned of cutting burrs prior to cementing. Use approved reaming tool. Pipe ends shall be wiped clean with a rag and lightly wetted with PVC primer. Cement shall be applied with a light coat on the inside of the fitting and a heavier coat on the outside of the pipe. Pipe shall be inserted into the fitting and given a quarter turn to seat the cement. Excess cement shall be wiped from the outside of the pipe. The pipe will be tested as indicated in paragraph 1.07.
- C. Cure welded joints at least 15 minutes before moving or handling, and at least 24 hours before applying pressure to system, unless otherwise recommended by joint solvent manufacturer.
- D. Irrigation piping installed under a driveway or sidewalk shall be sleeved. The sleeves shall be two pipe sizes larger than the pressure piping.
- E. Piping through cement and asphalt pavement shall be K type copper with ¼ inch of foam wrap or other required material around the pipe to allow for expansion.

- F. Holes cored through walls shall be two pipe sizes larger to allow for foam wrap around pipe.
- G. PVC pipes shall not be installed above grade unless reviewed by the ARCHITECT.
- H. Lettering shall be face up on below grade PVC piping. Pipe serving tree areas shall be located not more than 30 inch from center of tree area.

3.04 VALVE BOX INSTALLATION

- A. Automatic control valves shall be enclosed in valve boxes of HDPE or polyolefin fibrous material, with locking lids.
- B. Valve boxes shall be of sufficient size to provide no less than 1-1/2 inch of clearance on all sides of equipment installed within. The bottom section shall be slotted so as to extend below the pipe. Extensions shall be added as required to meet grade requirements.
- C. Valve boxes installed in concrete or asphalt shall be set one inch below pipe and extensions shall be added as required to meet grade requirements. A homogeneous finished material shall surround valve boxes 4 inches below finished grade and match existing grade conditions.
- D. Valve boxes shall be installed level to finish grade except in ground cover areas which shall extend 2 inches above finish grade.
- E. Bottom of valve boxes shall be set level on 4 full size corner bricks on 2 inches of gravel bed.
- F. Pea gravel shall be filled up to the bottom of the manual and remote valve and at least 4 inches of gravel inside of the valve box.

3.05 QUICK COUPLER VALVES AND ASSEMBLIES

- A. Quick couplers shall be one inch brass with one or two piece bodies and locking brass tops with rubber cover.
 - 1. For typical Baseball infield application behind Pitcher's mound, use quick coupler installed in 8-inch round, bolted, yard box.
 - 2. For football fields, install quick coupler up against cement curb surrounding the football field, and as indicated on the drawings.
 - 3. For athletic fields, install at the perimeter of the field, and as indicated on the drawings.
 - 4. In other applications, install next to walkways.
 - 5. Top of quick coupler assembly shall be installed within 2 inches from bottom of cover.
 - 6. Quick Coupler supply piping shall originate from a Point of Connection upstream of the Master Valve.

3.06 HOSE BIBS

- A. Hose bibs are prohibited.
- B. Where hose bib connections are needed provide a quick coupler valve.

3.07 VALVES

- A. Isolation and Shut Off Valves:
 - 1. Pressure piping system shall be furnished with valves at points indicated on Drawings or specified.
 - 2. Valves shall be installed with neat appearance and groupings, so parts are easily accessible. Valves near walks, curbs etcetera, to be set-in 12 inches and parallel to the adjacent surface. Remote control valves shall be installed in ground cover or shrub areas wherever possible.
 - 3. Valves shall be full size of line in which they are installed unless otherwise indicated.
- B. Remote Control Valves:

1. Remote control valves shall be low wattage (24 volts,) and shall be capable of operating properly on no larger than #14 gage UF wire.
2. Remote control valves shall be adjustable to control flow of water through valve adjustments and shall be accessible through valve boxes installed above each valve. Valves shall be highest quality of manufacturer.
3. Remote control valves shall be installed and adjusted so that sprinkler heads operate at pressure recommended by head manufacturer. Remote control valves shall be adjusted so that sprinkler heads to planting areas from each individual valve system applies a uniform distribution of water.
4. Remote control valves on any line shall be installed 3-inch minimum, 8-inch maximum below finish grade to top of flow control stem.
5. Remote control valves shall be installed with schedule 80 PVC nipples on each side of the valve.
6. Valves for lawn and shrub areas shall be installed within the perimeter of the area it serves. The location shall be accessible within 12 inches from curb or sidewalk and installed in a location to avoid wetting the person operating the valve manually.
7. Remote control valves for athletic fields shall be installed in one of the following specified locations:
 - a. Control valves shall be installed in groups of three or more. They shall be installed on the perimeter of the athletic field in valve boxes.
 - b. Control valves above ground shall be grouped together and installed on the perimeter outside of the athletic field, on a copper manifold and enclosed in a secure fenced enclosure.

3.08 CONTROLLER, CLOCK AND ENCLOSURE

- A. Refer to Section 32 8416.

3.09 BACKFLOW DEVICE ASSEMBLY

- A. Backflow devices shall be located where indicated on Drawings and in accordance with Los Angeles City and County Codes. Locate in an inconspicuous location close to buildings, walls, or fences.

- B. Assembly shall be furnished with valves, test cocks, and other appurtenances as required by the Los Angeles County Health Department Cross Connection and Water Pollution Control Section.
- C. Install thrust blocks and pipe support as required to support backflow assembly.
- D. Install backflow device in locked stainless steel or marine grade aluminum enclosure.
- E. Installations of backflow prevention devices shall be tested and certified by a certified L.A. County Backflow Prevention Device Tester before Substantial Completion. Test shall be performed in the presence of the Project Inspector. Test reports shall be turned over to the Project Inspector and sent to the jurisdictional authority.
- F. Backflow devices shall be Pressure Reducing Valves (PRV) and shall be the same size of main line where installed.

3.10 CONTROL WIRE

- A. Mainline control wires shall be taped together at five foot intervals with black electrical tape, then laid parallel to pressure line with 18 inches minimum cover to finish grade.
- B. Control wiring located under paved areas shall be encased in Schedule 40 PVC pipe and shall extend a minimum of 12 inches beyond pavement.
- C. Wires shall be color coded, white for common ground wire, red or black for valve control wires.
- D. Wire splicing shall only be performed in controller cabinet and at remote control valve boxes. Splices shall be made with a mechanical connector equal to Spears Dry Splice Wire Connectors and encased in epoxy resin to provide a permanent watertight connection.
- E. Stubbed out control wires shall terminate in concrete yard boxes.
- F. Wire passing under future or existing paving or structures shall be encased in Schedule 40 PVC pipe extending at least 12 inches beyond edges of the paving or structure.

3.11 COVERAGE TEST

- A. When drip and bubbler system has been completed, perform a coverage test to determine if coverage of water to planting areas is complete and adequate.
- B. Make adjustments, add dripline, change emitters, or other drip orifices as may be required to provide complete coverage and provide layout indicated on Drawings.

3.12 PRESSURE TEST

- A. After welded joints have cured at least 24 hours and before sprinkler heads are installed, flush out lines and cap outlets. Test system under normal street water pressure, in presence of the Project Inspector.
- B. Joints shall remain exposed for examination during pressure test. Center load pipe with small amount of sand to prevent arching or slipping under pressure. Use normal street water pressure for test. Maintain pressure on plastic pipe for not less than four hours.
- C. Replace or repair system, including joints that fail during pressure test. Repeat pressure testing until entire system passes the test period without leaks.

3.14 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.15 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site. Hard surfaces shall be washed clean. Daily clean up shall be required on areas used for circulation, parking, or other use.

END OF SECTION

SECTION 32 8416
IRRIGATION CONTROLS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Weather based irrigation controllers.
 - 2. Flow sensors.
 - 3. Master valves.
 - 4. Enclosures.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Division 22 - Plumbing.
 - 3. Division 26 - Electrical.
 - 4. Section 32 8413 - Potable Water Irrigation.
 - 5. Section 32 8416 - Irrigation Controls.
 - 6. Section 32 9000 - Planting.

1.02 PROJECT REQUIREMENTS

- A. Provide an EvapoTranspiration (ET) weather based irrigation controller with capabilities to receive data from weather stations and sensing devices or servers to automatically adjust or terminate programmed watering schedules.
- B. The controller must be capable of utilizing two way communications with server for remote programming and continuous control and monitoring of the central irrigation system from OWNER's designated location.

1.03 SUBMITTALS

- A. Product Data: Provide catalog cuts, technical data, and manufacturer's specifications for each product provided.

- B. Provide proof of purchase to the OWNER. OWNER will receive rebates as part of energy savings program.
- C. Operation and Maintenance Manuals:
 - 1. Provide complete operating and maintenance instruction manuals for each weather based irrigation controller provided.
 - 2. Provide complete programming instructions for each weather based controller.
 - 3. Provide documentation showing compliance with the California Code of Regulations, Title 23, Division 2, Chapter 2.7, Model Water Efficient Landscape Ordinance.

1.03 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with local, municipal and state laws, rules, and regulations governing or relating to this Work. Wiring shall conform to National Electrical.
- B. Conform to California Code of Regulations, Title 23 Division 2, Chapter 2.7, Model Water Efficient Landscape Ordinance.

1.05 PRODUCT HANDLING

- A. Do not damage materials during handling, loading, unloading, and storage. Transport materials in a manner to avoid undue stress on products.
- B. Packaging of weather based controller shall be sufficient to eliminate damage to the controller upon shipping.

1.06 TRAINING

- A. Provide a minimum 4 hours of on-site installation training per site from each ET irrigation controller manufacturer. Training shall explain facets necessary to set up a centrally managed irrigation system. Training is to include drawings and handouts for trainee reference. Training shall be provided by an authorized representative of the controller manufacturer.
- B. Provide a minimum 2 hours of on-site operation training per site from each ET irrigation controller manufacturer. Training shall demonstrate all irrigation control and hand held remote control programming features. Training shall be provided by an authorized representative of the controller manufacturer.
- C. Provide 8 hours of central management system training from each weather based irrigation control manufacturer. Training, for designated OWNER personnel shall include generating reports from the Central Management Control Area to satisfy the Model Water Efficient Landscape Ordinance,

requirements as well as operating and programming irrigation controllers using a remote personal computer. Training shall be provided by an authorized representative of the controller manufacturer.

- D. Provide an attendance sheet to the OWNER listing personnel trained. The attendance sheet shall list the date and time and type of training and shall have signatures and contact information of all attendees including the instructor.

1.07 WARRANTY

- A. Provide a two year manufacturer's warranty for controller units commencing from time of installation.

PART 2 – PRODUCTS

2.01 CENTRAL IRRIGATION CONTROLLERS

- A. General:

1. Controllers shall be UL approved.
2. Controllers shall operate on 110 volts, single phase current, shall be completely automatic, and shall function with clock. Controllers output shall be at least 2 Amps and minimum 24 volts.
3. Controllers shall fully perform without soil moisture sensors, or mandatory telephone wires, repeaters or CAT5/Ethernet wiring.
4. Controllers shall have a Master Valve output circuit.
5. Controllers shall be capable of operating normally open or normally closed master valves.
6. After installation all ET weather based irrigation controllers shall be capable of being monitored and programmed from a single central location away from individual project sites.
7. Controllers shall have a built in flow metering circuit.
8. Controllers shall be capable of receiving EvapoTranspiration (ET) data to automatically adjust or terminate existing programmed watering schedules.
9. Weather based controllers shall be provided with appropriate antenna for wireless transceiver.
10. Weather based controllers with more than six stations shall be furnished with at least 3 extra stations for future use.

11. Weather based controllers shall be capable of fully operating without the need of excavating to conceal wiring infrastructure.
12. Controllers shall be capable of watering using (ET) Data without the need of a central monitoring station.
 - a. Rain Master i-Central, Rain Bird ESP-LXME, Hunter Hydrowise, or equal.

B. Communications Capabilities:

1. System shall be capable of wireless 2-way communications.

C. Programming Capabilities:

1. Controllers shall be capable of allowing programming changes to be performed at the controller and from a central irrigation management center away from individual sites.
2. Each controller shall be capable of being automatically updated with daily ET weather data.
3. System shall be capable of providing ET data from more than one source.
4. Controllers shall be able to pause or suspend irrigation automatically in real time.
5. Controllers shall be able to automatically read flow sensing equipment without adding on flow meter circuits.
6. Flow metering circuit shall provide high flow shutoff protection to individual remote control valves or circuits.
7. Controllers shall be capable of programming appropriate pipe size for accurate water consumption reports.
8. System shall be able to fully function using a hand held remote transmitter without additional set up requirements.
9. Controllers shall be password protected.
10. Controller management system shall not impose a security, infrastructure or product support impact on OWNER's IT department.
11. Controllers shall be capable of producing water savings efficiency data reports required by state agencies.

D. WIFI Router Access:

1. Provide appropriate WIFI Router to allow complete operation of system.
2. After installation, WIFI Router must communicate with server to produce two way communications in order to manage the central irrigation system on site and from a central irrigation management center designated by OWNER.

E. Weather Based ET Data:

1. Provide with each controller a one year subscription of weather based ET data for each irrigation controller requiring a subscription.

2.02 FLOW SENSORS

- A. Spinning impeller type, brass or PVC tee as required and sized to accurately read irrigation system designed flow maximum and minimum.
 1. Hunter HC-Flow Meter, or equal.
- B. Provide Continuous Acting Air Vent before Flow Meter/Flow Sensor to ensure accurate Flow Readings.
 1. Netafim 65ARIB1-150, or equal.

2.03 MASTER VALVES

- A. Normally open, solid brass (ASTM B584, B271, B505), self-cleaning, automatic electric globe valve with manual flow control stem. Valve shall operate with pressures to 200 psi and shall be slow closing with one-piece molded diaphragm incorporated with an integral O-ring seal reinforced with 600 pound test fabric and be guaranteed for 15 years. Equip with an internal self-flushing filter and self-cleaning metering rod for dirty water. Plunger and solenoid coil shall be electroless nickel plated for corrosion protection. 24 VAC 3-way solenoid coil shall be guaranteed for the life of the valve.
 1. Hunter IBV-101G-FS Series, or equal.

2.04 ENCLOSURES

- A. Controllers shall be provided with a lockable weather resistant housing enclosure for protection of control panel and wireless transceiver.
- B. Wall Mounted Enclosures:
 1. Shall be constructed with 18 gage stainless steel.

2. Shall include a 110 Volt GFI power outlet inside enclosure.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Installations shall include at least one flow sensor and master valve.
- B. Installation of irrigation controllers, flow sensors, master valves, antennas, cabinets, and enclosures will be the CONTRACTOR's responsibility unless otherwise specified.

3.02 MANUFACTURERS' FIELD SERVICES

- A. Provide technical support to assure communication capabilities between controllers and sensing devices and between controllers and servers are within acceptable range for operation of the system.

3.03 MANUFACTURERS' TECHNICAL SERVICES

- A. ET irrigation control manufacturers shall provide phone in technical support to OWNER's of their irrigation controllers.

END OF SECTION

SECTION 32 9000

PLANTING

PART 1 – GENERAL

1.01 SUMMARY

- A. Provide labor, material, equipment, and appliances necessary to provide trees, plants, and ground cover as indicated on Drawings, specified, and as required for a complete installation.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 01 4524 - Environmental Import/Export Material Testing.
 - 3. Section 31 2200 - Grading.
 - 4. Section 32 1313 - Site Concrete Work.
 - 5. Section 32 8413 - Potable Water Irrigation.
 - 6. Section 32 8426 - Reclaimed Water Irrigation.

1.02 SUBMITTALS

- A. Comply with provisions of Section 01 3300.
- B. Submit complete lists of landscape materials and equipment to be used, including manufacturers name and address, specific trade names, catalog numbers complete with illustrations and descriptive literature and clearly mark or underline proposed items; list sources of landscape topsoil.
- C. Shop Drawings: Required for any landscape structure.
- D. Material List: Plant materials list.
- E. Certification: In addition to other required certification, furnish a certificate with each delivery of bulk material, including topsoil, planter mix soil, bark mulch, stating its source, quantity, type of material furnished and that such item or material conforms to requirements of this section.
- F. Sample: Submit topsoil Sample and soil amendments with analysis.
- G. Fertilizer analysis: Provide labels of each fertilizer used and quantities used at each applications recommended in Soil Analysis Report.

- H. Soil Test: After completing soil rough grading, have soil tested for fertility and agricultural suitability. Soil shall be tested from minimum of (3-4) locations per acre of planted area. Record locations where samples were taken. A copy of soil test results shall be submitted to Owner and Architect before landscape work begins. Pay cost of soil test.
- I. Sod: Furnish certificate by grower for type, and trueness to name of grass variety or strain. Where or seed issued, provide quality to be delivered.

1.03 QUALITY ASSURANCE

- A. Workers: Furnish skilled workers thoroughly trained and experienced in required crafts and familiar with specified requirements for proper performance of Work of this section.
- B. Codes and Regulations: Materials, fabrication, and installation in this section shall comply with applicable State Codes and Regulations. Deliver permits and testing certifications to Project Inspector.
- C. Quality and Size: Comply with current edition of “Horticultural Standards” for number one nursery stock as adopted by “American Association of Nurserymen”.
- D. Plants:
 - 1. True to name, with name of plants in accordance with standards of practice of “American Association of Nurserymen.”
 - 2. Botanical names take precedence over common names.

1.04 GENERAL REQUIREMENTS

- A. Project Inspector will verify that irrigation systems are operating before starting Work of this section.
- B. Inspection: Notify Architect at least 72 hours in advance to schedule following inspections:
 - 1. Plant material at time of delivery to Project site.
 - 2. Final location of plants prior to preparation of planting pits.
 - 3. Trees of 24-inch box size and larger at their source before delivery to Project site.
 - 4. Finish grades prior to sodding or seeding areas.
 - 5. Landscape construction items prior to start of maintenance of plant establishment period.

6. Final inspection.
- C. Existing Utilities and Plant Materials:
1. Protect utilities and plant materials from damage.
 - a. Perform modifications only as permitted by Architect, in accordance with applicable provisions noted or specified on Drawings, or in other sections of these Specifications.
 2. Replace damaged plant material with like type and size material. Architect shall determine cost of irreplaceable plant material according to “square inch” method as described by Council of Tree and Landscape Appraisers’ “Manual for Plant Appraisers” handbook, Current Edition, and “Guide for Establishing Values of Trees and Other Plants”.
- D. Verification of Dimensions and Quantities:
1. Verify scaled dimensions and quantities before starting landscaping Work.
 2. Promptly notify Architect of any discrepancies between Drawings, Specifications or actual Project site conditions.
- E. Tree Tagging: Architect will tag 24-inch box and larger trees at nursery. Request tree tagging from Architect by providing 3 days advance notice.
- F. Pest Management Method and Products:
1. Contractor shall ensure that plants provided are clean, healthy, free of physical damage, and show no symptoms of abiotic injury. Plants must also be free of diseases, arthropod pests, and any other type of plant pests. Before applying pesticides to plants on Owner’s property, the following criteria must be met:
 - a. Individuals who apply pesticides on behalf of contractor’s company must have a Qualified Applicator License in appropriate category of pest control issued by California Department of Pesticide Regulation and registered to conduct pest control for hire as a business by Los Angeles County Agricultural Commissioner’s Office.
 - b. Products used must be listed on LAUSD’s OEHS approved product list.
 - c. Length of time from date of use of a pesticide products until beneficial occupancy by Owner may not be less than five half lives of products used.
 - d. Contact Owner prior to any pesticide application to verify items above.

- e. Complete written records of pesticide applications made by a contractor and or their representative on Owner's property, must be provided to Owner within 10 days of applications.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Plants shall be protected in transit and after delivery to Project site. Plants in broken containers and plants with broken branches or injured trunks will be deemed defective Work.
- B. Plant materials damaged in planting operations shall be replaced.

1.06 WARRANTY

- A. Shrubs and groundcover shall be growth and health guaranteed by installer for a period of 90 days after completion of maintenance period. Trees shall be installer guaranteed to live and grow in upright position for a period of one year after completion of maintenance period.
- B. Within 15 days after notification by Owner, remove and replace failed plantings. Replacement plantings shall be guaranteed as specified for original plantings.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Topsoil: Designated as imported topsoil as specified herein. Soil test will determine suitability of topsoil before installation. Transport topsoil from source to its final position unless stockpiling is specified. Test in compliance with Section 01 4524.
 - 1. Imported Soil:
 - a. Shall be from a source outside Project site and in compliance with this section.
 - b. Architect may make such inspections and perform such tests as deemed necessary to determine material meets all requirements.
 - c. At least 30 days before scheduled installation, submit proposed source of topsoil and a sample to Architect. Submit a written request for review, accompanied by a written report stating that proposed source complies with these specifications by a testing laboratory registered by State of California for agricultural soil evaluation.
 - d. Comply with recommendations of soils testing laboratory and provide any soil amendments necessary to achieve proper nutrient levels to support healthy plant growth.

- e. Imported topsoil shall be of a uniform composition and structure, fertile and friable sandy loam soil, and be free of roots, decay, subsoil, clods and stones larger than ¼ inch in greatest dimension, pockets of coarse sand, noxious weeds, sticks, brush and other litter and not be infested with nematodes or other undesirable insects and plant disease organisms. Imported topsoil shall meet following additional requirements:
 - 1) Gradation Limits: Sand – 50 to 80 percent, clay – 20 percent maximum, and silt – 30 percent maximum. Sand, clay and silt gradation limits shall be as defined in ASTM D422.
 - 2) Agricultural Suitability and Fertility: Topsoil shall be fertile and friable garden soil suitable for sustaining and promoting growth of specified plants.
 - 3) Electrical conductivity less than 2.0 milliohms/centimeter or DS/m.
 - 4) Boron content maximum of 1.0 part per million.

B. Fertilizers and Conditioning Materials: Comply with applicable requirements of State of California Agricultural Code:

1 General:

- a. Fertilizing materials shall be packaged, first grade, commercial quality products identified as to source, type of material, weight and manufacturer's guaranteed analysis.
- b. Fertilizing material shall not contain toxic ingredients and fillers in quantities harmful to animal, human or plant life.
- c. Submit a certificate of compliance stating material substantially meets Specifications in accordance with provisions of Article 1.03B.

2. Materials:

- a. Bone Meal: Commercial raw bone meal shall be finely ground, steamed dry material with a minimum analysis of 2.5 percent nitrogen and 22 percent phosphoric acid.
- b. Gypsum: Hydrated calcium sulfate produce containing 23 percent calcium and 18 percent sulfur with a guarantee analysis of 84 percent calcium sulfate.
- c. Soil Sulfur: Guarantee analysis of 99 percent sulfur.

- d. Superphosphates: First grade finely ground phosphate rock used for agricultural purpose, containing minimum 18 percent phosphoric acid by volume.
- e. Commercial Fertilizer: Pellets or granular product having a chemical analysis of 14-14-14, with a minimum of 68 percent of nitrogen from slow release nitrogen unless otherwise specified in Soil Analysis Report: it should be a free flowing material delivered in unopened bags, do not install material which becomes caked or otherwise damaged.
- f. Nitrogen Fortified Wood Product: Derived from redwood, fir or cedar sawdust or from bark of fir or pine treated with a non-toxic agent to quickly absorb water and comply with following requirements:

1). Gradation:

SIEVE SIZE	PERCENT PASSING
¼-inch	95 percent minimum
#8	80 percent minimum
#35	30 percent minimum

Nitrogen Content:

NITROGEN CONTENT	PERCENT DRY WEIGHT
Redwood	0.4 to 0.6 percent
Fir	0.56 to 0.84 percent
Cedar	0.56 to 0.84 percent
Fir Bark	0.8 to 1.2 percent
Pine Bark	0.8 to 1.2 percent

- 3) Salinity: Maximum saturation extract conductivity 2.5 milliohms/centimeter at 25 degrees Celsius.
- 4) Absorption: When one teaspoon of water is applied to 4 cubic inches of air-dried products, material shall be become completely damp in a period of less than 2 minutes. Kellogg KRA, Sequoia Redwood/Cedar Blend or White Fir, Long Beach Soil Preparation, Bandini #101 Redwood Soil Builder of nitrogenized wood amendment.
- g. Organic Fertilizer: Treated, relatively dry friable organic compost derived from sewage sludge processed for agricultural use; containing at least 1 percent nitrogen by dry weight, 2 percent phosphoric acid and comply substantially with gradation noted in sub-section 2.1, B6. Milorganic, Kellogg’s Nitrohumus, or equal.

C. Prepared Backfill mix:

1. To be based upon recommendations from soils test performed by a certified laboratory.
 2. Mix (for bidding purposes):
 - a. Seventy percent by volume clean excavated topsoil/import soil.
 - b. Thirty percent by volume nitrogen stabilizer wood residual.
 - c. One pound per cubic yard gypsum.
 - d. Two pounds fertilizer per cubic yard (14-14-14 with a minimum 68 percent of nitrogen from slow release nitrogen. Additional secondary and micronutrients preferred).
 3. Mix (acid plants)
 - a. Thirty percent by volume clean excavated soil/imported soil.
 - b. Seventy percent by volume nitrogen stabilized wood residual.
 - c. Two pounds .per cubic yard. soil sulfur.
 - d. Two pounds. fertilizer per cubic yard (14-14-14 with a minimum 68 percent of nitrogen from slow release nitrogen. Additional secondary and micronutrients preferred).
- D. Plants (General): Plant names indicated or listed on Drawings shall conform with Sunset, Western Garden Book, latest edition.
1. Type and Size: Plant materials shall be listed on Drawings.
 2. Plants shall be true name, and one of each bundle or lot shall be tagged with Botanical/Common name and size of each plant in accordance with standards of practice recommended by American Association of Nurseryman
 3. Tag one plant of each variety for identifying purposes.
 4. Plantings shall be inspected before installation.
 5. Substitutions: When plants of a specified kind or size are not available, substitution may be requested in accordance with General Conditions.
 6. Plants shall have a growth habit normal to species in accordance with USA Standards for Nursery Stock, latest editions; shall be sound, healthy, vigorous, and free from insect pests, plant disease, sun scalds, fresh bark abrasions, excessive abrasions or other objectionable disfigurements. Tree trunks shall have normal well developed branch systems and vigorous and fibrous root systems, not root bound and shall be free of kinked or girding roots.

7. No pruning shall be performed before inspection at nursery by Architect. (Other than normal pruning during growth period).
8. Plantings specified for adverse conditions shall be Project site acclimated before planting. Purchase from local nurseries or store on Site for a period of 10 weeks for autumn planting and six weeks for spring planting.

E. Plant Material:

1. Trees: Trees shall conform to type and size noted on Drawings. Measure height from root crown to last division of terminal leader and measure diameter 1 ft. above root crown. Measure height of palm trees from ground line to base of growing bud. Palms shall stand reasonably erect without support.
2. Shrubs: Specified type and size selected from high quality well shaped nursery stock.
3. Flatted Plants: Grown and remain in flat until transplanted at Project site. Soil and spacing of plants in flat shall insure minimum disturbance of root system at time of transplanting. Maximum plants per flat to be 64 to 100 plants, or as indicated in Drawings.

H. General Materials:

1. Pipe: Galvanized steel, standard weight (schedule 40) complying with ASTM A120.
2. Nails, fasteners, etc.: Galvanized and commercial quality materials.
3. Fabricated metal items: Steel conforming to ASTM A36.
4. Concrete items: Standard 2000 psi concrete.

I. Concrete headers: 6-inch by 8-inch size, complete with pre-molded expansion joint material 10 ft. apart or as indicated on Drawings.

J. Composite Headers: Headers and stakes shall be composite material sizes as indicated on Drawings. Screws shall be plated deck screws. Stakes shall be 1 inch by 2-inch by 12-inch in length and headers shall be furnished in 2-inch by 4-inch by 20-foot in length and shall be of uniform width and thickness.

K. Tree Stakes: Steel stakes shall be the R2 Stake System (also known as the Reddy Stake System) manufactured by J. R. Partners or equal. Provide two R2 Stakes per tree. Use 7 feet R2 Stake for 15 gallon size trees and smaller and the 9 feet R2 Stake for 24-inch box size trees or smaller. Use the Mega Stake for 36 inches and 48 inches box size trees. If trees are surrounded by steel grates, utilize the Grate Stake for 24-inch box size trees and smaller and the Mega Grate Stake for 36-inch box size trees or smaller.

- L. Tree Ties:
 - 1. Wire Type: No. 10 gage BMG galvanized soft steel wire covered with garden hose.
 - 2. Cinch Tie: Flexible vinyl with adjustable interlocking capability.
- M. Tree-Root Control Barrier: Shall be fabricated from a high density and high impact plastic such as polyvinyl chloride, ABS or polyethylene, and have a minimum thickness of 0.06 inch. Plastic shall be furnished with ½ inch to ¾ inch high raised vertical ribs on inner surface spaced at least 6 inches but not more than 8 inches apart. Install a plastic root control barrier with each new tree planted within a tree well. Deep Root Corp., or equal.
- N. Pest Management Methods and Products: Refer to paragraph 1.04.F for details pertaining to Contractor applying pesticides.
- O. Jute matting shall be of a uniform open plain weave, single jute yarn, not varying in thickness by more than one half its normal diameter. Jute matting shall be furnished in rolled strips as follows: Length, approximately 50 to 75 yards, width, 45 inches to 50 inches. Ludlow Soil Saver No. 48, or equal.

PART 3 – EXECUTION

3.01 SURFACE CONDITIONS

- A. Examine areas and conditions under which Work of this Section will be performed. Correct detrimental conditions before commencing Work of this section.

3.02 GRADING AND SOIL PREPARATION

- A. Initial Rough Grading: Specified in Division 32.
- B. Earthwork and Topsoil Placement: Shall include excavation and backfilling for irrigation system and preparation for spreading, densification, cultivation, and raking of topsoil, including fertilization and conditioning.
- C. Preliminary Grading: Scarify existing soil to a depth of 6 inches before backfilling with topsoil. During preliminary grading operation, remove stones over ¾ inch.
- D. In Previously Paved Areas: Remove top 6 inches of existing soil and legally dispose of off Project site. Replace with approved imported topsoil to indicated finish grade.
- E. Topsoil Preparation and Conditioning:
 - 1. Type and Thickness: Topsoil shall have a minimum depth of 6 inches above subgrade or as indicated on Drawings, whichever is greater.

2. Before installing topsoil, subgrade shall be cleared of weeds, rock $\frac{3}{4}$ inch and larger and other extraneous materials from designated planting areas to a depth of 6 inches. The tools acceptable for this cleaning process are a Rock Picker by Harley Enterprise, Track Screener by Cherrington, Screen USA Inc. or other tools or machines designed for the purpose. The finished planting bed preparation is subject to the approval of the Owner's representative. OAR shall coordinate with the Owner's Landscape Office for a site visit and approval prior to plant/lawn installation.
 3. Do not process topsoil when it is so wet or dry as to cause excessive compaction or forming of hard clods or dust.
 4. Existing soil can be used as topsoil only if it meets the requirements of Article 2.01.A of this section.
- F. Fertilizing and Conditioning: Provide planting areas to finish grades, including mounds, before installation of specified fertilizer or soil conditioning materials.
1. Mechanically install following amount of fertilizer or soil conditioning materials at a uniform rate per 1,000 square feet of planting area:
 - a. Three cubic yards of nitrogen fortified wood compost.
 - b. Two cubic yards of organic fertilizer.
 - c. One hundred pounds. of gypsum.
 - d. Thirty pounds of commercial fertilizer.
 2. Quantities of required materials for planting areas shall be at Project site. Furnish Project Inspector with delivery tickets before installation to verify source, kind, and quantities delivered.
 3. After installation of fertilizer and soil conditioning materials, uniformly cultivate materials into upper 6 inches of soil with suitable equipment operated in at least two directions at approximate at right angles. Process soil until friable.
- G. Finish Grading:
1. Provide a finish grade, smooth, uniform, and free of abrupt grade changes and depressions to insure proper surface drainage.
 2. Finish grades adjacent to paving curbs or headers shall be 1 inch lower in sod areas and 2 inches lower in shrub or ground cover areas.
 3. Irrigate soil after installation of fertilizer and soil conditioning materials. Allow soil to settle. Provide a stable surface. After soil has dried out to a

workable condition, re-grade, rake, and smooth to required grades and contours. Finished surfaces to be left clean and suitable for planting.

4. Areas to be planted shall be graded and floated to provide complete surface drainage; water holding depressions and pockets shall be eliminated. Undulations and unsightly variations in grade which will not permit the use of normal mowing equipment without scalping or missing shall be removed so that proper use of mowing equipment can be performed.
 5. Areas to be planted shall also be finished graded to meet any walks, paths or other adjoining surfaces so that, after compaction, no water pockets or ridges remain.
 6. Areas where sod will interface with other modes of planting at catch basins and paved areas shall be finish shaped so as to counter sink the sod one inch such that once sod is placed, it shall be at grade with adjacent planting bed.
- H. Contour mounds: Construct with imported topsoil and specified soil amendments. Install and shape mounds to minimize settlement or erosion and to provide adequate footing for placement of boulders. Referenced dimensions of mound contours refer to height above finish grade.
- I. Trenching: After completion of soil conditioning or finish grading operations, backfill upper portion of trench so specified topsoil thickness in trench is restored.
- J. Weeding: Once site has been cleared, grubbed and rough graded, landscape areas shall be maintained free of vegetation growth until start of irrigation and planting phase of work.

3.03 HEADER INSTALLATION

- A. Install at locations and grades shown on Drawings, before planting.

3.04 PLANTING

- A. General: Planting materials shall be inspected before planting, including those tagged at nursery.
1. Perform planting with material, equipment and according to procedures favorable to optimum growth of plant. Do not plant during windy conditions.
 2. Except as noted for specimen planting in sub-section 3.04D, commence planting operations immediately following completion of irrigation system.
- B. Protection and Storage:
1. Maintain plantings delivered to Project site in a healthy condition.

2. Do not allow plantings to dry out.
 3. Separate bare root stock and “heal in” in moist earth or other suitable material.
 4. Cover root ball of baled or burlap wrapped plantings with moist sawdust, wood chips, or other permitted materials.
- C. Layout and Plant Locations:
1. Plant locations indicated on Drawings are approximate.
 2. Plants may be re-spotted before planting as required by Architect.
 3. Provide a detailed layout of plants and landscape elements in planting areas and obtain review of Architect before actual planting operations.
 4. Locate first row of plantings in areas designated for on center spacing at one-half the designated spacing from edge of area.
- D. Specimen Planting: Plantings in boxes 24 inches or larger shall be installed before installation of lateral irrigation lines. Re-route irrigation lines in conflict with specimen locations to clear root ball.
- E. Tree and Shrub Installation:
1. Excavate planting holes approximately square with vertical sides shall be twice the width of plant container or root ball; larger if necessary to permit handling and installation without damage to root ball system. Bottom of plant container or root ball shall be placed on existing undisturbed soil.
 2. Do not install plantings having a broken or cracked root ball.
 3. Containers should be opened and removed in such a manner not to damage root system.
 4. Remove balled plant wrappings after plant is positioned in hole.
 5. Scarify native soil at bottom half of holes to a depth of 6 inches.
 6. Backfill bottom half of hole with specified backfill mix minus fertilizers. Settle with water.
 7. After water settling bottom half of hole, set planting approximately in center of hole and adjust root flush to finish grade.
 8. Backfill balance of hole with specified backfill mix and fertilizer and water settle.
 9. Prune or remove any broken or damaged limbs.

10. Form a circular watering basin slightly larger than hole; 4-inch high for trees and 2-inch high for shrubs. Shape bottom of basin to be slightly lower than finish grade.
 11. Restore area around plantings to finish grade.
 12. After installation, plantings shall be plumb with root crown at its natural depth with respect to finish grade.
 13. New trees in sod areas to be installed with tree trunk protector.
- F. Backfill Planting Mix: Consists of 70 percent specified topsoil, and 30 percent nitrogen fortified sawdust mulch plus the amendments indicated in soil analysis report.
- G. Raised Planter Mix: Backfill mix for raised planters and tree pits in raised planters shall be of following materials.
1. Planter Mix by B.D. White Topsoil Co., Culver City, LAUSD Mix by AE Schmidt Co, Planter Mix by Gale Materials or equal.
 2. Weights shall be 45 pounds per cubic foot.
 3. Raised planters shall be backfilled with finish grade at 2 inches below the planter top.
 4. Required system for draining planters shall be in place prior to placing backfill.
- H. Ground Cover Planting:
1. Complete soil preparation and fine grading before installation of ground cover plantings.
 2. Install ground cover in moist soil, spaced as indicated on Drawings.
 3. Install each plant with its proportionate amount of flat soil to minimize root disturbance.
 4. The degree of soil moisture in flat shall be such that soil does not crumble when removing planting.
 5. Following installation of ground cover, restore finish grade to insure proper surface draining.
- M. Transplanting of Existing Plant Material: In accordance with current horticulture practices.
1. Box or root system as necessary to maintain plant materials in a healthy, growing condition.

2. Equivalent size and kind of plantings may be provided instead of transplanting an existing planting.
- N. Fertilizing: At 30 day intervals after sod or ground cover installation, install an all purpose 15-15-15 commercial fertilizer at rate of 10 pounds per 1,000 square feet of installed area. Thoroughly water area after applying fertilizer. Fertilizer applications shall be performed under observation of Project Inspector.

3.06 MAINTENANCE AND PLANT ESTABLISHMENT

- A. Required: Maintain areas on a continuous basis as they are completed during progress of Work and during establishment period. Maintenance shall include continuous operations of watering, weeding, trimming, rodent control, planting replacement irrespective of cause or any other operations necessary to assure normal plant growth.
- B. Keep planting areas free of debris and weeds. Cultivate at intervals not to exceed 10 days.
- D. Pruning: Required pruning of plants at start of plant establishment period shall be as required by Architect.
- E. Plant Establishment Inspection:
1. Request an inspection to begin plant establishment period after plantings and related Work has been completed in accordance with Contract Documents.
 2. Upon successful completion of inspection, effective commencement date of plant establishment period shall begin.
 3. Plant establishment period for shrubs and ground cover, shall be 90 calendar days and for trees shall be one year or as otherwise indicated in Contract Documents.
 4. Architect may recommend extension of plant establishment period if planting areas are improperly maintained, appreciable plant replacement is required, or other defective Work.
- F. Damage:
1. Immediately replace failed or damaged plantings.
 2. Provide replacement plantings of same type and size to match adjacent plantings. Furnish plantings and fertilizer as specified. New plantings shall be subject to a 30 day establishment period.
 3. Damage to planting areas shall be repaired immediately. Depressions caused by vehicles or foot traffic shall be filled with topsoil and leveled.

G. Final Inspection:

1. Upon completion of plant establishment period, Architect will perform a final inspection.
2. If plant establishment period is completed before Substantial Completion, planting areas shall be maintained until Final Completion.

3.07 PESTICIDE APPLICATION

- A. Contractor must comply with specifications outlined in paragraph 1.04.F.

3.08 PROTECTION

- A. Unless noted otherwise, protect Work of this section until Substantial Completion.

3.09 CLEANUP

- A. Remove rubbish, debris and waste materials and legally dispose of off Project site.

END OF SECTION

SECTION 32 9400 –

PAVEMENT MARKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes surface preparation and field application of pavement marking on hot-mix asphalt paving and Portland cement concrete paving.

1.3 SUBMITTAL

- A. Product Data:

1. Material List: Provide an inclusive list of required coating materials, including primers and other surface preparation materials. Indicate each material and cross-reference specific coating and application. Identify each material by manufacturer's catalog number and general classification.
2. Manufacturer's Information: Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
3. Certification by the manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).

- B. Results of preconstruction field testing.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of pavement marking material from one source and by a single manufacturer.
- B. Installer Qualifications: Engage an experienced installer who has completed pavement marking similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance of at least 5 years.
- C. Pre-Application Field Testing: Prepare a sample marking of each different paint formulation on asphalt substrates for the purpose of establishing quality of application, adherence of paint to the substrate, compatibility of the paint with the asphalt, and to determine whether a primer will be necessary if not otherwise required by the manufacturer.

1. Minimum length of test stripe: 3 feet.
2. Perform a minimum of 3 test stripes, located to provide a representative sample of entire area indicated to receive pavement marking paint.
3. Apply test markings using methods and equipment recommended by the manufacturer of the marking paint and as specified in this Section.
4. Arrange for a technical representative of the marking paint manufacturer to observe cured test samples and provide written recommendations for changes, if any, to materials or methods necessary to achieve optimum paint performance on specific substrates.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.
- B. Store pavement-marking materials in a clean, dry, protected location and within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.6 PROJECT CONDITIONS

- A. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 50 deg F, and not exceeding 90 deg F.

PART 2 - PRODUCTS

2.1 PAVEMENT MARKING MATERIALS

- A. Pavement-Marking Paint: Lead free latex, water-base emulsion, ready-mixed, complying with FS TT-P-1952, and suitable for use on both hot-mix asphalt and Portland cement concrete paving. Provide material having a volatile organic compound (VOC) content of 250 g/L, or less.
 1. Colors:
 - a. Color: White (for all parking stalls other than disabled access parking, for traffic and lane marking, and for painted text).
 - b. Color: Yellow, where indicated.
 - c. Color: Red (for "No Parking" areas as shown).
 - d. Color: Blue (for pavement markings identifying disabled access parking).

2. Gloss: Flat or eggshell with gloss at 30 percent or less when measured at a 60-degree meter.
- B. Primer: Type recommended by the marking paint manufacturer.
 - C. Surface Cleaning Material: Cleaning agent or agents suitable for removing grease, oil, and other contaminants that will not damage asphalt or Portland cement concrete paving and are acceptable to pavement marking paint manufacturer.

PART 3 - EXECUTION

3.1 PAVEMENT MARKING

- A. Allow paving to cure for a minimum of 30 days before starting pavement marking. Comply with recommendations of the pavement marking paint manufacturer for longer cure periods.
- B. Sweep and clean surface to eliminate loose material and dust. Ensure all surfaces indicated to receive pavement marking are clean and free from grease, oil, concrete sealers and curing agents, and other contaminants that might interfere with paint adhesion.
 1. Comply with manufacturer's instructions for use of special cleaning agents.
 2. For removal of substances that would interfere with paint adhesion use methods recommended by the paint manufacturer if applicable, or methods that will completely remove the substance without damaging or discoloring the underlying pavement substrate.
- C. Apply paint with mechanical equipment to produce pavement markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates based on substrate type and cure conditions to provide a minimum wet film thickness of 15 mils and dry film thickness of 8 mils, unless otherwise recommended by the manufacturer.
- D. Comply with paint manufacturer's maximum recommended drying time before allowing traffic in order to prevent undue softening of bitumen and pick-up, displacement, or discoloration of pavement marking by vehicular traffic.
- E. Paint pavement, curbs, and other surfaces as shown on the Drawings. Painting shall be straight, uniform, exact, and sharp without blobs at the start and finish. Edges shall be even, accurate, symmetrical, and free of fuzziness.
 1. Edge Tolerance: 1/2 inch in 20 feet, maximum.
- F. Apply markings for disabled access symbols in accordance with State of California Building Code, Part 2, Title 24, California Building Standards.

- G. Where work consists of modifications of, or additions to existing pavement marking, match existing color and line width.

3.2 ADJUSTING

- A. Touch up pavement markings not complying with requirements of this Section by painting out the errors with permanently opaque paint of the same color as the substrate pavement.
 - 1. Block out and eliminate all traces of splashed, tracked, and spilled pavement marking paint from the background surfaces.
 - 2. Paint over deviations in marking edges exceeding allowable tolerance and apply new marking meeting specified requirements.
- B. The Owner reserves the right to require sandblast removal of extensive defective pavement marking and application of new marking meeting specified requirements at no additional cost.

3.3 PROTECTION

- A. Provide traffic cones, barricades, and other devices needed to protect the pavement marking until it is sufficiently dry to withstand traffic without damage.

END OF SECTION

SECTION 32 4100

STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes drainage systems outside the building. Systems include the following:
 - 1. Storm drainage.
- B. Related Sections: The following Sections contain requirements that relate to this Section.
 - 1. "Subdrainage" Section for foundation drain connecting to storm drainage system.
 - 2. "Cast-in-Place Concrete" Section for cast-in-place concrete structures.
 - 3. "Facility Storm Drainage Piping" Section for building drains.

1.03 SYSTEM DESCRIPTION

- A. Provide systems according to the materials, workmanship, and other applicable requirements of the standard specifications of the state or of authorities having jurisdiction.
 - 1. Reference Specification: Perform all work in accordance with applicable provisions of "Standard Specifications for Public Works Construction", latest edition. Unless otherwise noted, mention herein of section numbers refers to sections of the Reference Specification. Where Reference Specification refers to "Agency", substitute the word "Owner". Where Reference Specification refers to "Engineer", substitute the word "Architect". Where Reference Specification is in conflict with these Specifications, these Specifications shall govern.
 - 2. Measurement and payment provisions and safety program submittals included in Reference Specifications do not apply to this Section.

- 1.04 DEFINITIONS
- A. Drainage Piping: System of pipe, fittings, and appurtenances for gravity flow of storm drainage.
- 1.05 PERFORMANCE REQUIREMENTS
- A. Gravity-Flow, Non-pressure Piping Pressure Ratings: At least equal to system test pressure.
- 1.06 SUBMITTALS
- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Product data for the following:
1. Pipe and fittings
2. Cleanouts and drains.
- C. Inspection and test reports specified in the "Field Quality Control" Article.
- 1.07 QUALITY ASSURANCE
- A. Environmental Agency Compliance: Comply with regulations pertaining to storm drainage systems.
- B. Utility Compliance: Comply with regulations pertaining to storm drainage systems. Include standards of water and other utilities where appropriate.
- C. Product Options: Drawings indicate sizes, profiles, connections, and dimensional requirements of system components and are based on specific manufacturer types indicated. Other manufacturers' products with equal performance characteristics may be considered. Refer to Section "Substitution Procedures."
- 1.08 DELIVERY, STORAGE, AND HANDLING
- A. Do not store plastic pipe or fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle precast concrete manholes and other structures according to manufacturer's rigging instructions.
- 1.09 PROJECT CONDITIONS
- A. Perform site survey, research public utility records and/or pothole as necessary to verify existing utility locations. Contact utility locating service for area where Project is located.

- B. Locate existing structures and piping to be closed and abandoned.
- C. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the Owner or others except when permitted under the following conditions and then only after arranging to provide acceptable temporary utility services.
 - 1. Notify Architect not less than 48 hours in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without receiving Architect's written permission.

1.10 SEQUENCING AND SCHEDULING

- A. Coordinate storm drainage system connections to utility company's storm drain.
- B. Coordinate storm drainage system connections to existing on-site storm drain.
- C. Coordinate with interior building drainage systems.
- D. Coordinate with other utility work.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Cleanouts and Drains:
 - a. Josam Co.
 - b. Jay R. Smith Mfg. Co. Div., Smith Industries, Inc.
 - c. Wade Div., Tyler Corp.
 - d. Zurn Specification Drainage Operation Div., Zurn Industries, Inc.,

2.02 PIPES AND FITTINGS

- A. Corrugated-Steel Pipe: ASTM A 760/A 760M, Type I, made from ASTM A 444/A 444M, zinc-coated steel sheet for banded joints.
 - 1. Fittings: Fabricated to types indicated and according to same standards as pipe.
 - 2. Connecting Bands: Standard couplings made for corrugated-steel pipe to form soiltight joints.

3. Protection: [Pipe and coupling bands] [Pipe, coupling bands and flared end sections] shall receive a bituminous coating in accordance with the Reference Specification, paragraph 207-11.5.
 4. Linings: [Bituminous] [Concrete] linings shall be applied to the interior of the pipe as specified in paragraph 207-11.5.3 of the Reference Specification.
 5. Slotted Pipe: Shall conform to paragraph 207-11.7 of the Reference Specification.
- B. Corrugated-Aluminum Pipe: ASTM B 745/B 745M, Type I, made from ASTM B 744/B 744M, aluminum-alloy sheet for banded joints.
1. Fittings: Fabricated to types indicated and according to same standards as pipe.
 2. Connecting Bands: Standard couplings made for corrugated-aluminum pipe to form soiltight joints.
 3. Flared End Sections: Shall be prefabricated galvanized steel.
- C. Polyvinyl Chloride (PVC) Sewer Pipe and Fittings: ASTM D 3034, SDR 35, with bell-and-spigot ends for gasketed joints.
1. Primer: ASTM F 656.
 2. Solvent Cement: ASTM D 2564.
 3. Gaskets: ASTM F 477, elastomeric seal.
- D. Vitrified Clay Piping for Gravity Flow: ASTM C 700 bell-and-spigot piping with ASTM C 425 compression joints.
- E. Reinforced Concrete Storm Drain Pipe and Fittings: ASTM C 76, Class as shown. Circular pipe with elliptical reinforcement shall have a readily visible line at least 12 inches long painted or otherwise applied on the inside and outside of the pipe at each end so that when the pipe is laid in the proper position, the line will be at the center of the top of the pipe. Fittings and specials shall conform to the same strength as the pipe.
1. Jointing Materials: Gaskets and pipe ends for rubber gasket joint shall conform to ASTM C 443. Gaskets shall be suitable for use with sewage.
 - a. O-Ring Gasketed bell and spigot, all concrete, with bell cast integrally with pipe, ASTM C 443.
 - b. Tongue and groove, cement mortared with mortar made of one part Type II Portland Cement to two parts sand.

- F. High Density Polyethylene Pipe (HDPE) for gravity flow, smooth interior and annular exterior corrugations. Gasketed integral bell-and-spigot joint meeting the requirements of ASTM F2736. Provide pipe per Paragraph 207-18 of the Reference specification.

2.03 SPECIAL PIPE COUPLINGS AND FITTINGS

- A. Sleeve-Type Pipe Couplings: Rubber or elastomeric sleeve and band assembly fabricated to match outside diameters of pipes to be joined, for non-pressure joints.
 - 1. Sleeves for Concrete Pipe: ASTM C 443 (ASTM C 443M), rubber.
 - 2. Sleeves for Plastic Pipe: ASTM F 477, elastomeric seal.
 - 3. Sleeves for Dissimilar Pipes: Compatible with pipe materials being joined.
 - 4. Bands: Stainless steel, at least one at each pipe insert.
- B. Gasket-Type Pipe Couplings: Rubber or elastomeric compression gasket, made to match outside diameter of smaller pipe and inside diameter or hub of adjoining larger pipe, for non-pressure joints.
 - 1. Gaskets for Concrete Pipe: ASTM C 443 (ASTM C 443M), rubber.
 - 2. Gaskets for Plastic Pipe: ASTM F 477, elastomeric seal.
 - 3. Gaskets for Dissimilar Pipes: Compatible with pipe materials being joined.

2.04 MANHOLES

- A. Precast Concrete Manholes: Per SPPWC Standard Plan 321-2 “Manhole Pipe-to-Pipe (One or Both Main Line ID’s 33” or Smaller)”.
- B. Manhole Frames and Covers: Per SPPWC Standard Plan 630-3 “24” Manhole Frame and Cover”.
 - 1. After installation of manhole and after installation of adjacent paving, if any, covers shall be sandblasted and painted with black bituminous paint.

2.05 CATCH BASINS

- A. Cast-in-Place Concrete Catch Basins-Grated: Construct of reinforced-concrete, designed according to ASTM C 857 for structural loading and as shown on the Drawings. Include depth, shape, dimensions, and appurtenances indicated.
 - 1. Bottom, Walls, and Top: Reinforced concrete.

2. Channels and Benches: Concrete.
 3. Steps: Fiber glass, individual steps. Omit steps for catch basins less than 48 inches (1500 mm) deep.
- B. Frames and Grates: ASTM A 536, Grade 60-40-18, heavy-duty ductile iron for A-16 structural loading, and as shown on Drawings.
 - C. Curb Inlets: Made with vertical curb opening, of materials and dimensions according to SPPWC Standard Plan 300-3 "Curb Opening Catch Basin".
 - D. Combination Inlets: Made with vertical curb and horizontal gutter openings, of materials and dimensions according to SPPWC Standard Plan 302-3 "Curb Opening Catch Basin with Grating(s). Include heavy-duty frames and grates. See Drawings for number of grates.
 - E. Frames and Grates: Heavy-duty frames and grates according to SPPWC Standard Plan 311-3 "Frame and grating for Catch Basins".

2.06 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318, ACI 350R, and the following:
 1. Cement: ASTM C 150, Type II.
 2. Fine Aggregate: ASTM C 33, sand.
 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 4. Water: Potable.
- B. Structures: Portland-cement design mix, 4000 psi (27.6 MPa) minimum, with 0.45 maximum water-cement ratio.
 1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
 2. Reinforcement Bars: ASTM A 615, Grade 60 (ASTM A 615M, Grade 400), deformed steel.
- C. Structure Channels and Benches: Factory or field formed from concrete. Portland-cement design mix, 4000 psi (27.6 MPa) minimum, with 0.45 maximum water-cement ratio.
 1. Include channels and benches in manholes.
 - a. Manhole Channels: Concrete invert, formed to same width as connected piping, with height of the vertical sides to 3/4 of the pipe diameter. Form curved channels with smooth, uniform radius and

slope. If channel invert slope is not indicated on the Drawings, slope as follows:

- 1) Invert Slope: 2.5 percent (1:40) through manhole.
- b. Manhole Benches: Concrete, sloped to drain into channel.
 - 1) Slope: 1 inch per foot (1:12).

2.07 CLEANOUTS

- A. Description: Round, gray-iron housing with round, secured, scoriated, cast-iron cover as detailed on the Drawings. Include gray-iron ferrule with inside caulk or spigot connection and countersunk, tapered-thread, brass closure plug. Use units with top-loading classifications according to the following applications:
 1. Light Duty: In earth or grass, foot-traffic areas.
 2. Medium Duty: In paved, foot-traffic areas.
 3. Heavy Duty: In vehicle-traffic service areas.
 4. Extra Heavy Duty: In roads.
- B. After installation of cleanout cover and after installation of adjacent paving, if any, covers shall be sandblasted or wire brushed as necessary and painted with bituminous black paint, unless another color is required by the Architect.

2.08 DRAINS

- A. Area Drains: ASME A112.21.1M, round, gray-iron body with anchor flange and round, secured, cast-iron grate. Include bottom outlet with inside caulk or spigot connection, of sizes indicated. Use units with top-loading classifications according to the following applications:
 1. Medium Duty: In paved, foot-traffic areas.
 2. Heavy Duty: In vehicle-traffic service areas.
- B. Cast-Iron Trench Drains: ASME A112.21.1M, 6-inch- (152-mm-) wide top surface, rectangular body with anchor flange or other anchoring device and rectangular, secured grate. Include units of total lengths indicated and number of bottom outlets with inside caulk or spigot connections, of sizes indicated. Use units with top-loading classifications according to the following applications:
 1. Medium Duty: In paved, foot-traffic areas.
 2. Heavy Duty: In vehicle-traffic service areas.
 3. Extra Heavy Duty: In roads.
- C. Steel Trench Drains: Fabricated from ASTM A 242/A 242M steel plate, to form rectangular body with uniform bottom slope of 2 percent down toward outlet,

anchor flange, and grate. Include units of total lengths indicated, bottom outlet of size indicated, outlet strainer, and acid-resistant enamel coating on inside and outside surfaces. Include grate openings with total free area at least 2 times the outlet cross-sectional area and with the following features:

1. Plate Thickness: 1/4 inch (6.4 mm).
2. Plate Thickness: 1/8 inch (3.2 mm).
3. Overall Width: 7-1/2 inches (190 mm).
4. Overall Width: 12-1/3 inches (313 mm).
5. Grate: 3-by-3/8-inch (76-by-9.5-mm) slots.
6. Grate: 3/8-inch- (9.5-mm-) diameter openings.
7. Grate: 1/4-inch- (6.4-mm-) diameter openings.
8. Cover: Solid with diamond pattern, where indicated.
9. Weepholes in body and flashing clamping ring for units used with waterproof membrane.

PART 3 - EXECUTION

3.01 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in the “Earth Moving” Section.

3.02 IDENTIFICATION

- A. Materials and their installation are specified in the “Earth Moving” Section. Arrange for installation of green warning tapes directly over piping and at outside edges of underground structures.
 1. Use warning tapes or detectable warning tape over ferrous piping.
 2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.03 DRAINAGE PIPING APPLICATIONS

- A. General: Include watertight, silttight, or soiltight joints, except where watertight or silttight joints are indicated.

- B. Refer to Part 2 of this Section for detailed specifications for pipe and fitting products listed below. Use pipe, fittings, and joining methods according to the following applications.
- C. Pipe Sizes 4 to 15 Inches (100 to 375 mm): ASTM D 3034, polyvinyl chloride (PVC) sewer pipe and fittings; solvent-cemented joints; or with gaskets and gasketed joints.
- C. Pipe Sizes 4 to 15 Inches (100 to 375 mm): ASTM D 1248, high-density polyethylene (HDPE) bell-and-spigot drainage pipe; gasketed joints.
- D. Pipe Sizes 15 to 36 Inches (375 to 900 mm): Reinforced-concrete storm drain pipe and fittings; rubber gaskets and gasketed joints; or tongue-in-groove, mortared joints.

3.04 SPECIAL PIPE COUPLING AND FITTING APPLICATIONS

- A. Special Pipe Couplings: Use where indicated and where required to join piping and no other appropriate method is specified. Do not use instead of specified joining methods.
 - 1. Use the following pipe couplings for non-pressure applications:
 - a. Straight-pattern, sleeve type to join piping, of same size, with small difference in outside diameters.
 - b. Increaser/reducer-pattern, sleeve type to join piping of different sizes.
 - c. Gasket type to join piping of different sizes where annular space between smaller piping's outside diameter and larger piping's inside diameter permits installation.
 - d. Internal-expansion type to join piping with same inside diameter.

3.05 INSTALLATION, GENERAL

- A. General Locations and Arrangements: Drawings (plans and details) indicate the general location and arrangement of underground drainage system piping. Location and arrangement of piping layout take into account many design considerations. Install piping as indicated, to extent practical.
- B. Install piping beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's recommendations for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line and pull past each joint as it is completed. Verify existing elevations prior to extensive excavating and notify Architect of any discrepancies. Contractor shall be liable for any premature construction which must be modified due to unforeseen existing conditions.

- C. Use fittings for branch connections.
- D. Use proper size increasers, reducers, and couplings, where different sizes or materials of pipes and fittings are connected. Reduction of the size of piping in the direction of flow is prohibited.
- E. Install gravity-flow-systems piping at constant slope between points and elevations indicated. Install straight piping runs at constant slope, not less than that specified, where slope is not indicated.
- F. Extend drainage piping and connect to building's storm drains, of sizes and in locations indicated. Terminate piping as indicated.
- G. Install drainage piping pitched down in direction of flow, at minimum slope of 1 percent (1:100) and 36-inch (1000-mm) minimum cover, except where otherwise indicated.

3.06 PIPE JOINT CONSTRUCTION AND INSTALLATION

- A. General: Join and install pipe and fittings according to the following.
- B. Polyvinyl Chloride (PVC) Plastic Pipe and Fittings: As follows:
 - 1. Join solvent-cement-joint pipe and fittings with solvent cement according to ASTM D 2855 and ASTM F 402.
 - 2. Join pipe and gasketed fittings with elastomeric seals according to ASTM D 2321.
- C. Concrete Pipe and Fittings: Install according to ACPA "Concrete Pipe Handbook." Use the following seals:
 - 1. Round Pipe and Fittings: ASTM C 443 (ASTM C 443M), rubber gaskets or tongue-in-groove with mortar.
- D. High Density Polyethylene (HDPE) drainage pipe: Install in accordance with ASTM D2321.
- E. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and fit both systems' materials and dimensions.

3.07 MANHOLE INSTALLATION

- A. General: Install manholes, complete with accessories, as indicated.
- B. Form continuous concrete channels and benches between inlets and outlet, where indicated.

- C. Set tops of frames and covers flush with finished surface where manholes occur in pavements. Set tops 3 inches (76 mm) above finished surface elsewhere, except where otherwise indicated.
- D. Place precast concrete manhole sections as indicated, and install according to ASTM C 891.
 - 1. Provide rubber joint gasket complying with ASTM C 443 (ASTM C 443M), at joints of sections.

3.08 CATCH BASIN INSTALLATION

- A. Construct catch basins to sizes and shapes indicated.
- B. Set frames and grates to elevations indicated.

3.09 DRAIN INSTALLATION

- A. Install type of drains in locations indicated. Embed drains in 4-inch minimum concrete around bottom and sides.
- B. Fasten grates to drains if indicated.
- C. Set drain frames and covers with tops flush with pavement surface.

3.10 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318, ACI 350R, and as indicated.

3.11 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extension from storm drain pipe to cleanout at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in pipe.
- B. Set cleanout frames and covers in earth in a cast-in-place concrete block, 18 by 18 by 12 inches (450 by 450 by 300 mm) deep. Set with tops 1 inch (25 mm) above surrounding earth grade.
- C. Set cleanout frames and covers in concrete paving with tops flush with surface of paving.

3.12 TAP CONNECTIONS

- A. Make connections to existing piping and underground structures so finished work conforms as nearly as practical to requirements specified for new work.
- B. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and

encase entire wye fitting plus 6-inch (150-mm) overlap, with not less than 6 inches (150 mm) of 3000-psi (20.7-MPa), 28-day, compressive-strength concrete.

- C. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.13 CLOSING ABANDONED DRAINAGE SYSTEMS

- A. Abandoned Piping: Close open ends of abandoned underground piping that is indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either of the following procedures:

1. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

- B. Abandoned Structures: Excavate around structure as required and use the following procedure:

1. Remove structure and close open ends of remaining piping.
2. Backfill to grade according to the Earth Moving Section.

3.14 FIELD QUALITY CONTROL

- A. Clean interior of piping and structures of dirt and superfluous material as the work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.

1. In large, accessible piping, brushes and brooms may be used for cleaning.
2. Place plug in end of incomplete piping at end of day and whenever work stops.
3. Flush piping between manholes and other structures, if required by authorities having jurisdiction, to remove collected debris.

- B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (600 mm) of backfill is in place, and again at completion of the Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visual between structures.

- b. Deflection: Flexible piping with deflection that prevents passage of a ball or cylinder of a size not less than 92.5 percent of piping diameter.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 - 3. Replace defective piping using new materials and repeat inspections until defects are within allowances specified.
 - 4. Re-inspect and repeat procedure until results are satisfactory.
- C. Test new piping systems and parts of existing systems that have been altered, extended, or repaired for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to authorities having jurisdiction.
 - 3. Schedule tests, and their inspections by authorities having jurisdiction, with at least 24 hours' advance notice.
 - 4. Submit separate reports for each test.
 - 5. Where authorities having jurisdiction do not have published procedures, perform tests per UNI-B-6 and the following:
 - a. Exception: Piping and soiltight joints unless required by authorities having jurisdiction.
 - b. Option: Test plastic piping according to ASTM F 1417.
 - c. Option: Test concrete piping according to ASTM C 924.
 - 6. Manholes: Perform hydraulic test according to ASTM C 969 (ASTM C 969M).
 - 7. Leaks and loss in test pressure constitute defects that must be repaired.
 - 8. Replace leaking piping using new materials and repeat testing until leakage is within allowances specified.

3.15 STANDARD PLANS

- A. The following Standard Plans have been specified on the Drawings and are included following this Section for Contractor's convenience:
 - 1. ***Standard Plans for Public Works Construction Standard Plan 300-3 "Curb Opening Catch Basin". (2 sheets)***

2. *Standard Plan for Public Works Construction Standard Plan 302-3 “Curb Opening Catch Basin with Grating(s)”. (2 sheets)*
3. *Standard plans for Public Works Construction Standard Plan 308-2 “Monolithic Catch Basin Connection”. (2 sheets)*
4. *Standard Plans for Public Works Construction Standard Plan 321-2 “Manhole Pipe to Pipe (One or Both Main Line ID’s 33” or Smaller)”. (3 sheets)*
5. *Standard Plans for Public Works Construction Standard Plan 335-2 “Pipe Connections to Existing Storm Drains”. (3 sheets)*

END OF SECTION

PARTNER

GEOTECHNICAL REPORT

Grade School Renovation
2299 Pacific Avenue
Long Beach, California 90402

July 8, 2022
Partner Project Number: 22-367784.1

Prepared for:

Economic Resources Corporation
2600 Industry Way
Lynwood, California 90262



Engineers who understand your business

July 8, 2022

Albert Carrol
Economic Resources Corporation
2600 Industry Way
Lynwood, California 90262

Subject: Geotechnical Report
Grade School Renovation
2299 Pacific Avenue
Long Beach, California 90806
Partner Project No. 22-364674.1

Dear Albert Carrol,

Partner Assessment Corporation (Partner) presents the following general opinion regarding the geotechnical conditions at the subject site, based on the information contained within this geotechnical report and our general experience with construction practices and geotechnical conditions on other sites. This statement does not constitute an engineering recommendation.

- *The geotechnical conditions on the site related to the planned construction are expected to be similar in comparison with other similar sites*; given the limited proposed renovations.*

The descriptions and findings of our geotechnical report are presented for your use in this electronic format, for your use as shown in the hyperlinked outline below. To return to this page after clicking a hyperlink, hold "alt" and press the "left arrow key" on your keyboard.

- [1.0 Geotechnical Executive Summary](#)
- [2.0 Report Overview and Limitations](#)
- [3.0 Geologic Conditions and Hazards](#)
- [4.0 Geotechnical Exploration and Laboratory Results](#)
- [5.0 Geotechnical Recommendations](#)

[Figures & Appendices](#)

We appreciate the opportunity to be of service during this phase of the work.



Sincerely,



Matthew Marcus, PE, PG
Principal Geotechnical Engineer/Geologist



Yuri Kawashima, GIT
Project Geologist



Andrew J. Atry, PE
Senior Engineer

* "similar sites" refers to sites with similar planned and current use, where we have recently performed similar work, and is a general statement not based on statistical analysis.

1. GEOTECHNICAL EXECUTIVE SUMMARY

The executive summary is meant to consolidate information provided in more detail in the body of this report. This summary in no way replaces or overrides the detailed sections of the report.

Geologic Zones and Site Hazards

The site is located in the City of Long Beach within the Peninsular Ranges geomorphic province of the state of California. According to the United States Geological Survey (USGS), surficial geology at the site can be described as Holocene- and Late Pleistocene-age young alluvium. These deposits consist of poorly consolidated, poorly sorted, permeable flood-plain deposits consisting of soft clay, silt and loose to moderately dense sand and silty sand. The site grades are relatively flat, sloping down slightly to the west. The site is currently developed as an existing vacant building that was formerly used for commercial purposes including a gasoline service station until 1973. The site may be impacted by existing buried foundations, utility lines, underground storage tanks, undocumented fills as well as other remnants of previous construction. This portion of the state is prone to strong ground shaking, and the site is mapped within a liquefaction hazard zone according to California Geological Survey (CGS). We did not analyze the site for liquefaction hazards as there are no major changes proposed to the existing building. No other geologic hazards are known or suspected onsite.

Excavation Conditions

Grading plans were not available at the time of our report; however, we anticipate excavations on the site to depths of up to 2 feet for new structures and paving. There are no slabs or foundations planned at this time. Based on our boring data, conventional construction equipment in good working condition should be able to perform the planned excavations. As previously mentioned, undocumented fills and remnants of previous construction may be present on the site and could cave or be difficult to remove and require additional planning and equipment. Groundwater was not encountered in our borings during drilling. However, groundwater levels fluctuate over time and may be different at the time of construction and during the project life.

Foundation/Slab Support

Based on our understanding of the proposed construction, the existing building is to be renovated and the existing footprint will remain in place. New construction will consist of an outdoor patio area and new parking areas south of the existing building. However, final grading and drainage plans were not available at the time of our report. We assume the new finished paved surface will be approximately at the elevation of the ground floor of the existing building. Should there be any changes to construction plans including the addition of any buildings, Partner should be contacted to perform additional work as needed. If auxiliary structures, such as site walls require foundations can be supported on shallow spread foundations over 12 inches of compacted on site soils. The base of excavation for new shallow foundations and slabs on grade should be evaluated by the engineer, with additional removal of soft or deleterious material if needed and should then be compacted in-place prior to the placement of new fills or foundations. Areas for new slabs on grade should be evaluated by proofrolling with soft, unstable areas removed and replaced with compacted fill.

Soil Reuse

Based on our borings site soils will generally usable as structural fill provided it is non-expansive ($PI < 20$) and free of organic material and other debris. Existing structural materials such as concrete, asphalt, crushed aggregate, or others could potentially be re-used as site fills if processed to meet fill requirements on the site. We recommend engineered fill for the site be moisture conditioned and compacted to at least 95% of the maximum dry density in accordance with ASTM D1557 and Appendix C of this report.

Pavement Design

Roadway Type	Subgrade Preparation	Pavement Section
Parking Area Light Duty	Proofrolled/Compacted Subgrade	4 in. asphalt / 4 in. Aggregate base
Parking Area Heavy Duty	Proofrolled/Compacted Subgrade	6 in. Concrete / 4 in. Aggregate base

Geotechnical Report

Project No. 22-364674.1

July 8, 2022

Page 1

PARTNER

2. REPORT OVERVIEW & LIMITATIONS

2.1 Report Overview

To develop this report, Partner accessed existing information and obtained site specific data from our exploration program. Partner also used standard industry practices and our experience on previous projects to perform engineering analysis and provide recommendations for construction along with construction considerations to guide the methods of site development. The opinions on the cover letter of this report do not constitute engineering recommendations, and are only general, based on our recent anecdotal experiences and not statistical analysis. Section 1.0, Executive Geotechnical Summary, compiles data from each of the report sections, while each of sections in the report presents a detailed description of our work. The detailed descriptions in Section 5.0 and Appendix C constitute our engineering recommendations for the project, and they supersede the Executive Geotechnical Summary.

The report overview, including a description of the planned construction and a list of references, as well as an explanation of the report limitations is provided in Section 2.0. The findings of Partner's geologic review are included in Section 3.0 Geologic Conditions and Hazards. The descriptions of our methods of exploration and testing, as well as our findings are included in Section 4.0 Geotechnical Exploration and Laboratory Results. In addition, logs of our exploration excavations are included in Appendix A of the report, and laboratory testing is included in Appendix B of the report. Site Location and Site Plan maps are included as Figures in the report.

2.2 Assumed Construction

Partner's understanding of the planned construction is that it will consist of building renovations, repaving, and landscaping with no new building or foundations. The report was based on information provided by the project team. The proposed site plan is included as Figure 2 to this report. Partner's assumptions regarding the new construction are presented in the below table.

Property Data	
Property Use:	Building Renovation, Repaving, and Landscaping
Building footprint/height	No new building or foundations planned
Land Acreage (Ac):	Approx. 0.5 acres
Number of Buildings:	None
Expected Cuts and Fills	2 feet or less
Type of Construction:	Existing slab-on-grade with wood framing and/or masonry units to remain in place
Foundations Type	Existing conventional spread foundations to remain in place
Anticipated Loads	Unknown, assumed 2,500 psf
Traffic Loading	Frequent vehicular traffic with occasional heavy truck traffic
Site Information Sources:	Environ Architects, 2299 Pacific Avenue Long Beach, preliminary site plan dated 1/12/2017

2.3 References

The following references were used to generate this report:

California Geological Survey (CGS), Fault Evaluation Report 259, Hollywood, Santa Monica and Newport Inglewood Faults, Beverly Hills and Topanga 7.5-minute Quadrangles

CGS Information Warehouse, Regulatory Maps, Zones of Required Investigation, Long Beach Quadrangle, accessed 7/1/2022

CGS Seismic Hazard Zone Report, Long Beach Quadrangle, accessed 7/1/2022

Federal Emergency Management Agency, FEMA Flood Map Service Center, accessed 7/1/2022

Google Earth Pro (Online), accessed 7/1/2022

Historic Aerials by NETR Online, accessed 7/1/2022

Partner Engineering and Science, Inc., Phase I, II Environmental Peer Review– 2299 Pacific Avenue, dated May 31, 2016

Saucedo, G.J., Greene, H.G., Kennedy, M.P., and Bezore, S.P., 2016, Geologic map of the Long Beach 30' x 60' quadrangle, California (ver. 2.0), California Geological Survey; scale 1:100,000

United States Department of Agriculture, Natural Resources Conservation Service, Web Soil Survey, accessed 7/1/2022

United States Geological Survey, California Interactive Geologic Map, accessed 7/1/2022

United States Geological Survey (USGS) Topanga, California Quadrangle 7.5-minute series topographic map, accessed 7/1/2022

United States Geological Survey, Lower 48 States 2014 Seismic Hazard Map accessed 7/1/2022

United States Geological Survey, Earthquake Hazards Program (Online), accessed 7/1/2022

United States Geological Survey, California Interactive Geologic Map accessed 7/1/2022

United States Geological Survey, Lower 48 States 2014 Seismic Hazard Map, accessed 7/1/2022

2.4 Limitations

The conclusions, recommendations, and opinions in this report are based upon soil samples and data obtained in widely spaced locations that were accessible at the time of exploration and collected based on project information available at that time. Our findings are subject to field confirmation that the samples we obtained were representative of site conditions. If conditions on the site are different than what was encountered in our borings, the report recommendations should be reviewed by our office, and new recommendations should be provided based on the new information and possible additional exploration if needed. It should be noted that geotechnical subsurface evaluations are not capable of predicting all subsurface conditions, and that our evaluation was performed to industry standards at the time of the study, no other warranty or guarantee is made.

Likewise, our document review and geologic research study made a good-faith effort to review readily available documents that we could access and were aware of at the time, as listed in this letter. We are not able to guarantee that we have discovered, observed, and reviewed all relevant site documents and

conditions. If new documents or studies are available following the completion of the report, the recommendations herein should be reviewed by our office, and new recommendations should be provided based on the new information and possible additional exploration if needed.

This report is intended for the use of the client in its entirety for the proposed project as described in the text. Information from this report is not to be used for other projects or for other sites. All of the report must be reviewed and applied to the project or else the report recommendations may no longer apply. If pertinent changes are made in the project plans or conditions are encountered during construction that appear to be different than indicated by this report, please contact this office for review. Significant variations may necessitate a re-evaluation of the recommendations presented in this report. The findings in this report are valid for one year from the date of the report. This report has been completed under specific Terms and Conditions relating to scope, relying parties, limitations of liability, indemnification, dispute resolution, and other factors relevant to any reliance on this report. Any parties relying on this report do so having accepted Partner's standard Terms and Conditions.

If parties other than Partner are engaged to provide construction geotechnical services, they must be notified that they will be required to assume complete responsibility for the geotechnical phase of the project by concurring with the findings and recommendations in this report or providing alternate recommendations.

3. GEOLOGIC CONDITIONS & HAZARDS

This section presents the results of a geologic review performed by Partner, for the proposed new construction on site. The general location of the project is shown on Figure 1.

3.1 Site Location and Project Information

The planned construction will be situated on a developed parcel within a mixed commercial/residential area of Long Beach, California. The subject property is currently occupied by a vacant building with paved parking. The project site is bordered by West 23rd Street followed by a commercial building to the north, Pacific Avenue followed by commercial buildings to the east, and residential buildings to the south and west. Figure 2 presents the project site and the locations of our site exploration. Based on our review of available documents, the site has had the following previous uses:

Historical Use Information		
Period/Date	Source	Description/Use
1928-1960s	Aerial Photographs, Topographic Maps, Building Records	Commercial Use
1960s-1969	Aerial Photographs, Topographic Maps, Building Records	Gas station
1973-2008	Aerial Photographs, Building Records	Commercial Use
2008-Present	Aerial Photographs, Building Records, Onsite Observations	Vacant Building

3.2 Geologic Setting

The subject property is situated within the City of Long Beach in the Peninsular Ranges physiographic province of the state of California. Regionally, the site is in the coastal foothills of Peninsular Ranges Physiographic Province. The province varies in width from approximately 30 to 100 miles. The western portion of the province, which includes the project area, consists generally of dissected coastal plain underlain by Late to Middle Pleistocene surficial gravel, sand and silt deposits. Old Lacustrine and Paralic deposits consisting of fine-grained sand, silt and clay also occurs within the regional area. According to the United States Geological Survey (USGS), surficial geology at the site can be described as Holocene- and Late Pleistocene-age young alluvium. These deposits consist of poorly consolidated, poorly sorted, permeable flood-plain deposits consisting of soft clay, silt and loose to moderately dense sand and silty sand.

The subject property is mapped as Urban Land-Metz-Pico complex. An urban land designation indicates that more than 85% of the original soils have been disturbed or covered by paved surfaces, buildings, or other structures. Due to the variability of the soil material, on-site investigation would be required to determine the specific soil composition at the subject property. Most areas are nearly level to gently sloping due to extensive grading and smoothing. Urban land is so modified by cuts and fills for works and structures that identification of the soil is not feasible. Soil materials underlying Urban land are ordinarily the same as the minor inclusions.

A general summary of the geologic data compiled for this project is provided in the below table.

Geologic Data

Parameter	Value	Source
Geomorphic Zone	Peninsular Ranges	CGS
Ground Elevation	15-17 feet above Mean Sea Level	USGS
Flood Elevation	Zone X (Area with Reduced Flood Risk Due to Levee)	FEMA
Seismic Hazard Zone	Moderate to Strong	USGS
Geologic Hazards	Ground shaking, Liquefaction	CGS
Surface Cover	Asphalt Pavement	Partner Borings
Site Modifications	Previous gasoline station, commercial	Historic Aerials
Surficial Geology	Young alluvium	USGS
Depth to Bedrock	Not Encountered	Partner Boring
Groundwater Depth	Not Encountered	Partner Boring
Historic High Groundwater Depth	Approximately 10 feet	CGS Hazard Zone Report

3.3 Geologic Hazards

California is tectonically active and contains numerous large, active faults. As a result, geologic hazards with the greatest potential to affect California include earthquakes and related hazards such as tsunamis, landslides, liquefaction, and ground shaking. According to the USGS Unified Hazard Deaggregation Tool, the faults most relevant to the site are the Newport-Inglewood (2.37 miles from the site, M_{max} 7.40), Compton (6.69 miles from the site, M_{max} 7.24), and Palos Verdes fault (8.19 miles from the site, M_{max} 7.37). The site was mapped within a zone of seismically included hazard for liquefaction; however, we did not analyze the site for liquefaction hazards as there are no major changes proposed to the existing building at the time of this report. Should there be any changes to construction plans including the addition of any buildings, Partner should be contacted to perform additional work as needed. Strong ground shaking should be anticipated at the project site.

3.4 Seismic Design Parameters

The site latitude and longitude are 33.79874320 degrees N and -118.19397640 degrees W, respectively.

Based on the recent edition of the American Society of Civil Engineers (ASCE), document 7-16, a site-specific ground motion hazard analysis (GMHA) is required for sites with:

- Structures on Site Class E with S_s greater than or equal to 1.0
- Structures on Site Class D and E sites with S_1 greater than or equal to 0.2.

However, exemptions are:

1) Structures on Site Class E sites with S_s greater than or equal to 1.0, provided the site coefficient F_a is taken as equal to that Site Class C.

2) Structures on Site Class D with S_1 greater than or equal to 0.2, provided the value of the seismic response coefficient C_s is determined by Eq. 12.8-2 for values of $T \leq 1.5T_s$ and taken as equal to 1.5 times the value computed in accordance with either: Eq. (12.8-3) for $1.5 T_s \leq T \leq T_L$ or Eq. (12.8-4) for $T > T_L$

3) Structures on Site Class E with S_1 greater than or equal to 0.2 provided that T is less than or equal to T_s and the equivalent static force procedure is used for design.

The site qualifies for exemption #2. Therefore, a site-specific ground motion hazard analysis is NOT needed for this site. In accordance with exemption #2, C_s should be taken as equal to 1.5 times the value computed in accordance with either: Eq. (12.8-3) for $1.5 T_s \leq T \leq T_L$ or Eq.(12.8-4) for $T > T_L$

$$C_s = S_{D1} / (R/I_e) \text{ (ASCE 7-16, Equation 12.8-3) with } T_L = 8 \text{ seconds}$$

Based on boring logs and SPT N values, the site is determined to be Site Class D. Using information obtained from the SEAOC (Structural Engineers Association of California) / OSHPD (Office of Statewide Health Planning and Development) Seismic Design Maps for ASCE 7-16, for a Site Class of D and risk category of II, the following values were obtained as shown on the below table.

The seismic design parameters based on the USGS Design Maps Detailed Report for ASCE 7-16 Standard Method are presented below. State, County, City, and other jurisdictions in seismically active areas update seismic standards on a regular basis. The design team should carefully evaluate all of the building requirements for the project.

Seismic Item	Value	Seismic Item	Value
Site Classification	D	Seismic Design Category	D
F_a	1.0	F_v	1.7
S_s	1.675g	S_1	0.605g
S_{MS}	1.675g	S_{M1}	1.029g
S_{DS}	1.116g	S_{D1}	0.686g
PGA_M	0.813g	Design PGA (2/3 PGA_M)	0.542g

4. GEOTECHNICAL EXPLORATION & LABORATORY RESULTS

Our evaluation of soils on the site included field exploration and laboratory testing. The field exploration and laboratory testing programs are briefly described below. Data reports from the field exploration and laboratory testing are provided in Appendix A and Appendix B, respectively.

4.1 Soil Borings

Subsurface materials and conditions at the site were investigated by Partner on June 8, 2022. Two (2) borings designated B-1 through B-3 were advanced by the use of a track-mounted drill using hollow-stem auger drilling techniques as well as a hand auger. The borings were made to depths to about 9.5 feet below existing site grades in the new pavement areas. The approximate locations of the exploratory borings are shown on Figure 2.

Logs of subsurface conditions encountered in the borings were prepared in the field by a representative of Partner Engineering. Soil samples consisting of Standard Penetration Tests (SPT) samples were collected at approximately 2.5 and 5-foot depth intervals and were returned to the laboratory for testing. The SPTs were performed in accordance with ASTM D 1586. Typed boring logs were prepared from the field logs and are presented in Appendix A. A summary table description is provided below:

Surficial Geology		
Strata	Depth to Bottom of Layer (bgs*)	Description
Surface Cover	Up to 7 inches	Asphalt over aggregate base
Native Stratum 1	> 9.5 feet	Silty sandy soils
Groundwater	Not Encountered	Partner Boring
Bedrock	Unknown, Not Encountered	Partner Boring

**bgs – below ground surface*

4.2 Groundwater/Soil Moisture

Groundwater was not encountered on the site during in our borings. However, groundwater levels fluctuate over time and may be different at the time of construction and during the project life.

4.3 Laboratory Evaluation

Selected samples collected during drilling activities were tested in the laboratory to assist in evaluating engineering properties of subsurface materials at the site. The results of laboratory analyses are presented in Appendix B.

4.4 Infiltration Test Results

Two infiltration tests were performed, as shown on Figure 2. The tests were performed at depths of about 5 feet. The testing was performed using the borehole percolation test method. The measured infiltration rates were calculated using the Los Angeles County method. The civil engineer should apply the proper

reduction factors or factors of safety based on the type of system used. Data is shown in [Appendix A](#), and is summarized below:

Parameter	P1	P2
Location	See Figure 2	See Figure 2
Depth of Tested Area	7 ft	7 ft
Pre-soak Depth (from top of pipe)	3 ft	3 ft
Test Start Depth (from top of pipe)	36 in.	36 in.
Water Drop During Test	20.0 in.	14.0 in.
Measured Percolation Rate	9.3 in./hr	6.7 in./hr

5. GEOTECHNICAL RECOMMENDATIONS & PARAMETERS

The following discussion of findings for the site is based on the assumed construction, geologic review, results of the field exploration, and laboratory testing programs. The recommendations of this report are contingent upon adherence to Appendix C of this report, General Geotechnical Design and Construction Considerations. For additional details on the below recommendations, please see Appendix C.

5.1 Geotechnical Recommendations

The proposed construction is generally feasible from a geotechnical perspective provided the recommendations and assumptions of this report are followed.

Geologic/General Site Considerations

- The site is located in the City of Long Beach within the Peninsular Ranges geomorphic province of the state of California. According to the United States Geological Survey (USGS), surficial geology at the site can be described as Holocene- and Late Pleistocene-age young alluvium. These deposits consist of poorly consolidated, poorly sorted, permeable flood-plain deposits consisting of soft clay, silt and loose to moderately dense sand and silty sand. The site grades are relatively flat, sloping down slightly to the west. The site is currently developed as an existing vacant building that was formerly operating as a bank building as well as a gasoline service station until 1973. The site may be impacted by existing buried foundations, utility lines, underground storage tanks, undocumented fills as well as other remnants of previous construction. This portion of the state is prone to strong ground shaking, and the site is mapped within a liquefaction hazard zone according to California Geological Survey (CGS). We did not analyze the site for liquefaction hazards as there are no major changes proposed to the existing building. No other geologic hazards are known or suspected onsite.
- Given the presence of the site in a seismically active area, ground shaking during earthquakes should be anticipated during the project life. State, County, City, and other jurisdictions in seismically active areas update seismic standards on a regular basis. The design team should carefully evaluate all of the building requirements for the project.

Excavation Considerations

- Grading plans were not available at the time of our report; however, we anticipate excavations on the site to depths of up to 2 feet for new structures and paving. There are no slabs or foundations planned at this time. Based on our boring data, conventional construction equipment in good working condition should be able to perform the planned excavations. As previously mentioned, undocumented fills and remnants of previous construction may be present on the site and could cave or be difficult to remove and require additional planning and equipment. Groundwater was not encountered in our borings during drilling. However, groundwater levels fluctuate over time and may be different at the time of construction and during the project life.
- Excavations should be sloped and/or shored to protect worker safety and adjacent properties, per OSHA and local guidelines and the presence of existing utilities should be thoroughly and carefully checked prior to digging. Appendix C further discusses excavation recommendations in the

following sections, which can be accessed by clicking hyper links: [Earthwork](#), [Underground Pipeline](#), [Excavation De-Watering](#).

Foundations

- Based on our understanding of the proposed construction, the existing building is to be renovated and the existing footprint will remain in place. New construction will consist of an outdoor patio area and new parking areas south of the existing building. However, final grading and drainage plans were not available at the time of our report. We assume the new finished paved surface will be approximately at the elevation of the ground floor of the existing building. Should there be any changes to construction plans including the addition of any buildings, Partner should be contacted to perform additional work as needed.
- If auxiliary structures, such as site walls require foundations can be supported on shallow spread foundations over 12 inches of compacted on site soils. The base of excavation for new shallow foundations and slabs on grade should be evaluated by the engineer, with additional removal of soft or deleterious material if needed and should then be compacted in-place prior to the placement of new fills or foundations. Areas for new slabs on grade should be evaluated by proofrolling with soft, unstable areas removed and replaced with compacted fill.
- Within the footprint of the building and paved areas, we recommend stripping of all pavements and debris, if any. The base of excavation for new foundations should be evaluated by the engineer, with the removal of soft or deleterious material if needed and should then be compacted in-place prior to the placement of new fills or foundations. Below slabs, we recommend the subgrade be proofrolled or otherwise evaluated and repaired under the direction of the engineer, and should then be scarified, moisture-conditioned, and compacted in-place prior to the placement of fills or slabs on grade.
- Section 5.2 of this report provides a table outlining the embedment depth, bearing capacity, settlement and other parameters for foundation design and construction.

On-Grade Construction Considerations

- In new structural areas of the site, all remnants of previous construction, vegetation and/or deleterious materials should be completely removed to exposed clean subgrade soil. In new fill, structural, and pavement areas, cleaned subgrade should be proofrolled and evaluated by the engineer with a loaded water truck (4,000 gallon) or equivalent rubber-tired equipment. In locations where proofrolling is not feasible, probing, dynamic cone penetration testing or other methods may be employed. Soft or unstable areas should be repaired per the direction of the engineer. Once approved, the subgrade soil should be scarified to a depth of 12 inches, moisture conditioned, and compacted as engineered fill. Improvements in these areas should extend laterally beyond the new structure limits 2 feet or a distance equal to or greater than the layer thickness, whichever is greater. This zone should extend vertically from the bearing grade elevation to the base of the fill. The thicknesses of the layer, settlement estimates, and modulus values are provided on the design tables in the next section.

- Based on our borings, we anticipate that some over-excavation may result from proofrolling operations. In areas where deep instability is encountered, we recommend test pits be excavated and an engineer be called to perform an evaluation of the issue and to propose a resolution. Such resolutions may include but are not limited to: the use of geotextiles, chemical treatments (soil cement, hydrated lime, etc.) thickened slabs or pavements sections, lime-treated aggregate base, or others. Pavement sections provided in Section 5.2 are based on approved, compacted in-place soils being used in the subgrade. If subgrade conditions in the upper 3 feet of pavement areas vary or are improved, the pavement sections may be modified.
- Appendix C provides additional recommendations for earthwork and on-grade construction in the following sections: [Cast-in-place Concrete](#), [Foundations](#), [Earthwork](#), [Paving](#), [Subgrade Preparation](#) which can be accessed by clicking the hyperlinks.

Soil Reuse Considerations

- Based on our borings site soils will generally usable as structural fill provided it is non-expansive ($PI < 20$) and free of organic material and other debris. Existing structural materials such as concrete, asphalt, crushed aggregate, or others could potentially be re-used as site fills if processed to meet fill requirements on the site. We recommend engineered fill for the site be moisture conditioned and compacted to at least 95% of the maximum dry density in accordance with ASTM D1557 and [Appendix C](#) of this report.
- Appendix C provides additional recommendations for soil reuse in the following sections: [EARTHWORK](#), [SUBGRADE PREPARATION](#) which can be accessed by clicking the hyperlinks.

Geotechnical Concrete and Steel Construction Considerations

- Soil/rock may be corrosive to concrete. We recommend using corrosion resistant concrete (*e.g.* Type II/V Portland Cement, a fly ash mixture of 25 percent cement replacement, and a water/cement ratio of 0.45 or less) as directed by the producer, engineer or other qualified party based on their knowledge of the materials and site conditions. Concrete exposed to freezing weather should be air-entrained. Mix designs should be well-established and reviewed by the project engineers prior to placement, to verify the design is appropriate to meet the project needs and parameters provided in this report. Quality control testing should be performed to verify appropriate mixes are used and are properly handled and placed. Please refer to Appendix C, [Cast In-Place Concrete](#) for more details.
- Soil/rock may be corrosive to un-protected metallic elements such as pipes, poles, rebar, etc. We recommend the use of coatings and/or cathodic protection for metals in contact with the ground, as directed by the product manufacturer, engineer or other qualified party based on their knowledge of the materials to be used and site soil conditions.

Site Storm Water Considerations

- Surface drainage and landscaping design should be carefully planned to protect the new structures from erosion/undermining, and to maintain the site earthwork and structure subgrades in a relatively consistent moisture condition. Water should not flow towards or pond near to new structures, and high water-demand plants should not be planned near to structures. Appendix C

provides additional recommendations for storm water management in the following sections: [SITE GRADING AND DRAINAGE](#), [WATER PROOFING](#) which can be accessed by clicking the hyperlinks.

- We recommend consulting with the landscape designer and civil engineer regarding management of site storm water and irrigation water, as changes in moisture content below the site after construction will lead to soil movement and potential distress to the building.

5.2 Geotechnical Parameters

Based on the findings of our field and laboratory testing, we recommend that design and construction proceed per industry accepted practices and procedures, as described in Appendix C, General Geotechnical Design and Construction Considerations (Considerations).

[Prepared Subgrade Parameters](#) – (hyperlink to Construction Considerations)

Prepared Subgrade Parameters				
Structure	Design Values	Cover Depth	Bearing Surface ^a	Static Settlement ^d
Slab on Grade	k=150 pci ^b q _{all} = 100 psf ^c μ = 0.35	NA	Proofrolled, Approved, Compacted In-place soil	< 1 inch
Auxiliary Spread Foundations ⁺⁺	q _{all} = 2.5 ksf ^c μ = 0.35	18 inches	12 inches of reworked site soils	< 1 inch

^a Repairs in bearing surface areas should be structural fill per the recommendation of the Earthwork section of Appendix C that is moisture conditioned to within 3 percent below to optimum moisture content and compacted to 95 percent or more of the soil maximum dry density per ASTM D1557. Expansive material should not be located within the upper 3 feet of the soil subgrade.

^b Subgrade modulus value "k", assuming the grade slab is supported by aggregate layer roughly equal to slab thickness (minimum 4 inches), as required for capillary break

^c Can be increased by 1/3 for temporary loading such as seismic and wind, allowable parameters, estimated FS of 2.5

^d Differential settlement is expected to be half to ¾ of total settlement

[Paving Structural Sections](#) – (hyperlink to Construction Considerations)

Pavement Sections		
Roadway Type	Subgrade Preparation ^a	Pavement Section ^b
Parking Area Light Duty	Proofrolled/Compacted Subgrade	4 in. asphalt / 4 in. Aggregate base
Parking Area Heavy Duty	Proofrolled/Compacted Subgrade	6 in. Concrete / 4 in. Aggregate base

^a Repairs in proofrolled areas should be structural fill per the recommendation of the APPCEarthwork (hyperlink to Construction Considerations) that is moisture conditioned to within 3 percent above to optimum moisture content and compacted to 95 percent or more of the soil maximum dry density per ASTM D1557.

^b 1 inch of pavement may be reduced if 6-in of lime or cement-treated soil is used with a 500 psi 28-day compressive strength. Soils with Plasticity Index of 10 or more are generally candidates for lime treatment, other soils are candidates for cement treatment, if any.

FIGURES

- Site Vicinity Plan
- Exploration Plan (Aerial)
- Exploration Plan (Site Plan)
- Geologic Map
- Geologic Hazards Map



Source: Google Earth Pro, 2022

FIGURE 2 – EXPLORATION PLAN (AERIAL)

KEY

 Approximate Boring Locations

 Approximate Infiltration Test Locations

 Approximate Project Limits

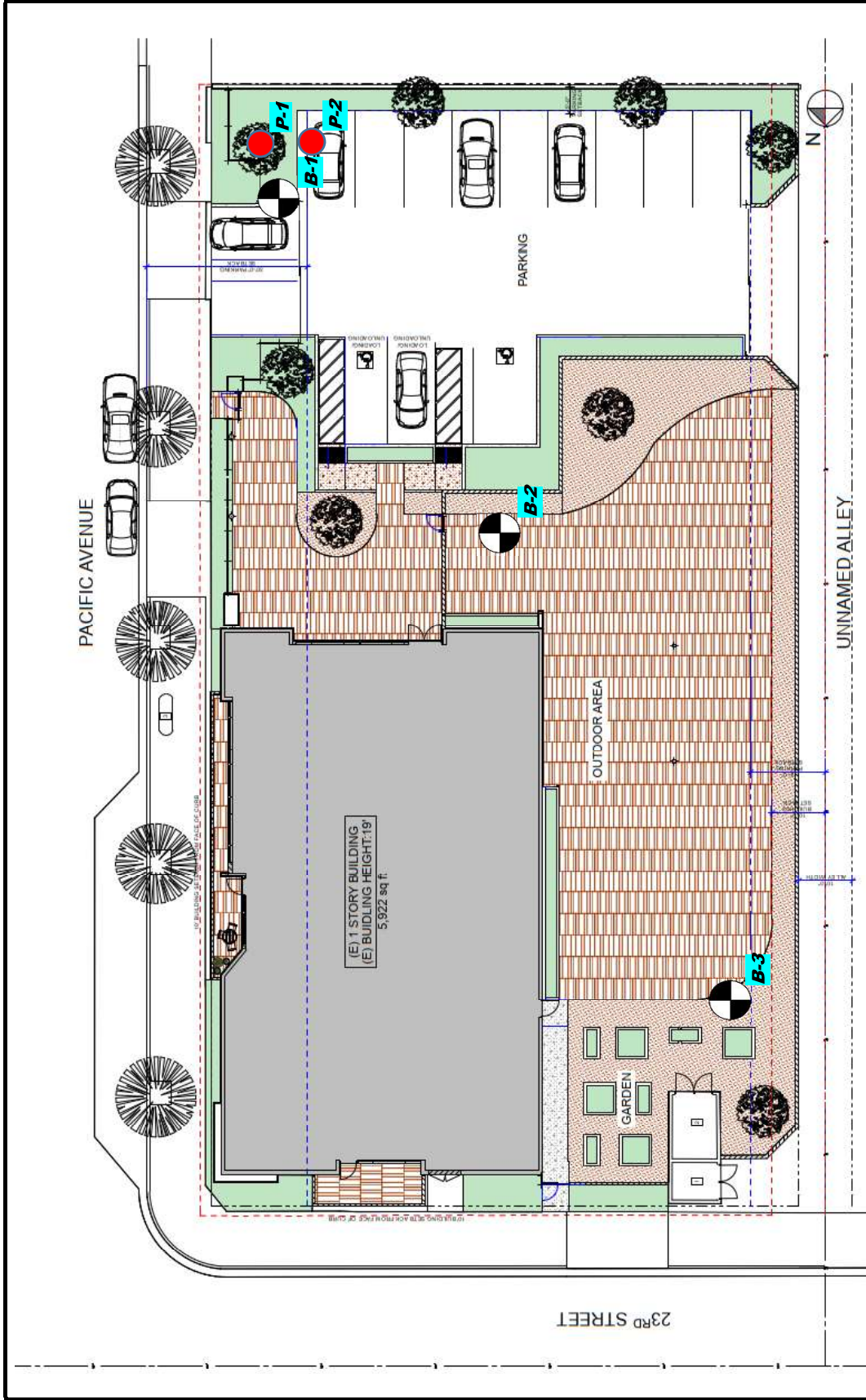



FIGURE 3 – EXPLORATION PLAN (AERIAL)

Source: Environ Architects, 2299 Pacific Avenue Long Beach, preliminary site plan dated 1/12/2017

- KEY**
-  Approximate Boring Locations
 -  Approximate Infiltration Test Locations

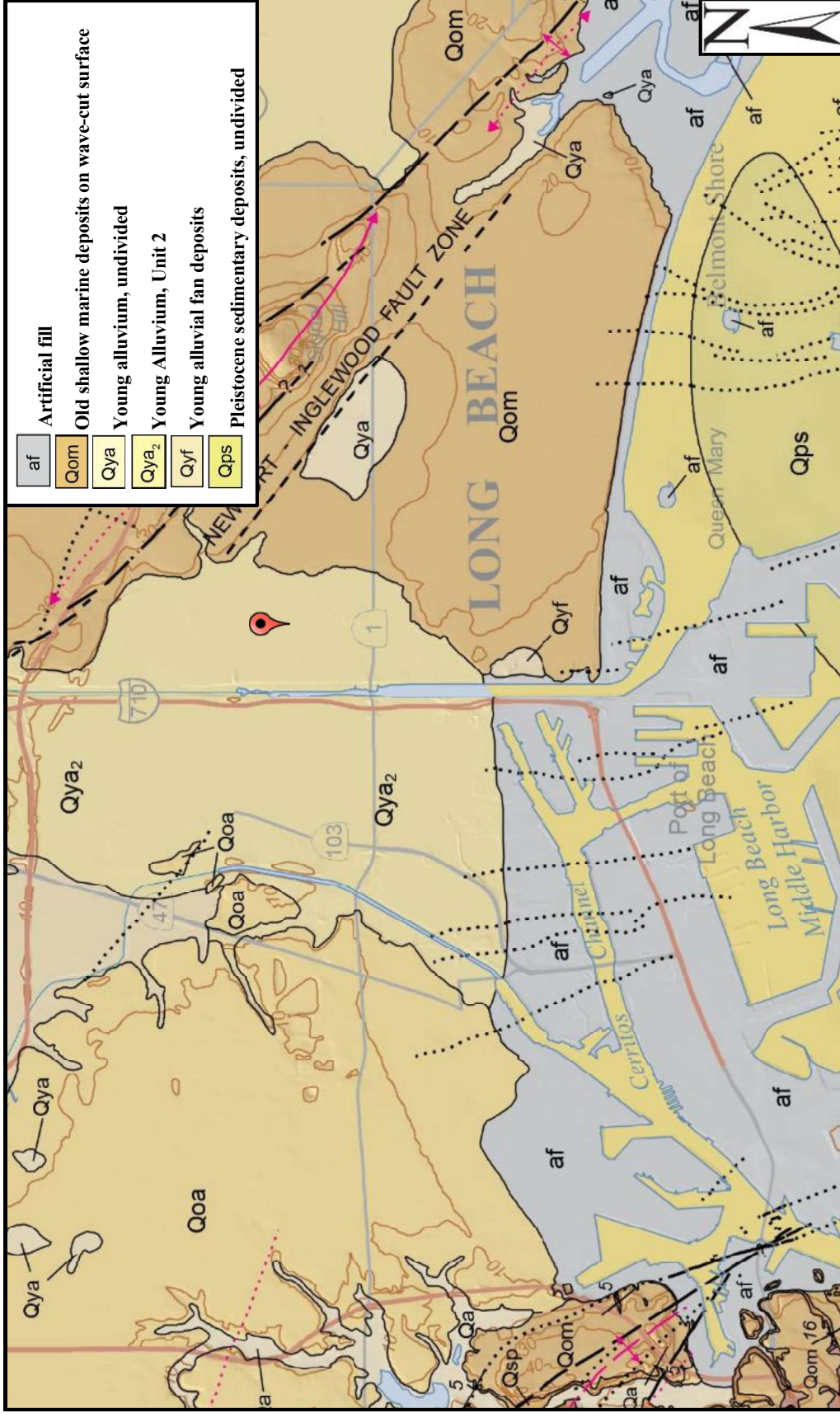



FIGURE 4 – GEOLOGIC MAP

Source: Saucedo, G.J., Greene, H.G., Kennedy, M.P., and Bezore, S.P., 2016, Geologic map of the Long Beach 30' x 60' quadrangle, California (ver. 2.0); Regional Geologic Map, scale 1:100,000

KEY

 Approximate Site Location

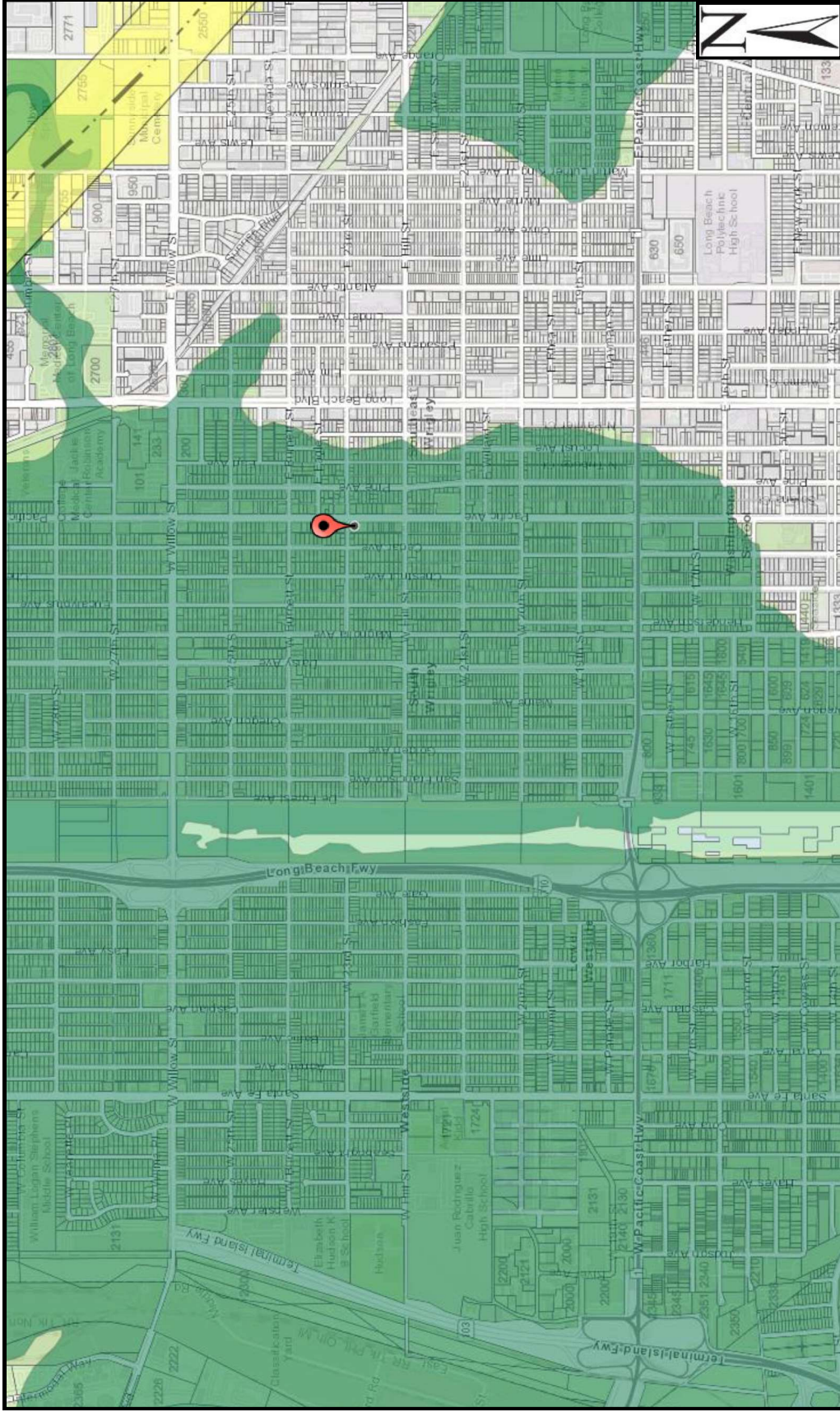


FIGURE 5 – GEOLOGIC HAZARDS MAP

Source: California Geological Survey, Earthquake Zones of Required Investigation

KEY

 Approximate Site Location

APPENDIX A

Boring Logs

Percolation Test Logs

PARTNER

BORING LOG KEY - EXPLANATION OF TERMS

SURFACE COVER: General description with thickness to the inch, ex. Topsoil, Concrete, Asphalt, etc,

FILL: General description with thickness to the 0.5 feet. Ex. Roots, Debris, Processed Materials (Pea Gravel, etc.)

NATIVE GEOLOGIC MATERIAL: Deposit type, 1.Color, 2.moisture, 3.density, 4.SOIL TYPE, other notes - Thickness to 0.5 feet

1. Color - Generalized

Light Brown (usually indicates dry soil, rock, caliche)

Brown (usually indicates moist soil)

Dark Brown (moist to wet soil, organics, clays)

Reddish (or other bright colors) Brown (moist, indicates some soil development/or residual soil)

Greyish Brown (Marine, sub groundwater - not the same as light brown above)

Mottled (brown and gray, indicates groundwater fluctuations)

2. Moisture

dry - only use for wind-blown silts in the desert

damp - soil with little moisture content

moist - near optimum, has some cohesion and stickyness

wet - beyond the plastic limit for clayey soils, and feels wet to the touch for non clays

saturated - Soil below the groundwater table, sampler is wet on outside

3A. Relative Density for Granular Soils

Relative Density	Ring	SPT
very loose	0-7	0-4
loose	7-14	4-10
medium dense	14-28	10-30
dense	28-100	30-50
very dense	100+	Over 50

3B. Consistency of Fine-Grained Cohesive Soils

Consistnecy	SPT	Undrained Shear Strength, tsf
very soft	0-2	less than 0.125
soft	2-4	0.125 - 0.25
medium stiff	4-8	0.25 - 0.50
stiff	8-15	0.50 - 1.0
very stiff	15-30	1.0 - 2.0
hard	Over 30	Over 2.0

4. Classification

Determine percent Gravel (Material larger than the No. 4 Sieve)

Determine percent fines (Material passing the No. 200 Sieve)

Determine percent sand (Passing the No. 4 and retained on the No. 200 Sieve)

Determine if clayey (make soil moist, if it easily roll into a snake it is clayey)

Coarse Grained Soils (Less than 50% Passing the No. 200 Sieve)

GP	SP	Mostly sand and gravel, with less than 5 % fines	sandy GRAVEL	SAND
GP-GM	SP-SM	Mostly sand and gravel 5-12% fines, non-clayey	sandy GRAVEL with silt	SAND with Silt
GP-GC	SP-SC	Mostly sand and gravel 5-12% fines, clayey	sandy GRAVEL with clay	SAND with clay
GC	SC	Mostly sand and gravel >12% fines clayey	clayey GRAVEL	clayey SAND
GM	SM	Mostly sand and gravel >12% fines non-clayey	silty GRAVEL	silty SAND

Fine Grained Soils (50% or more passes the No. 200 Sieve)

ML	Soft, non clayey	SILT with sand
MH	Very rare, holds a lot of water, and is pliable with very low strength	high plasticity SILT
CL	If sandy can be hard when dry, will be stiff/plastic when wet	CLAY with sand/silt
CH	Hard and resilient when dry, very strong/sticky when wet (may have sand in it)	FAT CLAY

H = Liquid limit over 50%, L - LL under 50%

C = Clay

M = Silt

Samplers

S = Standard split spoon (SPT)

R = Modified ring

Bulk = Excavation spoils

ST = Shelby tube

C = Rock core

Boring Number:		B-1		Boring Log Page 1 of 1	
Location:		See Figure 2		Date Started:	6/8/2022
Site Address:		2299 Pacific Avenue		Date Completed:	6/8/2022
		Long Beach, California 90806		Depth to Groundwater:	N/A
Project Number:		22-364674.1		Field Technician:	EA
Drill Rig Type:		CME-75		Partner Engineering and Science	
Sampling Equipment:		Cal Mod / Split Spoon Sampler		2154 Torrance Blvd., Suite 201	
Borehole Diameter:		8"		Torrance, CA 90501	
Depth, FT	Sample	N-Value	USCS	Description	
0				Surface Cover: 2.5-inch asphalt and 4-inch base	
0.5					
1					
1.5					
2	S	8	ML	Light brown, moist, medium stiff to stiff, sandy SILT	
2.5					
3					
3.5					
4	R	19		--- Very stiff	
4.5				(Dry Density: 78.4 pcf, Moisture Content: 20.1%, Fines: 92.4%)	
5					
5.5					
6	S	10		--- Stiff	
6.5					
7					
7.5					
8	R	20		--- Very stiff	
8.5				(Dry Density: 84.2 pcf, Moisture Content: 6.8%, Fines: 84.7%)	
9					
9.5				Boring terminated at 9.5'	
10				Groundwater not encountered	
10.5				Boring backfilled with soil cuttings	
11					
11.5					
12					
12.5					
13					
13.5					
14					
14.5					
15					
15.5					
16					
16.5					
17					
17.5					
18					
18.5					
19					
19.5					
20					
20.5					
21					
21.5					

Geotechnical Report

Project No. 22-364674.1

Boring Number:		B-2		Boring Log Page 1 of 1	
Location:		See Figure 2		Date Started:	6/8/2022
Site Address:		2299 Pacific Avenue		Date Completed:	6/8/2022
		Long Beach, California 90806		Depth to Groundwater:	N/A
Project Number:		22-364674.1		Field Technician:	EA
Drill Rig Type:		CME-75		Partner Engineering and Science	
Sampling Equipment:		Cal Mod / Split Spoon Sampler		2154 Torrance Blvd., Suite 201	
Borehole Diameter:		8"		Torrance, CA 90501	
Depth, FT	Sample	N-Value	USCS	Description	
0				Surface Cover: 2-inch asphalt and 3-inch base	
0.5					
1					
1.5					
2	R	27	GP	Dark brown, damp, medium dense, sandy GRAVEL (Dry Density: 77.9 pcf, Moisture Content: 16.7%)	
2.5					
3					
3.5					
4	S	4	ML	Brown, moist, medium stiff, sandy SILT with gravel (Moisture Content: 18.3%, Fines: 67.4%)	
4.5					
5					
5.5					
6	R	8		Light brown (Dry Density: 87.7 pcf, Moisture Content: 11.8%)	
6.5					
7					
7.5					
8	S	4		--- Brown, soft to medium stiff	
8.5					
9					
9.5				Boring terminated at 9.5'	
10				Groundwater not encountered	
10.5				Boring backfilled with soil cuttings	
11					
11.5					
12					
12.5					
13					
13.5					
14					
14.5					
15					
15.5					
16					
16.5					
17					
17.5					
18					
18.5					
19					
19.5					
20					
20.5					
21					
21.5					

Geotechnical Report

Project No. 22-364674.1

Boring Number:		B-3		Boring Log Page 1 of 1	
Location:		See Figure 2		Date Started:	6/8/2022
Site Address:		2299 Pacific Avenue		Date Completed:	6/8/2022
		Long Beach, California 90806		Depth to Groundwater:	N/A
Project Number:		22-364674.1		Field Technician:	EA
Drill Rig Type:		CME-75		Partner Engineering and Science	
Sampling Equipment:		Cal Mod / Split Spoon Sampler		2154 Torrance Blvd., Suite 201	
Borehole Diameter:		8"		Torrance, CA 90501	
Depth, FT	Sample	N-Value	USCS	Description	
0				Surface Cover: 2.5-inch asphalt and 3-inch base	
0.5					
1					
1.5					
2	S		ML	Light brown, moist, soft, sandy SILT (Moisture Content: 5.1%, LL: NP, PI: NP)	
2.5					
3					
3.5					
4	R	14		--- Stiff (Dry Density: 89.0 pcf, Moisture Content: 30.0%)	
4.5					
5					
5.5					
6	S	6		--- Medium stiff	
6.5					
7					
7.5					
8	R	8	CH	Dark brown, moist, medium stiff to stiff, fat CLAY (Dry Density: 93.2 pcf, Moisture Content: 28.1%, Fines: 98.4%)	
8.5					
9					
9.5				Boring terminated at 9.5'	
10				Groundwater not encountered	
10.5				Boring backfilled with soil cuttings	
11					
11.5					
12					
12.5					
13					
13.5					
14					
14.5					
15					
15.5					
16					
16.5					
17					
17.5					
18					
18.5					
19					
19.5					
20					
20.5					
21					
21.5					

Geotechnical Report

Project No. 22-364674.1



PERCOLATION TEST DATA SHEET

Project:		Grade School Development		Project No.:	22-364674.1	Date:	6/8/2022	
Test Hole No.:		P1		Tested By:	E. Archuleta			
Depth of Test Hole (ft):		5		USCS Soil Classification:				ML
length of slotted pipe (ft):		5		Test Hole Diameter (in):				8
Presoak Duration:		1 hour		Depth of Presoak (ft):				2
Trial No.	Date	Time of Measurement	Initial Depth to Water (ft)	Time of Measurement	Elapsed Time (min)	Time Interval (min)	Change in Water Level (in)	Percolation Rate, $K_{sat, measured}$ (in/hr)
Time Interval	6/8/2022	11:15 AM	3.00	11:45 AM	30	30	24.00	--
1	6/8/2022	11:46 AM	3.00	11:56 AM	10	10	13.32	6.15
2	6/8/2022	11:56 AM	3.00	12:06 PM	20	10	24.00	11.08
3	6/8/2022	12:07 PM	3.00	12:17 PM	31	10	13.32	6.15
4	6/8/2022	12:17 PM	3.00	12:27 PM	41	10	22.80	10.52
5	6/8/2022	12:27 PM	3.00	12:37 PM	51	10	24.00	11.08
6	6/8/2022	12:38 PM	3.00	12:48 PM	62	10	13.32	6.15
							Raw percolation rate (in/hr)	9.25

Comments:
 1. Percolation test was performed in general accordance with the "Guidelines for Geotechnical Investigation and Reporting Low Impact Development Stormwater Infiltration - GS200.2" prepared by County of Los Angeles Department of Public Works, dated 30 June 2017.
 2. Weather: overcast

APPENDIX B

Lab Data

PARTNER

Moisture and Density Data

Soil Sample	Dry Density	Moisture Content (%)
B1 @ 4 feet	78.4	20.1
B1 @ 8 feet	84.2	6.8
B2 @ 2 feet	77.9	16.7
B2 @ 6 feet	87.7	11.8
B3 @ 4 feet	89.0	30.0
B3 @ 8 feet	93.2	28.1

Index Test Data

Soil Sample	Plasticity Index	Liquid Limit	Percent Passing #200 Sieve	Moisture Content (%)
B1 @ 4 feet	-	-	92.4	20.1
B1 @ 8 feet	-	-	84.7	6.8
B2 @ 4 feet	-	-	67.4	18.3
B3 @ 2 feet	Non-Plastic	Non-Plastic	-	5.1
B3 @ 8 feet	-	-	98.4	28.1

APPENDIX C

General Geotechnical Design and Construction Considerations

Subgrade Preparation

Earthwork – Structural Fill/Excavations

Underground Pipeline Installation – Structural Backfill

Cast-in-Place Concrete

Foundations

Laterally Loaded Structures

Excavations and Dewatering

Waterproofing and Drainage

Chemical Treatment of Soils

Paving

Site Grading and Drainage

SUBGRADE PREPARATION

1. In general, construction should proceed per the project specifications and contract documents, as well as governing jurisdictional guidelines for the project site, including but not limited to the applicable State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Subgrade preparation in this section is considered to apply to the initial modifications to existing site conditions to prepare for new planned construction.
3. Prior to the start of subgrade preparation, a detailed conflict study including as-builts, utility locating, and potholing should be conducted. Existing features that are to be demolished should also be identified and the geotechnical study should be referenced to determine the need for subgrade preparation, such as over-excavation, scarification and compaction, moisture conditioning, and/or other activities below planned new structural fills, slabs on grade, pavements, foundations, and other structures.
4. The site conflicts, planned demolitions, and subgrade preparation requirements should be discussed in a pre-construction meeting with the pertinent parties, including the geotechnical engineer, inspector, contractors, testing laboratory, surveyor, and others.
5. In the event of preparations that will require work near to existing structures to remain in-place, protection of the existing structures should be considered. This also includes a geotechnical review of excavations near to existing structures and utilities and other concerns discussed in General Geotechnical Design and Construction Considerations, EARTHWORK and UNDERGROUND PIPELINE INSTALLATION.
6. Features to be demolished should be completely removed and disposed of per jurisdictional requirements and/or other conditions set forth as a part of the project. Resulting excavations or voids should be backfilled per the recommendations in the General Geotechnical Design and Construction Considerations, EARTHWORK section.
7. Vegetation, roots, soils containing organic materials, debris and/or other deleterious materials on the site should be removed from structural areas and should be disposed of as above. Replacement of such materials should be in accordance with the recommendations in the General Geotechnical Design and Construction Considerations, EARTHWORK section
8. Subgrade preparation required by the geotechnical report may also call for as over-excavation, scarification and compaction, moisture conditioning, and/or other activities below planned structural fills, slabs on grade, pavements, foundations, and other structures. These requirements should be provided within the geotechnical report. The execution of this work should be observed by the geotechnical engineering representative or inspector for the site. Testing of the subgrade preparation should be performed per the recommendations in the General Geotechnical Design and Construction Considerations, EARTHWORK section.

9. Subgrade Preparation cannot be completed on frozen ground or on ground that is not at a proper moisture condition. Wet subgrades may be dried under favorable weather if they are disked and/or actively worked during hot, dry, weather, when exposed to wind and sunlight. Frozen ground or wet material can be removed and replaced with suitable material. Dry material can be pre-soaked, or can have water added and worked in with appropriate equipment. The soil conditions should be monitored by the geotechnical engineer prior to compaction. Following this type of work, approved subgrades should be protected by direction of surface water, covering, or other methods, otherwise, re-work may be needed.

EARTHWORK – STRUCTURAL FILL

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Earthwork in this section is considered to apply to the re-shaping and grading of soil, rock, and aggregate materials for the purpose of supporting man-made structures. Where earthwork is needed to raise the elevation of the site for the purpose of supporting structures or forming slopes, this is referred to as the placement of structural fill. Where lowering of site elevations is needed prior to the installation of new structures, this is referred to as earthwork excavations.
3. Prior to the start of earthwork operations, the geotechnical study should be referenced to determine the need for subgrade preparation, such as over-excavation or scarification and compaction of unsuitable soils below planned structural fills, slabs on grade, pavements, foundations, and other structures. These required preparations should be discussed in a pre-construction meeting with the pertinent parties, including the geotechnical engineer, inspector, contractors, testing laboratory, surveyor, and others. The preparations should be observed by the inspector or geotechnical engineer representative, and following such subgrade preparation, the geotechnical engineer should observe the prepared subgrade to approve it for the placement of earthwork fills or new structures.
4. Structural fill materials should be relatively free of organic materials, man-made debris, environmentally hazardous materials, and brittle, non-durable aggregate, frozen soil, soil clods or rocks and/or any other materials that can break down and degrade over time.
5. In deeper structural fill zones, expansive soils (greater than 1.5 percent swell at 100 pounds per square foot surcharge) and rock fills (fills containing particles larger than 4 inches and/or containing more than 35 percent gravel larger than ¾-inch diameter or more than 50 percent gravel) may be used with the approval and guidance of the geotechnical report or geotechnical engineer. This may require the placement of geotextiles or other added costs and/or conditions. These conditions may also apply to corrosive soils (less than 2,000 ohm-cm resistivity, more than 50 ppm chloride content, more than 0.1 percent sulfates)
6. For structural fill zones that are closer in depth below planed structures, low expansive materials, and materials with smaller particle size are generally recommended, as directed by the geotechnical report (see criteria above in 5). This may also apply to corrosive soils.
7. For structural fill materials, in general the compaction equipment should be appropriate for the thickness of the loose lift being placed, and the thickness of the loose lift being placed should be at least two times the maximum particle size incorporated in the fill.
8. Fill lift thickness (including bedding) should generally be proportioned to achieve 95 percent or more of a standard proctor (ASTM D689) maximum dry density (MDD) or 90 percent or more of a

- modified proctor (ASTM D1557) MDD, depending on the state practices. For subgrades below roadways, the general requirement for soil compaction is usually increased to 100 percent or more of the standard proctor MDD and 95 percent or more of the modified proctor MDD.
9. Soil compaction should be performed at a moisture content generally near optimum moisture content determined by either standard or modified proctor, and ideally within 3 percent below to 1 percent over the optimum for a standard proctor, and from 2 percent below to 2 percent above optimum for a modified proctor.
 10. In some instances fill areas are difficult to access. In such cases a low-strength soil-cement slurry can be used in the place of compacted fill soil. In general such fills should be rated to have a 28-day strength of 75 to 125 psi, which in some areas is referred to as a "1-sack" slurry. It should be noted that these materials are wet during placement, and require a period of 2 days (24 hours) to cure before additional fill can be placed above them. Testing of this material can be done using concrete cylinder compression strength testing equipment, but care is needed in removing the test specimens from the molds. Field testing using the ball method, and spread or flow testing is also acceptable.
 11. For fills to be placed on slopes, benching of fill lifts is recommended, which may require cutting into existing slopes to create a bench perpendicular to the slope where soil can be placed in a relatively horizontal orientation. For the construction of slopes, the slopes should be over-built and cut back to grade, as the material in the outer portion of the slope may not be well compacted.
 12. For subgrade below roadways, runways, railways or other areas to receive dynamic loading, a proofroll of the finished, compacted subgrade should be performed by the geotechnical engineer or inspector prior to the placement of structural aggregate, asphalt or concrete. Proofrolling consists of observing the performance of the subgrade under heavy-loaded equipment, such as full, 4,000 Gallon water truck, loaded tandem-axel dump truck or similar. Areas that exhibit instability during proofroll should be marked for additional work prior to approval of the subgrade for the next stage of construction.
 13. Quality control testing should be provided on earthwork. Proctor testing should be performed on each soil type, and one-point field proctors should be used to verify the soil types during compaction testing. If compaction testing is performed with a nuclear density gauge, it should be periodically correlated with a sand cone test for each soil type. Density testing should be performed per project specifications and or jurisdictional requirements, but not less than once per 12 inches elevation of any fill area, with additional tests per 12-inch fill area for each additional 7,500 square-foot section or portion thereof.
 14. For earthwork excavations, OSHA guidelines should be referenced for sloping and shoring. Excavations over a depth of 20 feet require a shoring design. In the event excavations are planned near to existing structures, the geotechnical engineer should be consulted to evaluate whether such excavation will call for shoring or underpinning the adjacent structure. Pre-construction and post-construction condition surveys and vibration monitoring might also be helpful to evaluate any potential damage to surrounding structures.

15. Excavations into rock, partially weathered rock, cemented soils, boulders and cobbles, and other hard soil or “hard-pan” materials, may result in slower excavation rates, larger equipment with specialized digging tools, and even blasting. It is also not unusual in these situations for screening and or crushing of rock to be called for. Blasting, hard excavating, and material processing equipment have special safety concerns and are more costly than the use of soil excavation equipment. Additionally, this type of excavation, especially blasting, is known to cause vibrations that should be monitored at nearby structures. As above, a pre-blast and post-blast conditions assessment might also be warranted.

UNDERGROUND PIPELINE – STRUCTURAL BACKFILL

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable State Department of Transportation, the State Department of Environmental Quality, the US Environmental Protection Agency, City and/or County Public Works, Occupational Safety and Health Administration (OSHA), Private Utility Companies, and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered, and in some cases work may take place to multiple different standards. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Underground pipeline in this section is considered to apply to the installation of underground conduits for water, storm water, irrigation water, sewage, electricity, telecommunications, gas, etc. Structural backfill refers to the activity of restoring the grade or establishing a new grade in the area where excavations were needed for the underground pipeline installation.
3. Prior to the start of underground pipeline installation, a detailed conflict study including as-builts, utility locating, and potholing should be conducted. The geotechnical study should be referenced to determine subsurface conditions such as caving soils, unsuitable soils, shallow groundwater, shallow rock and others. In addition, the utility company responsible for the line also will have requirements for pipe bedding and support as well as other special requirements. Also, if the underground pipeline traverses other properties, rights-of-way, and/or easements etc. (for roads, waterways, dams, railways, other utility corridors, etc.) those owners may have additional requirements for construction.
4. The required preparations above should be discussed in a pre-construction meeting with the pertinent parties, including the geotechnical engineer, inspector, contractors, testing laboratory, surveyor, and other stake holders.
5. For pipeline excavations, OSHA guidelines should be referenced for sloping and shoring. Excavations over a depth of 20 feet require a shoring design. In the event excavations are planned near to existing structures or pipelines, the geotechnical engineer should be consulted to evaluate whether such excavation will call for shoring or supporting the adjacent structure or pipeline. A pre-construction and post-construction condition survey and vibration monitoring might also be helpful to evaluate any potential damage to surrounding structures.
6. Excavations into rock, partially weathered rock, cemented soils, boulders and cobbles, and other hard soil or “hard-pan” materials, may result in slower excavation rates, larger equipment with specialized digging tools, and even blasting. It is also not unusual in these situations for screening and or crushing of rock to be called for. Blasting, hard excavating and material processing equipment have special safety concerns and are more costly than the use soil excavation equipment. Additionally, this type of excavation, especially blasting, is known to cause vibrations that should be monitored at nearby structures. As above, a pre-blast and post-blast conditions assessment might also be warranted.

7. Bedding material requirements vary between utility companies and might depend of the type of pipe material and availability of different types of aggregates in different locations. In general, bedding refers to the material that supports the bottom of the pipe, and extends to 1 foot above the top of the pipe. In general the use of aggregate base for larger diameter pipes (6-inch diameter or more) is recommended lacking a jurisdictionally specified bedding material. Gas lines and smaller diameter lines are often backfilled with fine aggregate meeting the ASTM requirements for concrete sand. In all cases bedding with less than 2,000 ohm-cm resistivity, more than 50 ppm chloride content or more than 0.1 percent sulfates should not be used.
8. Structural backfill materials above the bedding should be relatively free of organic materials, man-made debris, environmentally hazardous materials, frozen material, and brittle, non-durable aggregate, soil clods or rocks and/or any other materials that can break down and degrade over time.
9. In general the backfill soil requirements will depend on the future use of the land above the buried line, but in most cases, excessive settlement of the pipe trench is not considered advisable or acceptable. As such, the structural backfill compaction equipment should be appropriate for the thickness of the loose lift being placed. The thickness of the loose lift being placed should be at least two times the maximum particle size incorporated in the fill. Care should be taken not to damage the pipe during compaction or compaction testing.
10. Fill lift thickness (including bedding) should generally be proportioned to achieve 95 percent or more of a standard proctor (ASTM D689) maximum dry density (MDD) or 90 percent or more of a modified proctor (ASTM D1557) MDD, depending on the state practices (in general the modified proctor is required in California and for projects in the jurisdiction of the Army Corps of Engineers). For backfills within the upper portions of roadway subgrades, the general requirement for soil compaction is usually increased to 100 percent or more of the standard proctor MDD and 95 percent or more of the modified proctor MDD.
11. Soil compaction should be performed at a moisture content generally near optimum moisture content determined by either standard or modified proctor, and ideally within 3 percent below to 1 percent over the optimum for a standard proctor, and from 2 percent below to 2 percent above optimum for a modified proctor.
12. In some instances fill areas are difficult to access. In such cases a low-strength soil-cement slurry can be used in the place of compacted fill soil. In general such fills should be rated to have a 28-day strength of 75 to 125 psi, which in some areas is referred to as a "1-sack" slurry. It should be noted that these materials are wet, and require a period of 2 days (24 hours) to cure before additional fill can be placed above it. Testing of this material can be done using concrete cylinder compression strength testing equipment, but care is needed in removing the test specimens from the molds. Field testing using the ball method, and spread or flow testing is also acceptable.
13. Quality control testing should be provided on structural backfill to assist the contractor in meeting project specifications. Proctor testing should be performed on each soil type, and one-point field proctors should be used to verify the soil types during compaction testing. If compaction testing is

performed with a nuclear density gauge, it should be periodically correlated with a sand cone test for each soil type.

14. Density testing should be performed on structural backfill per project specifications and or jurisdictional requirements, but not less than once per 12 inches elevation in each area, and additional tests for each additional 500 linear-foot section or portion thereof.

CAST-IN-PLACE CONCRETE

SLABS-ON-GRADE/STRUCTURES/PAVEMENTS

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Cast-in-place concrete (concrete) in this section is considered to apply to the installation of cast-in-place concrete slabs on grade, including reinforced and non-reinforced slabs, structures, and pavements.
3. In areas where concrete is bearing on prepared subgrade or structural fill soils, testing and approval of this work should be completed prior to the beginning of concrete construction.
4. In locations where a concrete is approved to bear on in-place (native) soil or in locations where approved documented fills have been exposed to weather conditions after approval, a concrete subgrade evaluation should be performed prior to the placement of reinforcing steel and or concrete. This can consist of probing with a "t"-handled rod, borings, penetrometer testing, dynamic cone penetration testing and/or other methods requested by the geotechnical engineer and/or inspector. Where unsuitable, wet, or frozen bearing material is encountered, the geotechnical engineer should be consulted for additional recommendations.
5. Slabs on grade should be placed on a 4-inch thick or more capillary barrier consisting of non-corrosive (more than 2,000 ohm-cm resistivity, less than 50 ppm chloride content and less than 0.1 percent sulfates) aggregate base or open-graded aggregate material. This material should be compacted or consolidated per the recommendations of the structural engineer or otherwise would be covered by the General Considerations for EARTHWORK.
6. Depending on the site conditions and climate, vapor barriers may be required below in-door grade-slabs to receive flooring. This reduces the opportunity for moisture vapor to accumulate in the slab, which could degrade flooring adhesive and result in mold or other problems. Vapor barriers should be specified by the structural engineer and/or architect. The installation of the barrier should be inspected to evaluate the correct product and thickness is used, and that it has not been damaged or degraded.
7. At times when rainfall is predicted during construction, a mud-mat or a thin concrete layer can be placed on prepared and approved subgrades prior to the placement of reinforcing steel or tendons. This serves the purpose of protecting the subgrades from damage once the reinforcement placement has begun.
8. Prior to the placement of concrete, exposed subgrade or base material and forms should be wetted, and form release compounds should be applied. Reinforcement support stands or ties should be

- checked. Concrete bases or subgrades should not be so wet that they are softened or have standing water.
9. For a cast-in-place concrete, the form dimensions, reinforcement placement and cover, concrete mix design, and other code requirements should be carefully checked by an inspector before and during placement. The reinforcement should be specified by the structural engineering drawings and calculations.
 10. For post-tension concrete, an additional check of the tendons is needed, and a tensioning inspection form should be prepared prior to placement of concrete.
 11. For Portland cement pavements, forms an additional check of reinforcing dowels should performed per the design drawings.
 12. During placement, concrete should be tested, and should meet the ACI and jurisdictional requirements and mix design targets for slump, air entrainment, unit weight, compressive strength, flexural strength (pavements), and any other specified properties. In general concrete should be placed within 90 minutes of batching at a temperature of less than 90 degrees Fahrenheit. Adding of water to the truck on the jobsite is generally not encouraged.
 13. Concrete mix designs should be created by the accredited and jurisdictionally approved supplier to meet the requirements of the structural engineer. In general a water/cement ratio of 0.45 or less is advisable, and aggregates, cement, flyash, and other constituents should be tested to meet ASTM C-33 standards, including Alkali Silica Reaction (ASR). To further mitigate the possibility of concrete degradation from corrosion and ASR, Type II or V Portland Cement should be used, and fly ash replacement of 25 percent is also recommended. Air entrained concrete should be used in areas where concrete will be exposed to frozen ground or ambient temperatures below freezing.
 14. Control joints are recommended to improve the aesthetics of the finished concrete by allowing for cracking within partially cut or grooved joints. The control joints are generally made to depths of about 1/4 of the slab thickness and are generally completed within the first day of construction. The spacing should be laid out by the structural engineer, and is often in a square pattern. Joint spacing is generally 5 to 15 feet on-center but this can vary and should be decided by the structural engineer. For pavements, construction joints are generally considered to function as control joints. Post-tensioned slabs generally do not have control joints.
 15. Some slabs are expected to meet flatness and levelness requirements. In those cases, testing for flatness and levelness should be completed as soon as possible, usually the same day as concrete placement, and before cutting of control joints if possible. Roadway smoothness can also be measured, and is usually specified by the jurisdictional owner if is required.
 16. Prior to tensioning of post-tension structures, placement of soil backfills or continuation of building on newly-placed concrete, a strength requirement is generally required, which should be specified by the structural engineer. The strength progress can be evaluated by the use of concrete compressive strength cylinders or maturity monitoring in some jurisdictions. Advancing with backfill, additional concrete work or post-tensioning without reaching strength benchmarks could result in damage and failure of the concrete, which could result in danger and harm to nearby people and property.

17. In general, concrete should not be exposed to freezing temperatures in the first 7 days after placement, which may require insulation or heating. Additionally, in hot or dry, windy weather, misting, covering with wet burlap or the use of curing compounds may be called for to reduce shrinkage cracking and curling during the first 7 days.

FOUNDATIONS

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Foundations in this section are considered to apply to the construction of structural supports which directly transfer loads from man-made structures into the earth. In general, these include shallow foundations and deep foundations. Shallow foundations are generally constructed for the purpose of distributing the structural loads horizontally over a larger area of earth. Some types of shallow foundations (or footings) are spread footings, continuous footings, mat foundations, and reinforced slabs-on-grade. Deep foundations are generally designed for the purpose of distributing the structural loads vertically deeper into the soil by the use of end bearing and side friction. Some types of deep foundations are driven piles, auger-cast piles, drilled shafts, caissons, helical piers, and micro-piles.
3. For shallow foundations, the minimum bearing depth considered should be greater than the maximum design frost depth for the location of construction. This can be found on frost depth maps (ICC), but the standard of practice in the city and/or county should also be consulted. In general the bearing depth should never be less than 18 inches below planned finished grades.
4. Shallow continuous foundations should be sized with a minimum width of 18 inches and isolated spread footings should be a minimum of 24 inches in each direction. Foundation sizing, spacing, and reinforcing steel design should be performed by a qualified structural engineer.
5. The geotechnical engineer will provide an estimated bearing capacity and settlement values for the project based on soil conditions and estimated loads provided by the structural engineer. It is assumed that appropriate safety factors will be applied by the structural engineer.
6. In areas where shallow foundations are bearing on prepared subgrade or structural fill soils, testing and approval of this work should be completed prior to the beginning of foundation construction.
7. In locations where the shallow foundations are approved to bear on in-place (native) soil or in locations where approved documented fills have been exposed to weather conditions after approval, a foundation subgrade evaluation should be performed prior to the placement of reinforcing steel. This can consist of probing with a "t"-handled rod, borings, penetrometer testing, dynamic cone penetration testing and/or other methods requested by the geotechnical engineer and/or inspector. Where unsuitable foundation bearing material is encountered, the geotechnical engineer should be consulted for additional recommendations.
8. For shallow foundations to bear on rock, partially weathered rock, hard cemented soils, and/or boulders, the entire foundation system should bear directly on such material. In this case, the rock surface should be prepared so that it is clean, competent, and formed into a roughly horizontal,

stepped base. If that is not possible, then the entire structure should be underlain by a zone of structural fill. This may require the over-excavation in areas of rock removal and/or hard dig. In general this zone can vary in thickness but it should be a minimum of 1 foot thick. The geotechnical engineer should be consulted in this instance.

9. At times when rainfall is predicted during construction, a mud-mat or a thin concrete layer can be placed on prepared and approved subgrades prior to the placement of reinforcing steel. This serves the purpose of protecting the subgrades from damage once the reinforcing steel placement has begun.
 10. For cast-in-place concrete foundations, the excavations dimensions, reinforcing steel placement and cover, structural fill compaction, concrete mix design, and other code requirements should be carefully checked by an inspector before and during placement.
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11. For deep foundations, the geotechnical engineer will generally provide design charts that provide foundations axial capacity and uplift resistance at various depths given certain-sized foundations. These charts may be based on blow count data from drilling and or laboratory testing. In general safety factors are included in these design charts by the geotechnical engineer.
 12. In addition, the geotechnical engineer may provide other soil parameters for use in the lateral resistance analysis. These parameters are usually raw data, and safety factors should be provided by the shaft designer. Sometimes, direct shear and or tri-axial testing is performed for this analysis.
 13. In general the spacing of deep foundations is expected to be 6 shaft diameters or more. If that spacing is reduced, a group reduction factor should be applied by the structural engineer to the foundation capacities per FHWA guidelines. The spacing should not be less than 2.5 shaft diameters.
 14. For deep foundations, a representative of the geotechnical engineer should be on-site to observe the excavations (if any) to evaluate that the soil conditions are consistent with the findings of the geotechnical report. Soil/rock stratigraphy will vary at times, and this may result in a change in the planned construction. This may require the use of fall protection equipment to perform observations close to an open excavation.
 15. For driven foundations, a representative of the geotechnical engineer should be on-site to observe the driving process and to evaluate that the resistance of driving is consistent with the design assumptions. Soil/rock stratigraphy will vary at times and may this may result in a change in the planned construction.
 16. For deep foundations, the size, depth, and ground conditions should be verified during construction by the geotechnical engineer and/or inspector responsible. Open excavations should be clean, with any areas of caving and groundwater seepage noted. In areas below the groundwater table, or areas where slurry is used to keep the trench open, non-destructive testing techniques should be used as outlined below.
 17. Steel members including structural steel piles, reinforcing steel, bolts, threaded steel rods, etc. should be evaluated for design and code compliance prior to pick-up and placement in the foundation. This includes verification of size, weight, layout, cleanliness, lap-splices, etc. In addition, if non-destructive testing such as crosshole sonic logging or gamma-gamma logging is required,

- access tubes should be attached to the steel reinforcement prior to placement, and should be relatively straight, capped at the bottom, and generally kept in-round. These tubes must be filled with water prior to the placement of concrete.
18. In cases where steel welding is required, this should be observed by a certified welding inspector.
 19. In many cases, a crane will be used to lower steel members into the deep foundations. Crane picks should be carefully planned, including the ground conditions at placement of outriggers, wind conditions, and other factors. These are not generally provided in the geotechnical report, but can usually be provided upon request.
 20. Cast-in-place concrete, grout or other cementations materials should be pumped or distributed to the bottom of the excavation using a tremmie pipe or hollow stem auger pipe. Depending on the construction type, different mix slumps will be used. This should be carefully checked in the field during placement, and consolidation of the material should be considered. Use of a vibrator may be called for.
 21. For work in a wet excavation (slurry), the concrete placed at the bottom of the excavation will displace the slurry as it comes up. The upper layer of concrete that has interacted with the slurry should be removed and not be a part of the final product.
 22. Bolts or other connections to be set in the top after the placement is complete should be done immediately after final concrete placement, and prior to the on-set of curing.
 23. For shafts requiring crosshole sonic logging or gamma-gamma testing, this should be performed within the first week after placement, but not before a 2 day curing period. The testing company and equipment manufacturer should provide more details on the requirements of the testing.
 24. Load testing of deep foundations is recommended, and it is often a project requirement. In some cases, if test piles are constructed and tested, it can result in a significant reduction of the amount of needed foundations. The load testing frame and equipment should be sized appropriately for the test to be performed, and should be observed by the geotechnical engineer or inspector as it is performed. The results are provided to the structural engineer for approval.

LATERALLY LOADED STRUCTURES - RETAINING WALLS/SLOPES/DEEP FOUNDATIONS/MISCELLANEOUS

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Laterally loaded structures for this section are generally meant to describe structures that are subjected to loading roughly horizontal to the ground surface. Such structures include retaining walls, slopes, deep foundations, tall buildings, box culverts, and other buried or partially buried structures.
3. The recommendations put forth in General Geotechnical Design and Construction Considerations for FOUNDATIONS, CAST-IN-PLACE CONCRETE, EARTHWORK, and SUBGRADE PREPARATION should be reviewed, as they are not all repeated in this section, but many of them will apply to the work. Those recommendations are incorporated by reference herein.
4. Laterally loaded structures are generally affected by overburden pressure, water pressure, surcharges, and other static loads, as well as traffic, seismic, wind, and other dynamic loads. The structural engineer must account for these loads. In addition, eccentric loading of the foundation should be evaluated and accounted for by the structural engineer. The structural engineer is also responsible for applying the appropriate factors of safety to the raw data provided by the geotechnical engineer.
5. The geotechnical report should provide data regarding soil lateral earth pressures, seismic design parameters, and groundwater levels. In the report the pressures are usually reported as raw data in the form of equivalent fluid pressures for three cases. 1. Static is for soil pressure against a structure that is fixed at top and bottom, like a basement wall or box culvert. 2. Active is for soil pressure against a wall that is free to move at the top, like a retaining wall. 3. Passive is for soil that is resisting the movement of the structure, usually at the toe of the wall where the foundation and embedded section are located. The structural engineer is responsible for deciding on safety factors for design parameters and groundwater elevations based on the raw data in the geotechnical report.
6. Generally speaking, direct shear or tri-axial shear testing should be performed for this evaluation in cases of soil slopes or unrestrained soil retaining walls over 6 feet in height or in lower walls in some cases based on the engineer's judgment. For deep foundations and completely buried structures, this testing will be required per the discretion of the structural engineer.
7. For non-confined retaining walls (walls that are not attached at the top) and slopes, a geotechnical engineer should perform overall stability analysis for sliding, overturning, and global stability. For walls that are structurally restrained at the top, the geotechnical engineer does not generally perform this analysis. Internal wall stability should be designed by the structural engineer.

8. Cut slopes into rock should be evaluated by an engineering geologist, and rock coring to identify the orientation of fracture plans, faults, bedding planes, and other features should be performed. An analysis of this data will be provided by the engineering geologist to identify modes of failure including sliding, wedge, and overturning, and to provide design and construction recommendations.
9. For laterally loaded deep foundations that support towers, bridges or other structures with high lateral loads, geotechnical reports generally provide parameters for design analysis which is performed by the structural engineer. The structural engineer is responsible for applying appropriate safety factors to the raw data from the geotechnical engineer.
10. Construction recommendations for deep foundations can be found in the General Geotechnical Design and Construction Considerations-FOUNDATIONS section.
11. Construction of retaining walls often requires temporary slope excavations and shoring, including soil nails, soldier piles and lagging or laid-back slopes. This should be done per OSHA requirements and may require specialty design and contracting.
12. In general, surface water should not be directed over a slope or retaining wall, but should be captured in a drainage feature trending parallel to the slope, with an erosion protected outlet to the base of the wall or slope.
13. Waterproofing for retaining walls is generally required on the backfilled side, and they should be backfilled with an 18-inch zone of open graded aggregate wrapped in filter fabric or a synthetic draining product, which outlets to weep holes or a drain at the base of the wall. The purpose of this zone, which is immediately behind the wall is to relieve water pressures from building behind the wall.
14. Backfill compaction around retaining walls and slopes requires special care. Lighter equipment should be considered, and consideration to curing of cementitious materials used during construction will be called for. Additionally, if mechanically stabilized earth walls are being constructed, or if tie-backs are being utilized, additional care will be necessary to avoid damaging or displacing the materials. Use of heavy or large equipment, and/or beginning of backfill prior to concrete strength verification can create dangers to construction and human safety. Please refer to the General Geotechnical Design and Construction Considerations-CAST-IN-PLACE CONCRETE section. These concerns will also apply to the curing of cell grouting within reinforced masonry walls.
15. Usually safety features such as handrails are designed to be installed at the top of retaining walls and slopes. Prior to their installation, workers in those areas will need to be equipped with appropriate fall protection equipment.

EXCAVATION AND DEWATERING

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Excavation and Dewatering for this section are generally meant to describe structures that are intended to create stable, excavations for the construction of infrastructure near to existing development and below the groundwater table.
3. The recommendations put forth in General Geotechnical Design and Construction Considerations for [LATERALLY LOADED STRUCTURES](#), [FOUNDATIONS](#), [CAST-IN-PLACE CONCRETE](#), [EARTHWORK](#), and [SUBGRADE PREPARATION](#) should be reviewed, as they are not all repeated in this section, but many of them will apply to the work. Those recommendations are incorporated by reference herein.
4. The site excavations will generally be affected by overburden pressure, water pressure, surcharges, and other static loads, as well as traffic, seismic, wind, and other dynamic loads. The structural engineer must account for these loads as described in Section 5.2 of this report. In addition, eccentric loading of the foundation should be evaluated and accounted for by the structural engineer. The structural engineer is also responsible for applying the appropriate factors of safety to the raw data provided by the geotechnical engineer.
5. The geotechnical report should provide data regarding soil lateral earth pressures, seismic design parameters, and groundwater levels. In the report the pressures are usually reported as raw data in the form of equivalent fluid pressures for three cases. 1. Static is for soil pressure against a structure that is fixed at top and bottom, like a basement wall or box culvert. 2. Active is for soil pressure against a wall that is free to move at the top, like a retaining wall. 3. Passive is for soil that is resisting the movement of the structure, usually at the toe of the wall where the foundation and embedded section are located. The structural engineer is responsible for deciding on safety factors for design parameters and groundwater elevations based on the raw data in the geotechnical report.
6. The parameters provided above are based on laboratory testing and engineering judgement. Since numerous soil layers with different properties will be encountered in a large excavation, assumptions and judgement are used to generate the equivalent fluid pressures to be used in design. Factors of safety are not included in those numbers and should be evaluated prior to design.
7. Groundwater, if encountered will dramatically change the stability of the excavation. In addition, pumping of groundwater from the bottom of the excavation can be difficult and costly, and it can result in potential damage to nearby structures if groundwater drawdown occurs. As such, we recommend that groundwater monitoring be performed across the site during design and prior to construction to assist in the excavation design and planning.

8. Groundwater pumping tests should be performed if groundwater pumping will be needed during construction. The pumping tests can be used to estimate drawdown at nearby properties, and also will be needed to determine the hydraulic conductivity of the soil for the design of the dewatering system.
9. For excavation stabilization in granular and dense soil, the use of soldier piles and lagging is recommended. The soldier pile spacing and size should be determined by the structural engineer based on the lateral loads provided in the report. In general, the spacing should be more than two pile diameters, and less than 8 feet. Soldier piles should be advanced 5 feet or more below the base of the excavation. Passive pressures from Section 5.2 can be used in the design of soldier piles for the portions of the piles below the excavation.
10. If the piles are drilled, they should be grouted in-place. If below the groundwater table, the grouting should be accomplished by tremmie pipe, and the concrete should be a mix intended for placement below the groundwater table. For work in a wet excavation, the concrete placed at the bottom of the excavation will displace the water as it comes up. The upper layer of concrete that has interacted with the water should be removed and not be a part of the final product. Lagging should be specially designed timber or other lagging. The temporary excavation will need to account for seepage pressures at the toe of the wall as well as hydrostatic forces behind the wall.
11. Depending on the loading, tie back anchors and/or soil nails may be needed. These should be installed beyond the failure envelope of the wall. This would be a plane that is rotated upward 55 degrees from horizontal. The strength of the anchors behind this plane should be considered, and bond strength inside the plane should be ignored. If friction anchors are used, they should extend 10 feet or more beyond the failure envelope. Evaluation of the anchor length and encroachment onto other properties, and possible conflicts with underground utilities should be carefully considered. Anchors are typically installed 25 to 40 degrees below horizontal. The capacity of the anchors should be checked on 10% of locations by loading to 200% of the design strength. All should be loaded to 120% of design strength, and should be locked off at 80%
12. The shoring and tie backs should be designed to allow less than 1/2 inch of deflection at the top of the excavation wall, where the wall is within an imaginary 1:1 line extending downward from the base of surrounding structures. This can be expanded to 1 inch of deflection if there is no nearby structure inside that plane. An analysis of nearby structures to locate their depth and horizontal position should be conducted prior to shored excavation design.
13. Assuming that the excavations will encroach below the groundwater table, allowances for drainage behind and through the lagging should be made. The drainage can be accomplished by using an open-graded gravel material that is wrapped in geotextile fabric. The lagging should allow for the collected water to pass through the wall at select locations into drainage trenches below the excavation base. These trenches should be considered as sump areas where groundwater can be pumped out of the excavation.
14. The pumped groundwater needs to be handled properly per jurisdictional guidelines.

15. In general, surface water should not be directed over a slope or retaining wall, but should be captured in a drainage feature trending parallel to the slope, with an erosion protected outlet to the base of the wall or slope.
16. Safety features such as handrails or barriers are to be designed to be installed at the top of retaining walls and slopes. Prior to their installation, workers in those areas will need to be equipped with appropriate fall protection equipment.

Waterproofing and Back Drainage

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Waterproofing and Back drainage structures for this section are generally meant to describe permanent subgrade structures that are planned to be below the historic high groundwater elevation of 20 feet below existing grades.
3. The recommendations put forth in General Geotechnical Design and Construction Considerations for [FOUNDATIONS](#), [CAST-IN-PLACE CONCRETE](#), [EARTHWORK](#), and [SUBGRADE PREPARATION](#) should be reviewed, as they are not all repeated in this section, but many of them will apply to the work. Those recommendations are incorporated by reference herein.
4. In general, surface water should not be directed over a slope or retaining wall, but should be captured in a drainage feature trending parallel to the slope, with an erosion protected outlet to the base of the wall or slope.
5. Waterproofing for retaining walls is generally required on the backfilled side, and they should be backfilled with an 18-inch zone of open graded aggregate wrapped in filter fabric or a synthetic draining product, which outlets to weep holes or a drain at the base of the wall. The purpose of this zone, which is immediately behind the wall is to relieve water pressures from building behind the wall.
6. For the basement walls on this site, sump pumps will be needed to reduce the build-up of water in the basement. The design should be for a historic high groundwater level of 20 feet bgs. The pumping system should be designed to keep the slab and walls relatively dry so that mold, efflorescence, and other detrimental effects to the concrete structure will not result.
7. Backfill compaction around retaining walls and slopes requires special care. Lighter equipment should be considered, and consideration to curing of cementitious materials used during construction will be called for. Additionally, if mechanically stabilized earth walls are being constructed, or if tie-backs are being utilized, additional care will be necessary to avoid damaging or displacing the materials. Use of heavy or large equipment, and/or beginning of backfill prior to concrete strength verification can create dangers to construction and human safety. Please refer to the General Geotechnical Design and Construction Considerations-[CAST-IN-PLACE CONCRETE](#) section. These concerns will also apply to the curing of cell grouting within reinforced masonry walls.

CHEMICAL TREATMENT OF SOIL

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, State Department of Environmental Quality, the US Environmental Protection Agency, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Chemical treatment of soil for this section is generally meant to describe the process of improving soil properties for a specific purpose, using cement or chemical lime.
3. A mix design should be performed by the geotechnical engineer to help it meet the specific strength, plasticity index, durability, and/or other desired properties. The mix design should be performed using the proposed chemical lime or cement proposed for use by the contractor, along with samples of the site soil that are taken from the material to be used in the process.
4. For the mix design the geotechnical engineer should perform proctor testing to determine optimum moisture content of the soil, and then mix samples of the soil at 3 percent above optimum moisture content with varying concentrations of lime or cement. The samples will be prepared and cured per ASTM standards, and then after 7-days for curing, they will be tested for compression strength. Durability testing goes on for 28 days.
5. Following this testing, the geotechnical engineer will provide a recommended mix ratio of cement or chemical lime in the geotechnical report for use by the contractor. The geotechnical engineer will generally specify a design ratio of 2 percent more than the minimum to account for some error during construction.
6. Prior to treatment, the in-place soil moisture should be measured so that the correct amount of water can be used during construction. Work should not be performed on frozen ground.
7. During construction, special considerations for construction of treated soils should be followed. The application process should be conducted to prevent the loss of the treatment material to wind which might transport the materials off site, and workers should be provided with personal protective equipment for dust generated in the process.
8. The treatment should be applied evenly over the surface, and this can be monitored by use of a pan placed on the subgrade. This can also be tested by preparing test specimens from the in-place mixture for laboratory testing.
9. Often, after or during the chemical application, additional water may be needed to activate the chemical reaction. In general, it should be maintained at about 3 percent or more above optimum moisture. Following this, mixing of the applied material is generally performed using specialized equipment.

10. The total amount of chemical provided can be verified by collecting batch tickets from the delivery trucks, and the depth of the treatment can be verified by digging of test pits, and the use of reagents that react with lime and or cement.
11. For the use of lime treatment, compaction should be performed after a specified amount of time has passed following mixing and re-grading. For concrete, compaction should be performed immediately after mixing and re-grading. In both cases, some swelling of the surface should be expected. Final grading should be performed the following day of the initial work for lime treatment, and within 2 to 4 hours for soil cement.
12. Quality control testing of compacted treated subgrades should be performed per the recommendations of the geotechnical report, and generally in accordance with General Geotechnical Design and Construction Considerations - EARTHWORK

PAVING

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Paving for this section is generally meant to describe the placement of surface treatments on travelways to be used by rubber-tired vehicles, such as roadways, runways, parking lots, etc.
3. The geotechnical engineer is generally responsible for providing structural analysis to recommend the thickness of pavement sections, which can include asphalt, concrete pavements, aggregate base, cement or lime treated aggregate base, and cement or lime treated subgrades.
4. The civil engineer is generally responsible for determining which surface finishes and mixes are appropriate, and often the owner, general contractor and/or other party will decide on lift thickness, the use of tack coats and surface treatments, etc.
5. The geotechnical engineer will generally be provided with the planned traffic loading, as well as reliability, design life, and serviceability factors by the jurisdiction, traffic engineer, designer, and/or owner. The geotechnical study will provide data regarding soil resiliency and strength. A pavement modeling software is generally used to perform the analysis for design, however, jurisdictional minimum sections also must be considered, as well as construction considerations and other factors.
6. The geotechnical report report will generally provide pavement section thicknesses if requested.
7. For construction of overlays, where new pavement is being placed on old pavement, an evaluation of the existing pavement is needed, which should include coring the pavement, evaluation of the overall condition and thickness of the pavement, and evaluation of the pavement base and subgrade materials.
8. In general, the existing pavement is milled and treated with a tack coat prior to the placement of new pavement for the purpose of creating a stronger bond between the old and new material. This is also a way of removing aged asphalt and helping to maintain finished grades closer to existing conditions grading and drainage considerations.
9. If milling is performed, a minimum of 2 inches of existing asphalt should be left in-place to reduce the likelihood of equipment breaking through the asphalt layer and destroying its integrity. After milling and before the placement of tack coat, the surface should be evaluated for cracking or degradation. Cracked or degraded asphalt should be removed, spanned with geosynthetic reinforcement, or be otherwise repaired per the direction of the civil and or geotechnical engineer prior to continuing construction. Proofrolling may be requested.

10. For pavements to be placed on subgrade or base materials, the subgrade and base materials should be prepared per the General Geotechnical Design and Construction Considerations – EARTHWORK section.
11. Following the proofrolling as described in the General Geotechnical Design and Construction Considerations – EARTHWORK section, the application of subgrade treatment, base material, and paving materials can proceed per the recommendations in the geotechnical report and/or project plans. The placement of pavement materials or structural fills cannot take place on frozen ground.
12. The placement of aggregate base material should conform to the jurisdictional guidelines. In general the materials should be provided by an accredited supplier, and the material should meet the standards of ASTM C-33. Material that has been stockpiled and exposed to weather including wind and rain should be retested for compliance since fines could be lost. Frozen material cannot be used.
13. The placement of asphalt material should conform to the jurisdictional guidelines. In general the materials should be provided by an accredited supplier, and the material should meet the standards of ASTM C-33. The material can be placed in a screed by end-dumping, or it can be placed directly on the paving surface. The temperature of the mix at placement should generally be on the order of 300 degrees Fahrenheit at time of placement and screeding.
14. Compaction of the screeded asphalt should begin as soon as practical after placement, and initial rolling should be performed before the asphalt has cooled significantly. Compaction equipment should have vibratory capabilities, and should be of appropriate size and weight given the thickness of the lift being placed and the sloping of the ground surface.
15. In cold and/or windy weather, the cooling of the screeded asphalt is a quality issue, so preparations should be made to perform screeding immediately after placement, and compaction immediately after screeding.
16. Quality control testing of the asphalt should be performed during placement to verify compaction and mix design properties are being met and that delivery temperatures are correct. Results of testing data from asphalt laboratory testing should be provided within 24 hours of the paving.

SITE GRADING AND DRAINAGE

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, State Department of Environmental Quality, the US Environmental Protection Agency, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Site grading and drainage for this section is generally meant to describe the effect of new construction on surface hydrology, which impacts the flow of rainfall or other water running across, onto or off-of, a newly constructed or modified development.
3. This section does not apply to the construction of site grading and drainage features. Recommendations for the construction of such features are covered in General Geotechnical Design and Construction Considerations for Earthwork – Structural Fills section and Underground Pipeline Installation – Backfill section.
4. In general, surface water flows should be directed towards storm drains, natural channels, retention or detention basins, swales, and/or other features specifically designed to capture, store, and or transmit them to specific off-site outfalls.
5. The surface water flow design is generally performed by a site civil engineer, and it can be impacted by hydrology, roof lines, and other site structures that do not allow for water to infiltrate into the soil, and that modify the topography of the site.
6. Soil permeability, density, and strength properties are relevant to the design of storm drain systems, including dry wells, retention basins, swales, and others. These properties are usually only provided in a geotechnical report if specifically requested, and recommendations will be provided in the geotechnical report in those cases.
7. Structures or site features that are not a part of the surface water drainage system should not be exposed to surface water flows, standing water or water infiltration. In general, roof drains and scuppers, exterior slabs, pavements, landscaping, etc. should be constructed to drain water away from structures and foundations. The purpose of this is to reduce the opportunity for water damage, erosion, and/or altering of structural soil properties by wetting. In general, a 5 percent or more slope away from foundations, structural fills, slopes, structures, etc. should be maintained.
8. Special considerations should be used for slopes and retaining walls, as described in the General Geotechnical Design and Construction Considerations - LATERALLY LOADED STRUCTURES section.
9. Additionally, landscaping features including irrigation emitters and plants that require large amounts of water should not be placed near to new structures, as they have the potential to alter soil moisture states. Changing of the moisture state of soil that provides structural support can lead to damage to the supported structures.

CLOSE-OUT DOCUMENTATION

2299 Pacific Ave

Long Beach, CA

Job # 6622021

October 24, 2022

Prepared For:

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Prepared By:

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- B Certificate of Insurance
- C Notifications
- D Containment Logs
- E Personal Air Sample
- F Manifest
- G Worker Documentation

Permits and Licenses

Attachment A





CONTRACTORS
STATE LICENSE BOARD
ACTIVE LICENSE



License Number **518740**

Entity **CORP**

Business Name **NORTHSTAR CONTRACTING GROUP
INC**

Classification(s) **B C21 ASB HAZ C35 C61/D63 A
C22**



Expiration Date **10/31/2023**

www.cslb.ca.gov

State of California



Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH

Certificate of Registration for Asbestos-related Work

Certificate No. 061

Expiration Date 4/14/2023

NorthStar Contracting Group, Inc.

(Name of Employer)

is duly registered by the Division of Occupational Safety and Health in accordance with the California Administrative Code, Title 8, Article 2.5 for asbestos-related work.


Division of Occupational Safety and Health
Joe Ferrell

Effective Date 4/14/2022

Contractor's License No. 518740

This registration is valid only when the following requirements and conditions are met:

1. The registered employer shall safely perform asbestos-related work in compliance with relevant occupational safety and health regulations.
2. The registered employer shall notify the Division of changes in work locations or conditions as specified by Section 341.9 of Title 8 of the California Administrative Code.
3. The registered employer shall post a sign readable at 20 feet at the location of any asbestos-related work stating:

**Danger - Asbestos
May Cause Cancer - Causes Damage to Lungs
Authorized Personnel Only**

4. A copy of the registration shall be posted at the jobsite beside the Cal-OSHA poster.
5. The registered employer shall provide a copy of this registration certificate to the prime contractor and any other employers at the site before the commencement of any asbestos-related work.
6. The registered employer shall conduct a safety conference prior to the commencement of any asbestos-related work as specified by Section 341.11 of Title 8 of the California Administrative Code.
7. The registered employer acknowledges the Division's right to revoke or suspend this registration as provided by Section 341.14 of Title 8 of the California Administrative Code.

Certificate of Insurance

Attachment B





CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY)

6/2/2022

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an **ADDITIONAL INSURED**, the policy(ies) must have **ADDITIONAL INSURED** provisions or be endorsed. If **SUBROGATION IS WAIVED**, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER Alliant Insurance Services, Inc. 333 Earle Ovington Blvd, Suite 700 Uniondale NY 11553	CONTACT NAME: Forward All Certificate Revision Requests to PHONE (A/C. No. Ext): the Below E-Mail FAX (A/C. No): E-MAIL ADDRESS: NorthStarGroupServices@alliant.com	
	INSURER(S) AFFORDING COVERAGE	
INSURED NorthStar Contracting Group, Inc. 13320 Cambridge Street Santa Fe Springs, CA 90670	LVIENVI-01	INSURER A : National Union Fire Insurance INSURER B : Zurich American Insurance Comp INSURER C : AIU Insurance Company INSURER D : Crum & Forster Specialty Insur INSURER E : Navigators Insurance Company INSURER F : Ascot Insurance Company
		NAIC #
		19445
		16535
		19399
		44520
	42307	
	23752	

COVERAGES

CERTIFICATE NUMBER: 1381959727

REVISION NUMBER:

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSD	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS
A	<input checked="" type="checkbox"/> COMMERCIAL GENERAL LIABILITY <input type="checkbox"/> CLAIMS-MADE <input checked="" type="checkbox"/> OCCUR <input checked="" type="checkbox"/> Contractual Liab GEN'L AGGREGATE LIMIT APPLIES PER: <input type="checkbox"/> POLICY <input checked="" type="checkbox"/> PRO-JECT <input checked="" type="checkbox"/> LOC <input type="checkbox"/> OTHER:	Y	Y	GL 746-88-43 (AOS) 746-88-44 (NY)	7/1/2021 7/1/2021	7/1/2022 7/1/2022	EACH OCCURRENCE \$2,000,000 DAMAGE TO RENTED PREMISES (Ea occurrence) \$300,000 MED EXP (Any one person) \$25,000 PERSONAL & ADV INJURY \$2,000,000 GENERAL AGGREGATE \$4,000,000 PRODUCTS - COMP/OP AGG \$4,000,000 NY Limits: \$5M OCC/\$10M Agg
A	<input checked="" type="checkbox"/> AUTOMOBILE LIABILITY <input checked="" type="checkbox"/> ANY AUTO <input type="checkbox"/> OWNED AUTOS ONLY <input type="checkbox"/> SCHEDULED AUTOS <input checked="" type="checkbox"/> HIRED AUTOS ONLY <input checked="" type="checkbox"/> NON-OWNED AUTOS ONLY	Y	Y	AL 134-14-52 (AOS) AL 134-14-53 (MA)	7/1/2021 7/1/2021	7/1/2022 7/1/2022	COMBINED SINGLE LIMIT (Ea accident) \$2,000,000 BODILY INJURY (Per person) \$ BODILY INJURY (Per accident) \$ PROPERTY DAMAGE (Per accident) \$ \$
B	<input checked="" type="checkbox"/> UMBRELLA LIAB <input checked="" type="checkbox"/> OCCUR <input checked="" type="checkbox"/> EXCESS LIAB <input type="checkbox"/> CLAIMS-MADE DED RETENTION \$	Y	Y	SXS 0195929-05 SEO-114069 IS21EXC903238IV EXNA2110000045-01	7/1/2021 7/1/2021 7/1/2021 7/1/2021	7/1/2022 7/1/2022 7/1/2022 7/1/2022	EACH OCCURRENCE \$25,000,000 AGGREGATE \$25,000,000 \$
C	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? (Mandatory in NH) If yes, describe under DESCRIPTION OF OPERATIONS below	Y/N N	Y	WC 12326669 (AOS) WC 012-32-6666 (CA) WC 013-75-1681 (NY) WC 012-32-6668 (WI)	7/1/2021 7/1/2021 7/1/2021 7/1/2021	7/1/2022 7/1/2022 7/1/2022 7/1/2022	<input checked="" type="checkbox"/> PER STATUTE <input type="checkbox"/> OTH-ER E.L. EACH ACCIDENT \$1,000,000 E.L. DISEASE - EA EMPLOYEE \$1,000,000 E.L. DISEASE - POLICY LIMIT \$1,000,000
B	Pollution Professional	Y	Y	PEC 0194414-05	7/1/2021	7/1/2022	Ea Claim: \$25,000,000 Occ/Agg \$5,000,000 Agg: \$25,000,000 \$5,000,000

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (ACORD 101, Additional Remarks Schedule, may be attached if more space is required)

RE: NS Project # 6622021, 2299 Pacific Ave Long Beach, 2299 Pacific Avenue, Long Beach, CA 90806

Economic Resources Corporation and 2299 Pacific Avenue LLC are included as Additional Insureds on a Primary and non-contributory basis with respect to General Liability (including ongoing and completed operations) and Automobile Liability as required by written contract. Waiver of Subrogation is included and applies in favor of the Additional Insureds with respect to General Liability, Auto Liability and Workers Compensation as required by written contract. Excess policies follow form to General Liability and Automobile Liability as required by written contract.

CERTIFICATE HOLDER**CANCELLATION**

Economic Resources Corporation
 2600 Industry Way
 Lynwood CA 90262

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE

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POLICY NUMBER: GL 7468843

COMMERCIAL GENERAL LIABILITY
CG 20 10 07 04

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

**ADDITIONAL INSURED - OWNERS, LESSEES OR
CONTRACTORS - SCHEDULED PERSON OR
ORGANIZATION**

This endorsement modifies insurance provided under the following:

COMMERCIAL GENERAL LIABILITY COVERAGE PART

SCHEDULE

Name Of Additional Insured Person(s) Or Organization(s):	Location(s) Of Covered Operations
<p>ANY PERSON OR ORGANIZATION WHOM YOU BECOME OBLIGATED TO INCLUDE AS AN ADDITIONAL INSURED AS A RESULT OF ANY WRITTEN CONTRACT OR AGREEMENT YOU HAVE ENTERED INTO.</p>	<p>PER THE WRITTEN CONTRACT OR AGREEMENT.</p>
<p>Information required to complete this Schedule, if not shown above, will be shown in the Declarations.</p>	

A. Section II - Who Is An Insured is amended to include as an additional insured the person(s) or organization(s) shown in the Schedule, but only with respect to liability for "bodily injury", "property damage" or "personal and advertising injury" caused, in whole or in part, by:

1. Your acts or omissions; or
 2. The acts or omissions of those acting on your behalf;
- In the performance of your ongoing operations for the additional insured(s) at the location(s) designated above.

B. With respect to the insurance afforded to these additional insureds, the following additional exclusions apply:

This insurance does not apply to "bodily injury" or "property damage" occurring after:

1. All work, including materials, parts or equipment furnished in connection with such work, on the project (other than service, maintenance or repairs) to be performed by or on behalf of the additional insured(s) at the location of the covered operations has been completed; or
2. That portion of "your work" out of which the injury or damage arises has been put to its intended use by any person or organization other than another contractor or subcontractor engaged in performing operations for a principal as a part of the same project.

POLICY NUMBER: GL 7468843

COMMERCIAL GENERAL LIABILITY
CG 20 37 07 04

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

ADDITIONAL INSURED - OWNERS, LESSEES OR CONTRACTORS - COMPLETED OPERATIONS

This endorsement modifies insurance provided under the following:

COMMERCIAL GENERAL LIABILITY COVERAGE PART

SCHEDULE

Name Of Additional Insured Person(s) Or Organization(s):	Location And Description Of Completed Operations
ANY PERSON OR ORGANIZATION WHOM YOU BECOME OBLIGATED TO INCLUDE AS AN ADDITIONAL INSURED AS A RESULT OF ANY WRITTEN CONTRACT OR AGREEMENT YOU HAVE ENTERED INTO.	PER THE WRITTEN CONTRACT OR AGREEMENT.
Information required to complete this Schedule, if not shown above, will be shown in the Declarations.	

Section II - Who Is An Insured is amended to include as an additional insured the person(s) or organization(s) shown in the Schedule, but only with respect to liability for "bodily injury" or "property damage" caused, in whole or in part, by "your work" at the location

designated and described in the schedule of this endorsement performed for that additional insured and included in the "products-completed operations hazard."

POLICY NUMBER: GL 7468843

COMMERCIAL GENERAL LIABILITY
CG 24 04 05 09

WAIVER OF TRANSFER OF RIGHTS OF RECOVERY AGAINST OTHERS TO US

This endorsement modifies insurance provided under the following:

COMMERCIAL GENERAL LIABILITY COVERAGE PART
PRODUCTS/COMPLETED OPERATIONS LIABILITY COVERAGE PART

SCHEDULE

Name Of Person Or Organization:
PURSUANT TO APPLICABLE WRITTEN CONTRACT OR AGREEMENT YOU ENTER INTO.

Information required to complete this Schedule, if not shown above, will be shown in the Declarations.

The following is added to Paragraph 8. Transfer Of Rights Of Recovery Against Others To Us of Section IV - Conditions:

We waive any right of recovery we may have against the person or organization shown in the Schedule above because of payments we make for injury or damage arising out of your ongoing operations or "your work" done under a contract with that person or organization and included in the "products-completed operations hazard". This waiver applies only to the person or organization shown in the Schedule above.

POLICY NUMBER: GL 7468843

COMMERCIAL GENERAL LIABILITY
CG 20 01 04 13

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

PRIMARY AND NONCONTRIBUTORY - OTHER INSURANCE CONDITION

This endorsement modifies insurance provided under the following:

**COMMERCIAL GENERAL LIABILITY COVERAGE PART
PRODUCTS/COMPLETED OPERATIONS LIABILITY COVERAGE PART**

The following is added to the Other Insurance Condition and supersedes any provision to the contrary:

Primary And Noncontributory Insurance

This insurance is primary to and will not seek contribution from any other insurance available to an additional insured under your

policy provided that:

- (1) The additional insured is a Named Insured under such other insurance; and
- (2) You have agreed in writing in a contract or agreement that this insurance would be primary and would not seek contribution from any other insurance available to the additional insured.

POLICY NUMBER: GL 7468843

COMMERCIAL GENERAL LIABILITY
CG 25 03 05 09**THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.****DESIGNATED CONSTRUCTION PROJECT(S)
GENERAL AGGREGATE LIMIT**

This endorsement modifies insurance provided under the following:

COMMERCIAL GENERAL LIABILITY COVERAGE PART

SCHEDULE

Designated Construction Project(s): PROJECTS OUTSIDE OF NEW YORK STATE

Information required to complete this Schedule, if not shown above, will be shown in the Declarations.
--

- A.** For all sums which the insured becomes legally obligated to pay as damages caused by "occurrences" under Section I - Coverage A, and for all medical expenses caused by accidents under Section I - Coverage C, which can be attributed only to ongoing operations at a single designated construction project shown in the Schedule above:
1. A separate Designated Construction Project General Aggregate Limit applies to each designated construction project, and that limit is equal to the amount of the General Aggregate Limit shown in the Declarations.
 2. The Designated Construction Project General Aggregate Limit is the most we will pay for the sum of all damages under Coverage A, except damages because of "bodily injury" or "property damage" included in the "products-completed operations hazard", and for medical expenses under Coverage C regardless of the number of:
 - a. Insureds;
 - b. Claims made or "suits" brought; or
 - c. Persons or organizations making claims or bringing "suits".
 3. Any payments made under Coverage A for damages or under Coverage C for medical expenses shall reduce the Designated Construction Project General Aggregate Limit for that designated construction project. Such payments shall not reduce the General Aggregate Limit shown in the Declarations nor shall they reduce any other Designated Construction Project General Aggregate Limit for any other designated construction project shown in the Schedule above.
- B.** For all sums which the insured becomes legally obligated to pay as damages caused by "occurrences" under Section I - Coverage A, and for all medical expenses caused by accidents under Section I - Coverage C, which cannot be attributed only to ongoing operations at a single designated construction project shown in the Schedule above:
1. Any payments made under Coverage A for damages or under Coverage C for medical expenses shall reduce the amount available under the General Aggregate Limit or the Products-completed Operations Aggregate Limit, whichever is applicable; and
 2. Such payments shall not reduce any Designated Construction Project General Aggregate Limit.
- C.** When coverage for liability arising out of the "products-completed operations hazard" is provided, any payments for damages because of "bodily injury" or "property damage" included in the "products-completed operations hazard" will reduce the Products-completed Operations Aggregate Limit, and not reduce the General Aggregate Limit nor the Designated Construction Project General Aggregate Limit.

D. If the applicable designated construction project has been abandoned, delayed, or abandoned and then restarted, or if the authorized contracting parties deviate from plans, blueprints, designs, specifications or timetables, the project

will still be deemed to be the same construction project.

E. The provisions of Section III - Limits Of Insurance not otherwise modified by this endorsement shall continue to apply as stipulated.

POLICY NUMBER: GL 7468844

COMMERCIAL GENERAL LIABILITY
CG 20 10 04 13

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

**ADDITIONAL INSURED - OWNERS, LESSEES OR
CONTRACTORS - SCHEDULED PERSON OR
ORGANIZATION**

This endorsement modifies insurance provided under the following:

COMMERCIAL GENERAL LIABILITY COVERAGE PART

SCHEDULE

Name Of Additional Insured Person(s) Or Organization(s)	Location(s) Of Covered Operations
<p>ANY PERSON OR ORGANIZATION WHOM YOU BECOME OBLIGATED TO INCLUDE AS AN ADDITIONAL INSURED AS A RESULT OF ANY WRITTEN CONTRACT OR AGREEMENT YOU HAVE ENTERED INTO.</p>	<p>PER THE WRITTEN CONTRACT OR AGREEMENT.</p>
<p>Information required to complete this Schedule, if not shown above, will be shown in the Declarations.</p>	

A. Section II - Who Is An Insured is amended to include as an additional insured the person(s) or organization(s) shown in the Schedule, but only with respect to liability for "bodily injury", "property damage" or "personal and advertising injury" caused, in whole or in part, by:

1. Your acts or omissions; or
2. The acts or omissions of those acting on your behalf;

in the performance of your ongoing operations for the additional insured(s) at the location(s) designated above.

However:

1. The insurance afforded to such additional insured only applies to the extent permitted by law; and
2. If coverage provided to the additional insured is required by a contract or agreement, the insurance afforded to such additional insured will not be broader than

that which you are required by the contract or agreement to provide for such additional insured.

B. With respect to the insurance afforded to these additional insureds, the following additional exclusions apply:

This insurance does not apply to "bodily injury" or "property damage" occurring after:

1. All work, including materials, parts or equipment furnished in connection with such work, on the project (other than service, maintenance or repairs) to be performed by or on behalf of the additional insured(s) at the location of the covered operations has been completed; or
2. That portion of "your work" out of which the injury or damage arises has been put to its intended use by any person or organization other than another contractor or subcontractor engaged in performing operations for a principal as a part of the same project.

C. With respect to the insurance afforded to these additional insureds, the following is added to Section III - Limits Of Insurance:

If coverage provided to the additional insured is required by a contract or agreement, the most we will pay on behalf of the additional insured is the amount of insurance:

1. Required by the contract or agreement; or

2. Available under the applicable Limits of Insurance shown in the Declarations;

whichever is less.

This endorsement shall not increase the applicable Limits of Insurance shown in the Declarations.

POLICY NUMBER: GL 7468844

COMMERCIAL GENERAL LIABILITY
CG 20 37 04 13

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

ADDITIONAL INSURED - OWNERS, LESSEES OR CONTRACTORS - COMPLETED OPERATIONS

This endorsement modifies insurance provided under the following:

COMMERCIAL GENERAL LIABILITY COVERAGE PART
PRODUCTS/COMPLETED OPERATIONS LIABILITY COVERAGE PART

SCHEDULE

Name Of Additional Insured Person(s) Or Organization(s)	Location And Description Of Completed Operations
<p>ANY PERSON OR ORGANIZATION WHOM YOU BECOME OBLIGATED TO INCLUDE AS AN ADDITIONAL INSURED AS A RESULT OF ANY WRITTEN CONTRACT OR AGREEMENT YOU HAVE ENTERED INTO.</p>	<p>PER THE WRITTEN CONTRACT OR AGREEMENT</p>
<p>Information required to complete this Schedule, if not shown above, will be shown in the Declarations.</p>	

A. Section II - Who is An Insured is amended to include as an additional insured the person(s) or organization(s) shown in the Schedule, but only with respect to liability for "bodily injury" or "property damage" caused, in whole or in part, by "your work" at the location designated and described in the Schedule of this endorsement performed for that additional insured and included in the "products-completed operations hazard".

However:

1. The insurance afforded to such additional insured only applies to the extent permitted by law; and
2. If coverage provided to the additional insured is required by a contract or agreement, the insurance afforded to such additional insured will not be broader than that

which you are required by the contract or agreement to provide for such additional insured.

B. With respect to the insurance afforded to these additional insureds, the following is added to Section III - Limits Of Insurance:

If coverage provided to the additional insured is required by a contract or agreement, the most we will pay on behalf of the additional insured is the amount of insurance:

1. Required by the contract or agreement; or
2. Available under the applicable Limits of Insurance shown in the Declarations;

whichever is less.

This endorsement shall not increase the applicable Limits of Insurance shown in the Declarations.

ENDORSEMENT

This endorsement, effective 12:01 AM. 07/01/2021 forms a part of

policy No. GL 7468844 issued to NORTHSTAR GROUP SERVICES, INC.

by NATIONAL UNION FIRE INSURANCE COMPANY OF PITTSBURGH, PA

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY

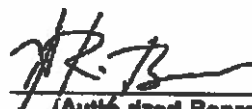
ADDITIONAL INSURED - PRIMARY INSURANCE

This endorsement modifies insurance provided under the following:

COMMERCIAL GENERAL LIABILITY COVERAGE FORM

Section IV, Commercial General Liability Conditions, paragraph 4., Other Insurance, subparagraph a. Primary Insurance, is amended by the addition of the following:

However, coverage under this policy afforded to an additional insured will apply as primary insurance where required by contract, and any other insurance issued to such additional insured shall apply as excess and noncontributory insurance.



**Authorized Representative or
Countersignature (in States Where
Applicable)**

POLICY NUMBER: GL 7468844

COMMERCIAL GENERAL LIABILITY
CG 24 04 05 09

WAIVER OF TRANSFER OF RIGHTS OF RECOVERY AGAINST OTHERS TO US

This endorsement modifies insurance provided under the following:

COMMERCIAL GENERAL LIABILITY COVERAGE PART
PRODUCTS/COMPLETED OPERATIONS LIABILITY COVERAGE PART

SCHEDULE

Name Of Person Or Organization:
PURSUANT TO APPLICABLE WRITTEN CONTRACT OR AGREEMENT YOU ENTER INTO.

Information required to complete this Schedule, if not shown above, will be shown in the Declarations.

The following is added to Paragraph 8. Transfer Of Rights Of Recovery Against Others To Us of Section IV - Conditions:

We waive any right of recovery we may have against the person or organization shown in the Schedule above because of payments we make for injury or damage arising out of your ongoing operations or "your work" done under a contract with that person or organization and included in the "products-completed operations hazard". This waiver applies only to the person or organization shown in the Schedule above.



POLICY NUMBER: AL 1341452

COMMERCIAL AUTO
CA 20 48 10 13**THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.****DESIGNATED INSURED FOR
COVERED AUTOS LIABILITY COVERAGE**

This endorsement modifies insurance provided under the following:

AUTO DEALERS COVERAGE FORM
BUSINESS AUTO COVERAGE FORM
MOTOR CARRIER COVERAGE FORM

With respect to coverage provided by this endorsement, the provisions of the Coverage Form apply unless modified by this endorsement.

This endorsement identifies person(s) or organization(s) who are "insureds" for Covered Autos Liability Coverage under the Who Is An Insured provision of the Coverage Form. This endorsement does not alter coverage provided in the Coverage Form.

This endorsement changes the policy effective on the inception date of the policy unless another date is indicated below.

Named Insured:
NORTHSTAR GROUP SERVICES, INC.

Endorsement Effective Date: 07/01/2021

SCHEDULEName Of Person(s) Or Organization(s):
ANY PERSON OR ORGANIZATION FOR WHOM YOU ARE CONTRACTUALLY BOUND TO
PROVIDE ADDITIONAL INSURED STATUS BUT ONLY TO THE EXTEND OF SUCH
PERSON'S OR ORGANIZATION'S LIABILITY ARISING OUT OF THE USE OF A
COVERED "AUTO".

Information required to complete this Schedule, if not shown above, will be shown in the Declarations.

Each person or organization shown in the Schedule is an "insured" for Covered Autos Liability Coverage, but only to the extent that person or organization qualifies as an "insured" under the Who Is An Insured provision contained in Paragraph A.1.

of Section II - Covered Autos Liability Coverage in the Business Auto and Motor Carrier Coverage Forms and Paragraph D.2. of Section I - Covered Autos Coverages of the Auto Dealers Coverage Form.

ENDORSEMENT

This endorsement, effective 12:01 A.M. 07/01/2021 forms a part of

policy No. AL 1341452 issued to NORTHSTAR GROUP SERVICES, INC.

by NATIONAL UNION FIRE INSURANCE COMPANY OF PITTSBURGH, PA

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

WAIVER OF TRANSFER OF RIGHTS OF RECOVERY AGAINST OTHERS TO US

This endorsement modifies insurance provided under the following:

BUSINESS AUTO COVERAGE FORM

Section IV - Business Auto Conditions, A. - Loss Conditions, 5. - Transfer of Rights of Recovery Against Others to Us, is amended to add:

However, we will waive any right of recover we have against any person or organization with whom you have entered into a contract or agreement because of payments we make under this Coverage Form arising out of an "accident" or "loss" if:

- (1) The "accident" or "loss" is due to operations undertaken in accordance with the contract existing between you and such person or organization; and
- (2) The contract or agreement was entered into prior to any "accident" or "loss".

No waiver of the right of recovery will directly or indirectly apply to your employees or employees of the person or organization, and we reserve our rights or lien to be reimbursed from any recovery funds obtained by any injured employee.



AUTHORIZED REPRESENTATIVE

The Transfer Of Rights Of Recovery Against Others To Us condition does not apply to the person(s) or organization(s) shown in the Schedule, but only to the extent that subrogation is waived prior to the "accident" or the "loss" under a contract with that person or organization.

ENDORSEMENT

This endorsement, effective 12:01A.M. 07/01/2021 forms a part of

policy No. AL 1341452 issued to NORTHSTAR GROUP SERVICES, INC.

by NATIONAL UNION FIRE INSURANCE COMPANY OF PITTSBURGH, PA

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

INSURANCE PRIMARY AS TO CERTAIN ADDITIONAL INSURED

This endorsement modifies insurance provided under the following:

BUSINESS AUTO COVERAGE FORM

Section IV - Business Auto Conditions, B., General Conditions, 5., Other Insurance, c., is amended by the addition of the following sentence:

The insurance afforded under this policy to an additional insured will apply as primary insurance for such additional insured where so required under an agreement executed prior to the date of accident. We will not ask any insurer that has issued other insurance to such additional insured to contribute to the settlement of loss arising out of such accident.

All other terms and conditions remain unchanged.



Authorized Representative or
Countersignature (in States Where
Applicable)

ENDORSEMENT

This endorsement, effective 12:01 A.M. 07/01/2021, forms a part of

policy No. AL 1341453 Issued to NORTHSTAR GROUP SERVICES, INC.

by National Union Fire Insurance Company of Pittsburgh, Pa.

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

INSURANCE PRIMARY AS TO CERTAIN ADDITIONAL INSUREDS

This endorsement modifies insurance provided under the following:

BUSINESS AUTO COVERAGE FORM

Section IV - Business Auto Conditions, B., General Conditions, 5., Other Insurance, c, is amended by the addition of the following sentence:

The insurance afforded under this policy to an additional insured will apply as primary insurance for such additional insured where so required under an agreement executed prior to the date of accident. We will not ask any insurer that has issued other insurance to such additional insured to contribute to the settlement of loss arising out of such accident.

All other terms and conditions remain unchanged.



ENDORSEMENT

This endorsement, effective 12:01 A.M. 07/01/2021, forms a part of

policy No. AL 1341453 issued to NORTHSTAR GROUP SERVICES, INC.

by National Union Fire Insurance Company of Pittsburgh, Pa.

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

WAIVER OF TRANSFER OF RIGHTS OF RECOVERY AGAINST OTHERS TO US

This endorsement modifies insurance provided under the following:

BUSINESS AUTO COVERAGE FORM

Section IV - Business Auto Conditions, A. - Loss Conditions, 5. - Transfer of Rights of Recovery Against Others to Us, is amended to add:

However, we will waive any right of recovery we have against any person or organization with whom you have entered into a contract or agreement because of payments we make under this Coverage Form arising out of an "accident" or "loss" if:

- (1) The "accident" or "loss" is due to operations undertaken in accordance with the contract existing between you and such person or organization; and
- (2) The contract or agreement was entered into prior to any "accident" or "loss".

No waiver of the right of recovery will directly or indirectly apply to your employees or employees of the person or organization, and we reserve our rights or lien to be reimbursed from any recovered funds obtained by any injured employee.



AUTHORIZED REPRESENTATIVE

ENDORSEMENT

This endorsement, effective 12:01 A.M. 07/01/2021, forms a part of

policy No. AL 1341453 issued to NORTHSTAR GROUP SERVICES, INC.

by National Union Fire Insurance Company of Pittsburgh, Pa.

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

ADDITIONAL INSURED - WHERE REQUIRED UNDER CONTRACT OR AGREEMENT

This endorsement modifies insurance provided under the following:

BUSINESS AUTO COVERAGE FORM

SCHEDULE

ANY PERSON OR ORGANIZATION FOR WHOM YOU ARE CONTRACTUALLY BOUND TO PROVIDE ADDITIONAL INSURED STATUS BUT ONLY TO THE EXTENT OF SUCH PERSON'S OR ORGANIZATION'S LIABILITY ARISING OUT OF THE USE OF A COVERED "AUTO".

- i. **SECTION II - LIABILITY COVERAGE, A. Coverage, 1. -Who Is Insured, is amended to add:**
 - d. Any person or organization, shown in the schedule above, to whom you become obligated to include as an additional insured under this policy, as a result of any contract or agreement you enter into which requires you to furnish insurance to that person or organization of the type provided by this policy, but only with respect to liability arising out of use of a covered "auto". However, the insurance provided will not exceed the lesser of:
 - 1. The coverage and/or limits of this policy, or
 - 2. The coverage and/or limits required by said contract or agreement.



AUTHORIZED REPRESENTATIVE

WAIVER OF OUR RIGHT TO RECOVER FROM OTHERS ENDORSEMENT

This endorsement changes the policy to which it is attached effective on inception date of the policy unless a different date is indicated below.

(The following "attaching clause" need be completed only when this endorsement is issued subsequent to preparation of the policy)

This endorsement, effective 12:01 AM 07/01/2021 forms a part of Policy No. WC 12326669

issued to NORTHSTAR GROUP SERVICES, INC. By

AIU Insurance Company

We have the right to recover our payments from anyone liable for an injury covered by this policy. We will not enforce our right against the person or organization named in the Schedule. This agreement applies only to the extent that you perform work under a written contract that requires you to obtain this agreement from us.

This agreement shall not operate directly or indirectly to benefit any one not named in the Schedule.

Schedule

ANY PERSON OR ORGANIZATION WITH WHOM YOU HAVE ENTERED INTO A WRITTEN CONTRACT, A CONDITION OF WHICH REQUIRES YOU TO OBTAIN THIS WAIVER FROM US. THIS ENDORSEMENT DOES NOT APPLY TO BENEFITS OR DAMAGES PAID OR CLAIMED:

1. PURSUANT TO THE WORKERS' COMPENSATION OR EMPLOYERS' LIABILITY LAWS OF KENTUCKY, NEW HAMPSHIRE, OR NEW JERSEY; OR,
2. BECAUSE OF INJURY OCCURRING BEFORE YOU ENTERED INTO SUCH A CONTRACT.

This form is not applicable in California, Kentucky, New Hampshire, New Jersey, Texas, or Utah. This form is not applicable in Missouri when there is a construction code on the policy and there is Missouri premium or exposure.

WC 00 03 13
(Ed. 04/84)

Countersigned by _____



Authorized Representative

WAIVER OF OUR RIGHT TO RECOVER FROM OTHERS ENDORSEMENT--CALIFORNIA

This endorsement changes the policy to which it is attached effective on the inception date of the policy unless a different date is indicated below.

(The following "attaching clause" need be completed only when this endorsement is issued subsequent to preparation of the policy)

This endorsement, effective 12:01 AM, 07/01/2021 forms a part of Policy No.

WC 12326666 Issued to NORTHSTAR GROUP SERVICES, INC.

By AIU Insurance Company

Premium

We have the right to recover our payments from anyone liable for an injury covered by this policy. We will not enforce our right against the person or organization named in the Schedule. (This agreement applies only to the extent that you perform work under a written contract that requires you to obtain this agreement from us).

You must maintain payroll records accurately segregating the remuneration of your employees while engaged in the work described in the Schedule.

The additional premium for this endorsement shall be % of the California workers' compensation premium otherwise due on such remuneration.

Schedule

Person or Organization

Job Description

ANY PERSON OR ORGANIZATION TO WHOM WE BECOME OBLIGATED TO WAIVE YOUR RIGHTS OF RECOVERY AGAINST, UNDER ANY CONTRACT OR AGREEMENT YOU ENTER INTO, PRIOR TO THE OCCURRENCE OF LOSS.



WC 04 03 08
(Ed. 04/84)

Countersigned by _____

Authorized Representative

WAIVER OF OUR RIGHT TO RECOVER FROM OTHERS ENDORSEMENT

This endorsement changes the policy to which it is attached effective on inception date of the policy unless a different date is indicated below.

(The following "attaching clause" need be completed only when this endorsement is issued subsequent to preparation of the policy)

This endorsement, effective 12:01 AM 07/01/2021 forms a part of Policy No. WC 13751681

Issued to NORTHSTAR GROUP SERVICES, INC.

By AIU Insurance Company

We have the right to recover our payments from anyone liable for an injury covered by this policy. We will not enforce our right against the person or organization named in the Schedule. This agreement applies only to the extent that you perform work under a written contract that requires you to obtain this agreement from us.

This agreement shall not operate directly or indirectly to benefit any one not named in the Schedule.

Schedule

ANY PERSON OR ORGANIZATION FOR WHOM YOU HAVE ENTERED INTO A CONTRACT, A CONDITION OF WHICH REQUIRES YOU TO OBTAIN THIS WAIVER FROM US. THIS ENDORSEMENT DOES NOT APPLY TO BENEFITS OR DAMAGES PAID OR CLAIMED:

1. PURSUANT TO THE WORKERS' COMPENSATION OR EMPLOYERS' LIABILITY LAWS OF KENTUCKY, NEW HAMPSHIRE, OR NEW JERSEY; OR,
2. BECAUSE OF INJURY OCCURRING BEFORE YOU ENTERED INTO SUCH A CONTRACT.

This form is not applicable in California, Kentucky, New Hampshire, New Jersey, Texas, or Utah. This form is not applicable in Missouri when there is a construction code on the policy and there is Missouri premium or exposure.

WC 00 03 13
(Ed. 04/84)

Countersigned by _____



Authorized Representative

WAIVER OF OUR RIGHT TO RECOVER FROM OTHERS ENDORSEMENT-CALIFORNIA

This endorsement changes the policy to which it is attached effective on the inception date of the policy unless a different date is indicated below.

(The following "attaching clause" need be completed only when this endorsement is issued subsequent to preparation of the policy)

This endorsement, effective 12:01 AM, 07/01/2021 forms a part of Policy No.

WC 12326666 Issued to NORTHSTAR GROUP SERVICES, INC.

By NORTHSTAR GROUP SERVICES, INC.

Premium

We have the right to recover our payments from anyone liable for an injury covered by this policy. We will not enforce our right against the person or organization named in the Schedule. (This agreement applies only to the extent that you perform, work under a written contract that requires you to obtain this agreement from us).

You must maintain payroll records accurately segregating the remuneration of your employees while engaged in the work described in the Schedule.

The additional premium for this endorsement shall be _____ % of the California workers' compensation premium otherwise due on such remuneration.

Schedule

person or organization

Job Description

ANY PERSON OR ORGANIZATION TO WHOM WE BECOME OBLIGATED TO WAIVE YOUR RIGHTS OF RECOVERY AGAINST, UNDER ANY CONTRACT OR AGREEMENT YOU ENTER INTO, PRIOR TO THE OCCURRENCE OF LOSS.



WC 0403 08
(Ed. 04/84)

Countersigned by _____

Authorized Representative

WAIVER OF OUR RIGHT TO RECOVER FROM OTHERS ENDORSEMENT

This endorsement changes the policy to which it is attached effective on inception date of the policy unless a different date is indicated below.

(The following "attaching clause" need be completed only when this endorsement is issued subsequent to preparation of the policy)

This endorsement, effective 12:01 AM 07/01/2021 forms a part of Policy No. WC 12326668

Issued to NORTHSTAR GROUP SERVICES, INC.

By AIU Insurance Company

We have the right to recover our payments from anyone liable for an injury covered by this policy. We will not enforce our right against the person or organization named in the Schedule. This agreement applies only to the extent that you perform work under a written contract that requires you to obtain this agreement from us.

This agreement shall not operate directly or indirectly to benefit any one not named in the Schedule.

Schedule

ANY PERSON OR ORGANIZATION FOR WHOM YOU HAVE ENTERED INTO A CONTRACT, A CONDITION OF WHICH REQUIRES YOU TO OBTAIN THIS WAIVER FROM US. THIS ENDORSEMENT DOES NOT APPLY TO BENEFITS OR DAMAGES PAID OR CLAIMED:

1. PURSUANT TO THE WORKERS' COMPENSATION OR EMPLOYERS' LIABILITY LAWS OF KENTUCKY, NEW HAMPSHIRE, NEW JERSEY; OR,
2. BECAUSE OF INJURY OCCURING BEFORE YOU ENTERED INTO SUCH A CONTRACT.

This form is not applicable in California, Kentucky, New Hampshire, New Jersey, Texas, or Utah. This form is not applicable in Missouri when there is a construction code on the policy and there is Missouri premium or exposure.

WC 00 03 13
(Ed. 04/84)

Countersigned by _____



Authorized Representative

Endorsement # 03

Limited Other Insurance Condition Amendment – New York



Policy No.	Eff. Date of Pol.	Exp. Date of Pol.	Eff. Date of End.	Producer	Add'l Prem.	Return Prem.
SXS 0195929-05	07/01/2021	07/01/2022	07/01/2021	50261000	-----	-----

Named Insured and Mailing Address:
 NORTHSTAR GROUP SERVICES, INC
 370 7TH AVENUE
 NEW YORK, NY 10001

Producer:
 ATLANTIC RISK SPECIALISTS INC
 1 INTERNATIONAL BLVD STE 350
 MAHWAH, NJ 07495-0025

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

Condition **G. Other Insurance** of SECTION V. CONDITIONS, paragraph G., Other Insurance is deleted and replaced with the following:

G. Other Insurance

If other valid and collectible insurance applies to damages that are also covered by this policy, this policy will apply excess of the other insurance. However, this provision will not apply:

1. If the other insurance is written to be excess of this policy; or
2. If you have agreed in a written contract to carry insurance to apply prior to and be non-contributory with that of another person or organization's insurance, but only as respects damages arising out of insured operations or work on your behalf performed under such written contract. However, the limits available to the other person or organization will be the lesser of our policy Limits of Insurance or the limits required by such written contract. In that case, other insurance of that person or organization will apply as excess and not contribute prior to the insurance afforded by this policy.

Nothing herein will be construed to make this policy subject to the terms, conditions and limitations of such other insurance.

ALL OTHER TERMS AND CONDITIONS OF THIS POLICY REMAIN UNCHANGED.



ZURICH[®]

Straight Excess Liability Policy

There are provisions in this policy that restrict coverage. Read the entire policy carefully to determine rights, duties and what is and is not covered.

Throughout this policy, the words "you" and "your" refer to the Named Insured shown in the Declarations, and any other person or organization qualifying as such in **underlying insurance**. The words "we", "us" and "our" refer to the company providing this insurance.

The word "insured(s)" means any person or organization qualifying as such in **underlying insurance** but only to the extent and within the scope for which such "insured(s)" qualify for coverage in **underlying insurance**.

Words and phrases that are printed in bold-face type are defined in this policy. These definitions are found in **SECTION VI. DEFINITIONS** of this policy or in the specific policy provision where they appear.

In consideration of the payment of the premium and in reliance upon the statements in the Declarations and in accordance with the provisions of this policy, we agree with you to provide coverage as follows:

Insuring Agreements

SECTION I. COVERAGE

- A.** We will pay on behalf of the insured those damages covered by this insurance in excess of the total Applicable Limits of **underlying insurance**. This policy includes:
1. The terms and conditions of **underlying insurance** to the extent such terms and conditions are not inconsistent or do not conflict with the terms and conditions referred to in Paragraph 2. below; and
 2. The terms and conditions that apply to this policy.
- B.** Notwithstanding anything to the contrary contained in Paragraph A. above, if **underlying insurance** does not apply to damages for reasons other than exhaustion of total applicable limits of insurance by payment of loss, then this policy does not apply to such damages.
- C.** The amount we will pay under this policy is limited as described in **SECTION II. LIMITS OF INSURANCE**.
- D.** We have no obligation under this policy with respect to any settlement made without our consent.
- E.** The insurance afforded under this policy applies to bodily injury or property damage only if prior to the Policy Period, neither you nor any **authorized person** knew that the bodily injury or property damage had occurred, in whole or in part. If you or any **authorized person** knew, prior to the Policy Period, that the bodily injury or property damage occurred, then any continuation, change or resumption of such bodily injury or property damage during or after the Policy Period will be deemed to have been known prior to the Policy Period.

Bodily injury or property damage which occurs during the Policy Period and was not, prior to the Policy Period, known to have occurred by you or any **authorized person** includes any continuation, change or resumption of that bodily injury or property damage after the Policy Period; and

Bodily injury or property damage will be deemed to have been known to have occurred at the earliest time when you or any **authorized person**:

1. Reports all or any part of, the bodily injury or property damage to us or any other insurer;
2. Receives a written or verbal demand or claim for damages because of the bodily injury or property damage; or
3. Becomes aware by any other means that bodily injury or property damage has occurred or has begun to occur.

I. Transfer of Rights of Recovery Against Others to Us

1. If the insured has rights to recover all or part of any payment we have made under this insurance, those rights are transferred to us. The insured must do nothing after the loss to impair them. At our request, the insured will bring suit or transfer those rights to us and help us enforce them.

However, if any insured is required to waive their rights of recovery from others by a written contract or agreement executed before a loss, we agree to waive our rights of recovery to the extent required by the written contract or agreement. This waiver of rights will not be construed to be a waiver with respect to any other operations for which the insured has not waived their rights of recovery by contract.

2. Any amount recovered will be apportioned in the inverse order of payment of loss to the extent of actual payment. The expenses of all such recovery proceedings will be apportioned in the ratio of respective recoveries.

J. Unintentional Errors and Omissions

Any unintentional error or omission in the description of, or failure to describe completely, any premises or operations intended to be covered by this policy, shall not invalidate or affect the coverage for those operations or premises. However, the insured must report such error or omission to the company as soon as practicable after its discovery.

K. When Loss Is Payable

Coverage under this policy will not apply unless and until the insured or the insured's underlying insurer has paid or is legally obligated to pay the full amount of the total Applicable Limits of underlying insurance.

When the amount of loss is determined by an agreed settlement or a final judgment against an insured obtained after an actual trial, we will promptly pay on behalf of the insured the amount of loss covered under the terms of this policy.

L. Audit of Books and Records

We may audit and examine your books and records as they relate to this policy at any time during the period of this policy and for up to three (3) years after the expiration or termination of this policy.

M. Changes

Notice to any agent or knowledge possessed by any agent or any other person will not effect a waiver or a change in any part of this policy. This policy can only be changed by a written endorsement that becomes a part of this policy.

N. First Named Insured

The person or organization first named in Item 1. of the Declarations is responsible for the payment of all premiums. The first Named Insured will act on behalf of all other insureds for the giving and receiving of notice of cancellation or any other notice required under this policy or by statute or regulation, for the receipt and acceptance of this policy and any endorsements forming a part of this policy, and for the receiving of any return premiums that become payable under this policy.

O. Inspection

We have the right, but are not obligated to inspect the insured's premises and operations at any time. Our inspections are not safety inspections. They relate only to the insurability of the premises and operations and the premium to be charged. We may provide reports on the conditions we find. We may also recommend changes. While these reports may help reduce losses, we do not undertake to perform the duty of any person or organization to provide for the health or safety of workers or the public. We do not warrant that the premises or operations are safe or healthful, or that they comply with laws, regulations, codes or standards.

P. Legal Action Against Us

There will be no right of action against us under this insurance unless:

1. You have complied with all the terms of this policy; and
2. The amount you owe has been determined by settlement with our consent or by actual trial and final judgment.

This insurance does not give anyone the right to add us as a party in an action against you to determine your liability.

Professional Environmental Consultant's Liability Insurance Policy Declarations – New York



Zurich American Insurance Company
1299 Zurich Way
Schaumburg, Illinois 60196

THIS POLICY PROVIDES COVERAGE ON BOTH A CLAIMS MADE AND AN OCCURRENCE BASIS. COVERAGE FOR I.C.1. IS ON AN OCCURRENCE BASIS. COVERAGE FOR I.A.1., I.A.2., I.B., AND I.C.2. IS ONLY PROVIDED FOR CLAIMS FIRST MADE AGAINST THE INSURED WHILE THE POLICY REMAINS IN EFFECT AND WITHIN THE AUTOMATIC EXTENDED REPORTING PERIOD OR THE OPTIONAL EXTENDED REPORTING PERIOD. THERE IS NO COVERAGE FOR CLAIMS MADE FOR WRONGFUL ACTS OCCURRING PRIOR TO THE RETROACTIVE DATE, IF ANY. PAYMENT OF CLAIM EXPENSES UNDER THIS POLICY ERODE THE APPLICABLE LIMITS OF INSURANCE.

UPON TERMINATION OF COVERAGE, AN AUTOMATIC EXTENDED REPORTING PERIOD WILL BE GRANTED FOR SIXTY (60) DAYS. AN OPTIONAL EXTENDED REPORTING PERIOD FOR A TIME PERIOD OF AT LEAST ONE (1) YEAR IS AVAILABLE, BUT ONLY BY ENDORSEMENT AND FOR AN ADDITIONAL PREMIUM. POTENTIAL COVERAGE GAPS MAY ARISE UPON EXPIRATION OF THE AUTOMATIC EXTENDED REPORTING PERIOD OR THE OPTIONAL EXTENDED REPORTING PERIOD.

DURING THE FIRST SEVERAL YEARS OF THE CLAIMS MADE RELATIONSHIP, CLAIMS-MADE RATES ARE COMPARATIVELY LOWER THAN OCCURRENCE RATES, AND ANNUAL PREMIUM INCREASES CAN BE EXPECTED INDEPENDENT OF OVERALL RATE LEVEL INCREASES UNTIL THE CLAIMS-MADE RELATIONSHIP REACHES MATURITY.

THE ITEMS BELOW MAY BE MODIFIED BY ENDORSEMENT. READ THE DECLARATIONS, POLICY, AND ALL ENDORSEMENTS CAREFULLY.

Policy Number: PEC 0194414-05

Renewal of: PEC 0194414-04

Item 1. **Named Insured:** NORTHSTAR GROUP SERVICES, INC.

Address: 7 PENN PLAZA
 370 7TH AVENUE, SUITE 1803
 NEW YORK, NY 10001

Item 2. **Policy Period:** From: 07/01/2021 To: 07/01/2022
 12:01 A.M. Local time at the address shown in Item 1.

NYFTZ Class: 2 Class Code: 2-14055

NOTICE: THESE POLICY FORMS AND THE APPLICABLE RATES ARE EXEMPT FROM THE FILING REQUIREMENTS OF THE NEW YORK INSURANCE LAW AND REGULATIONS. HOWEVER, THE FORMS AND RATES MUST MEET THE MINIMUM STANDARDS OF THE NEW YORK INSURANCE LAW AND REGULATIONS.

Item 3. a. Limits of Insurance: Coverage applies if a Limit is shown below. If no Limit or N/A shows, the Coverage does not apply.

Policy Aggregate Limit of Insurance		\$25,000,000
Aggregate Claim Expenses Limit		\$N/A
Coverage A-1	Professional Liability Each Claim Limit	\$5,000,000
Coverage A-2	Rectification Each Claim Limit	\$5,000,000
Coverage B	Protective Professional Each Claim Limit	\$5,000,000
Coverage C-1	Contractor's Pollution Liability Each Pollution Event Limit	\$25,000,000
Coverage C-2	Contractor's Pollution Mitigation Each Claim Limit	\$10,000,000

Item 3.b. Supplementary Payments:

Crisis Management Expenses:

Policy Period Limit:	\$10,000,000
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Item 4. Self-Insured Retentions (SIR):

Coverage A-1	Professional Liability Each Claim SIR	\$250,000
Coverage A-2	Rectification Each Claim SIR	\$250,000
Coverage B	Protective Professional Each Claim SIR	\$250,000
Coverage C-1	Contractor's Pollution Liability - Each Pollution Event SIR	\$250,000
Coverage C-2	Pollution Mitigation Each Claim SIR	\$250,000

Item 5. Retroactive Date(s)

Coverage A-1	Professional Liability Retroactive Date	07/01/2002
Coverage A-2	Rectification Retroactive Date	07/01/2002
Coverage B	Protective Professional Retroactive Date	07/01/2002
Coverage C-2	Pollution Mitigation Retroactive Date	07/01/2002



Schedule of Forms and Endorsements

Policy No.	Eff. Date of Pol.	Exp. Date of Pol.	Eff. Date of End.	Producer	Add'l Prem.	Return Prem.
PEC 0194414-05	07/01/2021	07/01/2022	07/01/2021	02781000	-----	-----

Named Insured and Mailing Address:
 NORTHSTAR GROUP SERVICES, INC.
 7 PENN PLAZA
 370 7TH AVENUE, SUITE 1803
 NEW YORK, NY 10001

Producer:
 RSG SPECIALTY, LLC
 2465 KUSER RD STE 202
 HAMILTON, NJ 08690-3303

The following provides an index of the forms and endorsements attached to this policy:

<u>Form Number</u>	<u>Form Name</u>
U-GU-319-F (01/09)	Important Notice - In Witness Clause
STF-PECO-D-100-A NY (04/18)	Professional Environmental Consultant's Liability Insurance Policy Declarations - New York
STF-PECO-119-D CW (01/18)	Professional Environmental Consultant's Liability Insurance Policy
STF-ENVL-1579-A CW (08/08)	Minimum Earned Premium at Inception
STF-ENVL-1583-A CW (08/08)	Named Insured - Additions
STF-ENVL-1603-B CW (04/10)	Waste Brokering
STF-ENVL-1632-A CW (11/10)	Blanket Notification to Others of Cancellation
STF-PECO-150-C CW (01/18)	Prior Acts Coverage (Nose Coverage)
STF-ENVL-MAN 07-A CW (07/20)	Client Specific Other Insurance Endorsement
STF-ENVL-MAN 08-A CW (07/20)	Client Specific Other Insurance Endorsement
STF-PECO-MAN 03 A CW (07/21)	Staging Location Coverage
STF-PECO-MAN 04 A CW (07/21)	Amendment to Definition of Transportation
STF-PECO-MAN 05 A CW (07/21)	Amendment to Non-Owned Disposal Sites Coverage
STF-ENVL-MAN 06 A CW (07/21)	Amendment to the Bodily Injury Definition
STF-ENVL-MAN 09 A CW (07/21)	EIL Coverage For Your Covered Locations
STF-PECO-MAN 10 CW (07/21)	Amendment to Definitions: Responsible Insured
STF-PECO-MAN 11 CW (07/21)	Amendment to Definition GG - Professional Services
STF-ENVL-MAN 12 A CW (07/21)	Amendment to Cancellation - Reasons
STF-ENVL-MAN 13 A CW (07/21)	Pollution Event Modification
STF-ENVL-MAN 14 CW (07/21)	ADDITIONAL INSURED - CENTRALIA SCHOOL DISTRICT
STF-ENVL-MAN 15 CW (07/21)	Additional insured - BnB Builders, Inc.
STF-ENVL-MAN 16 CW (07/21)	Additional insured - BnB Builders, Inc., Snohomish County
STF-ENVL-MAN 17 CW (07/21)	Additional insured - BnB Builders, Inc., Facebook
STF-ENVL-MAN 18 CW (07/21)	Additional insured - BnB Builders, Inc., Juno Theraputcs, Inc.
STF-ENVL-MAN 19 CW (07/21)	Additional insured - BnB Builders, Inc., WRC 400 University, LLC
STF-ENVL-MAN 20 CW (07/21)	Additional insured - BnB Builders, Inc., First & Utah Properties
STF-ENVL-MAN 21 CW (07/21)	Additional insured - AT&T
STF-ENVL-MAN 22 CW (07/21)	Additional insured - Sellen Constrction Co., Inc.

STF-ENVL-MAN 23 CW (07/21)
STF-ENVL-MAN 24 CW (07/21)
STF-ENVL-MAN 25 CW (07/21)
STF-ENVL-MAN 26 CW (07/21)
STF-PECO-MAN 02 A CW (06/21)
STF-PECO-MAN 01 A CW (06/21)
STF-ENVL-MAN 27 CW (07/21)
STF-PECO-250-A NY (01/18)
U-GU-1191-A CW (03/15)

Additional insured - 167 Front Properties
Additional insured - 58 West 58th Street
Additional insured - City Center Harmon Hotel Holding, LLC
Additional insured - Commodore Recovery, LLC
Definition of Public Relations Expense
AMENDMENT OF FAULTY WORKMANSHIP EXCLUSION
Additional Insured - 60 Nyala Farms, Agreement 4700134115
New York Amendatory Endorsement
Sanctions Exclusion Endorsement



Additional Insured - Automatic - Owners, Lessees Or Contractors

Coverage B: Contractor's Pollution Liability

Policy No.	Eff. Date of Pol.	Exp. Date of Pol.	Eff. Date of End.	Producer	Add'l Prem.	Return Prem.
PEC 0194414-05	07/01/2021	07/01/2022	07/01/2021	02781000		

Named Insured and Mailing Address:

NORTHSTAR GROUP SERVICES, INC.
7 PENN PLAZA, 370 7TH AVE. SUITE 1803
NEW YORK, NEW YORK 1000

Producer:

RSG SPECIALTY, LLC
2465 KUSER RD. STE 202
HAMILTON, NJ 08690-3303

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

This endorsement modifies insurance provided under the following:

Professional Environmental Consultant's Liability Insurance Policy

Professional Environmental Consultant's Liability Insurance Policy - Claims Made and Reported Coverage

In consideration of the payment of premium and the Deductible by you and in reliance upon the statements in the Application made a part hereof, we agree with you, subject to all the terms, exclusions and conditions of the policy and the terms and conditions of this endorsement, that with respect to COVERAGE B: CONTRACTOR'S POLLUTION LIABILITY only, the following changes shall apply:

- I. Pursuant to DEFINITIONS (Section III.) definition of "insured" paragraph S., is amended to include as an "insured" any person or organization who you are required to add as an additional insured on this policy under a written contract or written agreement executed and effective prior to the performance of your "covered operations" which is the subject of such written contract or written agreement.
- II. The insurance provided to the additional insured person or organization applies only to "claims" arising out of a "pollution event" but only with respect to liability for "bodily injury" or "property damage" caused, in whole or in part, by:
 - A. Your acts or omissions; or
 - B. The acts or omissions of those acting on your behalf, and resulting directly from your "covered operations" or "completed operations" of the "covered operations", which is the subject of the written contract or written agreement, performed for the additional insured person or organization.
- III. However, regardless of the provisions of Paragraphs I. and II. above:
 - A. We will not extend any insurance coverage to any additional insured person or organization:
 1. That is not provided to you in this policy; or
 2. That is any broader coverage than you are required to provide to the additional insured person or organization in the written contract or written agreement; and
 - B. We will not provide Limits of Insurance to any additional insured person or organization that exceed the lower of:
 1. The Limits of Insurance provided to you in this policy; or
 2. The Limits of Insurance you are required to provide in the written contract or written agreement.

- IV.** The insurance provided to the additional insured person or organization does not apply to "bodily injury" or "property damage" arising out of the rendering or failure to render any professional architectural, engineering or surveying services including:
- A.** The preparing, approving or failing to prepare or approve maps, shop drawings, opinions, reports, surveys, field orders, change orders or drawings and specifications; and
 - B.** Supervisory, inspection, architectural or engineering activities.
- V.** The additional insured must see to it that:
- A.** We are notified as soon as practicable of a "pollution event" that may result in a claim;
 - B.** We receive written notice of a "claim" as soon as practicable; and
 - C.** A request for defense and indemnity of the "claim" or suit will promptly be brought against any policy issued by another insurer under which the additional insured may be an insured in any capacity. This provision does not apply to insurance on which the additional insured is a Named Insured, if the written contract or written agreement requires that this coverage be primary and non-contributory.
- VI.** For the coverage provided by this endorsement:
- K.** Other Insurance in the CONDITIONS (Section VII.), is amended by the addition of the following paragraphs:
 - 1.** This insurance is primary insurance as respects our coverage to the additional insured person or organization, where the written contract or written agreement requires that this insurance be primary and non-contributory with respect to any other policy upon which the additional insured is a Named Insured. In that event, we will not seek contribution from any other such insurance policy available to the additional insured on which the additional insured person or organization is a Named Insured.
 - 2.** The following sub-paragraph is added to paragraph K. OTHER INSURANCE, CONDITIONS (Section VII.)

This insurance is excess over any of the other insurance, whether primary, excess, contingent or on any other basis, available to an additional insured, in which the additional insured on our policy is also covered as an additional insured on another policy providing coverage for the same "pollution event" or "claim". This provision does not apply to any policy in which the additional insured is a Named Insured on such other policy and where our policy is required by written contract or written agreement to provide coverage to the additional insured on a primary and non-contributory basis.
- VII.** This endorsement does not apply to an additional insured which has been added to this policy by an endorsement showing the additional insured in a Schedule of additional insureds, and which endorsement applies specifically to that identified additional insured.

ALL OTHER TERMS AND CONDITIONS OF THE POLICY SHALL APPLY AND REMAIN UNCHANGED.



ZURICH

Waiver of Transfer Rights of Recovery Against Others Blanket as Required by Contract

Policy No.	Eff. Date of Pol.	Exp. Date of Pol.	Eff. Date of End.	Producer	Add'l Prem.	Return Prem.
PEC 0194414-05	07/01/2021	07/01/2022	07/01/2021	02781000		

Named Insured and Mailing Address:

NORTHSTAR GROUP SERVICES, INC.
7 PENN PLAZA, 370 7TH AVE. SUITE 1803
NEW YORK, NEW YORK 1000

Producer:

RSG SPECIALTY, LLC
2465 KUSER RD. STE 202
HAMILTON, NJ 08690-3303

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

This endorsement modifies insurance provided under the following:

Professional Environmental Consultant's Liability Insurance Policy

Professional Environmental Consultant's Liability Insurance Policy - Claims Made and Reported Coverage

In consideration of the payment of premium and the Deductible by you and in reliance upon the statements in the Application made a part hereof, we agree with you, subject to all the terms, exclusions and conditions of the policy that CONDITIONS, Condition O., Subrogation and Transfer of Rights of Recovery is amended by the addition of the following:

We waive any right of recovery we may have against any person or organization whom you are required to waive your right of subrogation by a written contract or written agreement executed and effective prior to the performance of your services which is the subject of such written contract or written agreement.

ALL OTHER TERMS AND CONDITIONS OF THE POLICY SHALL APPLY AND REMAIN UNCHANGED.

Notifications

Attachment C



South Coast Air Quality Management District

21865 Copley Drive, Diamond Bar, CA 91765-4182
Phone: (909) 396-2336
www.aqmd.gov

Facility ID
183066

Notification Number
704141

Rule 1403 Notification of Procedure 3 Asbestos Removal

Please maintain a copy of this Notification at the job site, either electronic or paper.

Project Type

Project Type	Asbestos Removal	Project Urgency	Routine
Origin Date	6/17/2022 12:58:04 PM		
Completed By	Mayra Duenas	Phone Number	(714) 672-3500-5840(Ex.)
User Email	mgomez@northstar.com		

Contractor Information

Company Name	NORTHSTAR CONTRACTING GROUP INC.	Address	13320 CAMBRIDGE ST
City	SANTA FE SPRINGS	State	CA
Zip	90670		
CSLB License #	518740	OSHA REG #	00061
Supervisor #1	Walter Castro	Phone	(213) 700-0628

Site Information

Site Name	2299 Pacific Ave, Long Beach	Project #	6622021
Site Street #	2299	Street Name	PACIFIC AVE
Cross Street	W. 23RD STREET	Site County	LOS ANGELES
City	LONG BEACH	State	CA
Zip	90806		
Contact Name	Albert V Carrol	Contact Phone	(310)537-4610

Site Owner	2299 Pacific Avenue LLC c/o Economic Res	Owner Address	2900 Industry Way
City	Lynwood	State	CA
Zip	90262		

Project Start Date	6/20/2022	Project End Date	6/23/2022
Project Work Shift(s)	Day	Building Size in Sq.ft	6448
Number of Floors	1	Building Age (years)	50
Number of Building/Dwelling Units	0	Building Prior Use	Commercial
Asbestos Survey	Yes	Asbestos Found	Yes
Asbestos Removed	No	Building to be Demolished	No
Describe Work	asbestos abatement removal	Describe Work Location	Roof

Project Information

Asbestos Information

Amount of Asbestos in each type in Sq.Ft

Acoustic Ceiling	0	Linoleum	0	Insulation	0	Fire Proofing	0
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Ducting	0	Dry Wall / Joint Compound	0	HEPA Vacuum & wet wipe	0	Personal Contents, Disposed	0
Mastic (Non-friable)	0	Floor Tiles (Non-friable)	0	Transite	0	Roofing	100
Stucco	0	Plaster	0	Other (Friable)	0	Coal Tar Wrap	0
Mastic (Friable)	0	Floor Tile (Friable)	0	Other (Non-friable)	0	Contaminated Soil	0
Transite (Damaged)	0	Nonporous Contents, HV&WW	0				

Asbestos Amount to be Removed in Sq.Ft

FRIABLE	0
CLASS I	100
CLASS II	0
Total	100

Asbestos Removal From	Surfaces	Control Procedures	3
Asbestos Detection Procedure(s)	Survey , Bulk Sampling , Inspection , PLM , PCM , TEM		

Survey Information

Certified Asbestos Inspector Name	Christopher F. Romanowski	Certification Expiration Date	3/12/2022 12:00:00 AM
Survey Plan Date	2/1/2022 12:00:00 AM	Phone Number	(213)213-9400
Email	cromanowski@trc.com		

Waste Information

Waste Transporter	BDC SPECIAL WASTE SERVICES		
Address	1211 WEST GLADSTONE AVENUE	City	AZUSA
State	CA	Zip	91702
Landfill	Azusa Land Reclamation		
Address	1211 W Gladstone St	City	Azusa
State	CA	Zip	91702

Revision History

Notification #	Project Start Date	project End Date	Quantity of Asbestos	Revision Comments	Revised Date
704141	6/20/2022	6/23/2022	100	Revise Dates	6/17/2022 1:09:17 PM
702642	6/20/2022	6/22/2022	100		6/17/2022 1:09:18 PM

Fee Payment

Total Amount of Asbestos to be Removed in sq.ft	100
Tracking Number	4022925
Project Size Fee	0
Additional Fee	25.22
Total Fee	\$ 25.22
Payment Made	\$ 25.22
Balance Due	\$ 0

By clicking the Sign & Submit button, I certify that an individual trained in the provisions of SCAQMD Rule 1403 and the Asbestos NESHAP (CFR Title 40, Part 61, Subpart M) will be onsite during the demolition or renovation and evidence that the required training has been accomplished by this person will be available for inspection during normal business hours. In addition, I certify that all of the information contained herein and information submitted with this Notification is true and correct.



CAL/OSHA OFFICE: LONG BEACH
3939 Atlantic Ave, Ste 212
Long Beach, CA 90807
FAX: 562-426-8340

**CAL/OSHA TEMPORARY JOBSITE NOTIFICATION
ASBESTOS RELATED WORK**

REVISED

DATE: **June 17, 2022**
PROJECT NUMBER: **6622021**
CONTRACTOR: **NorthStar Contracting Group, Inc.** CONTACT NAME: **Mayra Gomez**
13320 Cambridge Street
Santa Fe Springs, CA 90670
(714) 639-7600

CSLB NUMBER: **518740**
DOSH REGISTRATION NO. **061**
CERTIFIED SUPERVISOR & QUALIFIED PERSON: ~~Walter Castro~~ **Phillip Walker**
NUMBER OF EMPLOYEES IN WORK AREA: **3**

PROPERTY OWNER/
OPERATOR: **2299 Pacific Avenue LLC c/o Economic Resources Corporation**
2600 Industry Way
Lynwood CA 90262
Name (310) 537-4610

JOBSITE NAME: **2299 Pacific Ave, Long Beach**
JOBSITE ADDRESS: **2299 Pacific Avenue**
Long Beach CA 90806
CROSS STREET: **Willow**

WORK LOCATION: **Roof**

START DATE: **6/20/22** END DATE: ~~6/22/22~~ **6/23/22**

ASBESTOS TYPE & QUANTITY: **Roof Penetration 100 SF**

DESCRIPTON OF WORK PRACTICES, ENGINEERING CONTROLS, METHOD OF REMOVAL, METHOD OF EMISSION CONTROLS:
3 - Open wet removal, HEPA vacuum, respirators, signage.

EVALUATION OF THE POTENTIAL FOR EXPOSURE: **LOW**

NOTE: Any change in the information provided to the division by written notice shall be reported to the division at or before the time of the change. In accordance with Section 5208 of Title No. 8 of the California Administrative Code, this letter serves to notify you that the substance asbestos shall be removed.

LEAD-WORK PRE-JOB NOTIFICATION



Annual Notification for Steel Structures

(Note: items marked * are required)

*Name of employer doing 'Lead Work'		*Address	*Zipcode	*Phone
NorthStar Contracting Group, Inc. 518740		13320 Cambridge Street Santa Fe Springs, CA 90670		(714) 639-7600
Calif. Cont. Lic. No. (if applicable)				Job Number 6622021
Supervisor:		*Number of lead-job workers: (check one below)		
* Supervisor name: Walter Castro Phillip Walker California Department of Health Services Lead Cert. No. (if applicable) LCR-0007887		<input checked="" type="checkbox"/> 1 - 5	<input type="checkbox"/> 31 - 40	
		<input type="checkbox"/> 6 - 10	<input type="checkbox"/> 41 - 50	
		<input type="checkbox"/> 11 - 20	<input type="checkbox"/> > 50	
		<input type="checkbox"/> 21 - 30		

*Job start date/time	*Job completion date/time	Shift	*Approximate duration of 'Lead Work' in days
6/16/22 7:00 AM	6/17/22 6/23/22 3:30 PM	<input checked="" type="checkbox"/> Day <input type="checkbox"/> Swing <input type="checkbox"/> Graveyard <input type="checkbox"/> Other	#VALUE!

*Street address or location of job	City	Nearest cross street
2299 Pacific Avenue Long Beach 2299 Pacific Ave	Long Beach	Willow
	County	Zipcode
	Los Angeles	90806

*Precise Location of work (building no., room no., etc.): Through the Bldg			
Entity contracting the lead-work	Address	Zipcode	Phone
<input checked="" type="checkbox"/> Premises Owner <input type="checkbox"/> Lessee (check one) 2299 Pacific Avenue LLC c/o Economic Resources Corporation	2600 Industry Way Lynwood, CA	90262	(310) 537-4610
			Pager/cellular phone No.

Type of structure and use:

<input type="checkbox"/> Office Building	<input type="checkbox"/> Residence	<input type="checkbox"/> Steel Structure/Type _____
<input checked="" type="checkbox"/> Public Access/Commercial	<input type="checkbox"/> School	<input type="checkbox"/> Other _____

Scope of work and work practices:

*Describe lead-related work to be done (check all that apply)

<input type="checkbox"/> Surface Preparation	<input type="checkbox"/> Wall Repair	<input type="checkbox"/> Other _____
<input type="checkbox"/> Water/Moisture Damage Repair	<input checked="" type="checkbox"/> Paint Removal	
<input type="checkbox"/> Window/Door Repair/Replacement	<input checked="" type="checkbox"/> Demolition	

*Describe paint removal methods (check all that apply):

<input checked="" type="checkbox"/> Manual Scraping/Sanding	<input checked="" type="checkbox"/> Demolition	<input type="checkbox"/> Hydroblasting	<input type="checkbox"/> Other work practices disturbing lead: _____
<input type="checkbox"/> Power Sanding/Grinding	<input type="checkbox"/> Heat Guns	<input type="checkbox"/> Torch Cutting	
<input type="checkbox"/> Chemical Stripping	<input type="checkbox"/> Abrasive Blasting	<input checked="" type="checkbox"/> Welding	

*Amount of area to be disturbed: (check one per column)

<input type="checkbox"/> < 10 square feet	<input type="checkbox"/> < 10 linear feet
<input checked="" type="checkbox"/> 10 - 100 square feet	<input type="checkbox"/> 10 - 100 linear feet
<input type="checkbox"/> 101 - 1000 square feet	<input type="checkbox"/> 100 - 1000 linear feet
<input type="checkbox"/> > 1000 square feet	<input type="checkbox"/> > 1000 linear feet

Torch Cutting/Welding
 Duration of work: _____

Concentration of lead in disturbed materials:

_____ parts per million (ppm) _____ % percent by weight
 _____ mg/cm² Assumed to be lead-containing: YES

*Name of notifier	Title:	*Date signed:
Mayra Gomez	Administrator	6/17/2022 REVISED

Containment Logs

Attachment D



Personal Air Sample

Attachment E



Certificate of Analysis

Lead in Air

SOP IV.6.1c/IV.5c

tel - 714-607-5227
free - 855-968-7522
OCLab@patriotlab.com
1041 S. Placentia Avenue, Fullerton, CA 92831



NorthStar Contracting Group, Inc.
13320 Cambridge Street
Santa Fe Springs, CA 90670

Report Number: 917890
Project Number: 6622021
Project Name: 2299 Pacific Ave Long Beach
Project Location: 2299 Pacific Ave
Long Beach, CA

Date Collected: 6/16/2022
Date Received: 6/20/2022
Date Analyzed: 6/22/2022
Date Reported: 6/22/2022

Collected By: Lorenzo Ramirez
Claim Number:
PO Number:
Number of Samples: 2

Lab/Client ID	Location	Material Description	Volume (m ³)	Result (µg/m ³)
917890-001 1	Octavio Olivares 661069 Half Face Exterior Roof Panels Remove Panels Area It's on Exterior Roof Canopy Next to the Bldg Parking Lot	Lead Air Sample	0.777	<7.7
917890-002 2	Blank	Lead Air Sample		<6.0

8hr TWA for Octavio Olivares = <5.9 µg/m³

Ian Reyes - Analyst

Kwin Sheena Legaspi - Approved By

Reporting Limit: 6 µg/filter or 6µg/m³ for a 1000L sample under normal preparatory conditions. Reporting limit may change depending on the volume of air sampled and/or final preparatory dilution. OSHA 8hr-Action Level 30ug/m³, OSHA 8hr-PEL 50ug/m³ (Reference OSHA 1910.1025). Results for samples lacking volume of air drawn or sampling time and flow rate information are reported as µg/filter. Condition of samples as received is fair unless otherwise noted. The results reported may not be representative of other locales and time frames, and pertain only to the items tested. Test data are accurate to two significant figures. Data have not been corrected with instrument or process blanks. Unless otherwise noted, the reported test results have passed necessary quality control requirements. Reference Method: NIOSH 7082/EPA 7420. This report was issued by a DOHS ELAP (Lab No-2540) accredited laboratory and may not be reproduced, except in full, without the expressed written consent of Patriot Environmental Laboratory Services, Inc. This report must not be used to claim product certification, approval or endorsement by DOHS ELAP or any government agency.

Certificate of Analysis
Lead in Air
 SOP IV.6.1c/IV.5c

tel - 714-607-5227
 free - 855-968-7522
 OCLab@patriotlab.com
 1041 S. Placentia Avenue, Fullerton, CA 92831



NorthStar Contracting Group, Inc.
 13320 Cambridge Street
 Santa Fe Springs, CA 90670

Report Number: 917892
 Project Number: 6622021
 Project Name: 2299 Pacific Ave Long Beach
 Project Location: 2299 Pacific Ave
 Long Beach, CA

Date Collected: 6/17/2022
 Date Received: 6/20/2022
 Date Analyzed: 6/22/2022
 Date Reported: 6/22/2022

Collected By: Lorenzo Ramirez
 Claim Number:
 PO Number:
 Number of Samples: 2

Lab/Client ID	Location	Material Description	Volume (m ³)	Result (µg/m ³)
917892-001 1	Octavio Olivares 1955 Half Face Roof Canopy #2 Removal / Clean Up Area Its Roof Canopy Located at Pacific Ave	Lead Air Sample	0.914	<6.6
917892-002 2	Blank	Lead Air Sample		<6.0

8hr TWA for Octavio Olivares = <6.0 µg/m³

Ian Reyes - Analyst

Kwin Sheena Legaspi - Approved By

Reporting Limit: 6 µg/filter or 6µg/m³ for a 1000L sample under normal preparatory conditions. Reporting limit may change depending on the volume of air sampled and/or final preparatory dilution. OSHA 8hr-Action Level 30ug/m³, OSHA 8hr-PEL 50ug/m³ (Reference OSHA 1910.1025). Results for samples lacking volume of air drawn or sampling time and flow rate information are reported as µg/filter. Condition of samples as received is fair unless otherwise noted. The results reported may not be representative of other locales and time frames, and pertain only to the items tested. Test data are accurate to two significant figures. Data have not been corrected with instrument or process blanks. Unless otherwise noted, the reported test results have passed necessary quality control requirements. Reference Method: NIOSH 7082/EPA 7420. This report was issued by a DOHS ELAP (Lab No-2540) accredited laboratory and may not be reproduced, except in full, without the expressed written consent of Patriot Environmental Laboratory Services, Inc. This report must not be used to claim product certification, approval or endorsement by DOHS ELAP or any government agency.

Certificate of Analysis

Lead in Air

SOP IV.6.1c/IV.5c

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 free - 855-968-7522
 OCLab@patriotlab.com
 1041 S. Placentia Avenue, Fullerton, CA 92831



NorthStar Contracting Group, Inc.
 13320 Cambridge Street
 Santa Fe Springs, CA 90670

Report Number: 918132
 Project Number: 6622021
 Project Name: 2299 Pacific Ave LB
 Project Location: 2299 Pacific Ave
 Long Beach, CA 90806

Date Collected: 6/20/2022
 Date Received: 6/22/2022
 Date Analyzed: 6/22/2022
 Date Reported: 6/22/2022

Collected By: Phillip Walker
 Claim Number:
 PO Number:
 Number of Samples: 3

Lab/Client ID	Location	Material Description	Volume (m ³)	Result (µg/m ³)
918132-001 1	Octavio Olivares 661069 Half Face East Roof Remove LBP Sheeting	Lead Air Sample	0.864	<6.9
918132-002 2	Blank	Lead Air Sample		<6.0
918132-003 3	Blank	Lead Air Sample		<6.0

Ian Reyes - Analyst

Kwin Sheena Legaspi - Approved By

Reporting Limit: 6 µg/filter or 6µg/m³ for a 1000L sample under normal preparatory conditions. Reporting limit may change depending on the volume of air sampled and/or final preparatory dilution. OSHA 8hr-Action Level 30ug/m³, OSHA 8hr-PEL 50ug/m³ (Reference OSHA 1910.1025). Results for samples lacking volume of air drawn or sampling time and flow rate information are reported as µg/filter. Condition of samples as received is fair unless otherwise noted. The results reported may not be representative of other locales and time frames, and pertain only to the items tested. Test data are accurate to two significant figures. Data have not been corrected with instrument or process blanks. Unless otherwise noted, the reported test results have passed necessary quality control requirements. Reference Method: NIOSH 7082/EPA 7420. This report was issued by a DOHS ELAP (Lab No-2540) accredited laboratory and may not be reproduced, except in full, without the expressed written consent of Patriot Environmental Laboratory Services, Inc. This report must not be used to claim product certification, approval or endorsement by DOHS ELAP or any government agency.

Certificate of Analysis

Lead in Air
SOP IV.6.1c/IV.5c

tel - 714-607-5227
 free - 855-968-7522
 OCLab@patriotlab.com
 1041 S. Placentia Avenue, Fullerton, CA 92831



NorthStar Contracting Group, Inc.
 13320 Cambridge Street
 Santa Fe Springs, CA 90670

Report Number: 918565
 Project Number: 6622021
 Project Name: 2299 Pacific Ave
 Project Location: 2299 Pacific Ave
 LB, CA

Date Collected: 6/21/2022
 Date Received: 6/24/2022
 Date Analyzed: 6/24/2022
 Date Reported: 6/25/2022

Collected By: Phillip Walker
 Claim Number:
 PO Number:
 Number of Samples: 3

Lab/Client ID	Location	Material Description	Volume (m ³)	Result (µg/m ³)
918565-001 1	Salvador Garcia 661351 Half Face North Roof Demo Metal Sheet	Lead Air Sample	0.882	<6.8
918565-002 2	Blank	Lead Air Sample		<6.0
918565-003 3	Blank	Lead Air Sample		<6.0

8hr TWA for Salvador Garcia = 4.0 µg/m³

Ian Reyes - Analyst

Kwin Sheena Legaspi - Approved By

Reporting Limit: 6 µg/filter or 6µg/m³ for a 1000L sample under normal preparatory conditions. Reporting limit may change depending on the volume of air sampled and/or final preparatory dilution. OSHA 8hr-Action Level 30µg/m³, OSHA 8hr-PEL 50µg/m³ (Reference OSHA 1910.1025). Results for samples lacking volume of air drawn or sampling time and flow rate information are reported as µg/filter. Condition of samples as received is fair unless otherwise noted. The results reported may not be representative of other locales and time frames, and pertain only to the items tested. Test data are accurate to two significant figures. Data have not been corrected with instrument or process blanks. Unless otherwise noted, the reported test results have passed necessary quality control requirements. Reference Method: NIOSH 7082/EPA 7420. This report was issued by a DOHS ELAP (Lab No-2540) accredited laboratory and may not be reproduced, except in full, without the expressed written consent of Patriot Environmental Laboratory Services, Inc. This report must not be used to claim product certification, approval or endorsement by DOHS ELAP or any government agency.

Certificate of Analysis
Phase Contrast Microscopy
SOP IV.2/IV.3

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 free - 855-968-7522
 OCLab@patriotlab.com
 1041 S. Placentia Avenue, Fullerton, CA 92831



NorthStar Contracting Group, Inc.
 13320 Cambridge Street
 Santa Fe Springs, CA 90670

Report Number: 918829
 Project Number: 6622021
 Project Name: 2299 Pacific Ave
 Project Location: 2299 Pacific Ave
 LB, CA

Date Collected: 6/21/2022
 Date Received: 6/25/2022
 Date Analyzed: 6/25/2022
 Date Reported: 6/25/2022

Collected By: Phillip Walker
 Claim Number:
 PO Number:
 Number of Samples: 5
 Job Type: ACM Abate Roof Mastic

Lab/ Client ID	Sample Activity	Flow Rate	Volume	Fiber Count	Field Count	Blank Count	Result f/cc	Result f/mm ²
918829-001 Jose Lopez 661170	1 Half Face NE Roof	2.20	66.0	<5.5	100.0	2.0	<0.0409	<7.01
918829-002 Jose Lopez 661170	2 Half Face NE Roof	1.64	270.6	<5.5	100.0	2.0	<0.0100	<7.01
918829-003 Jose Lopez 661170	3 Half Face NE Roof	1.64	237.8	<5.5	100.0	2.0	<0.0113	<7.01
918829-004	4 Field Black			3.0	100			
918829-005	5 Field Black			1.0	100			

Name **PCM TWA (f/cc)**
 Jose Lopez 661170 ----- 0.0094 Sample(s): 918829-001, 918829-002, 918829-003, were used to calculate TWA for Jose Lopez 661170.

Anna Portillo - Analyst

Kwin Sheena Legaspi - Approved By

Reference method NIOSH 7400-A rules. Units of Measurement: Flow rate = Liters/min; Volume = Liters; OLD = Overloaded; For laboratory, Sr' Values: Range 1 =.71, Range 2 =.37, Range 3 =.28 where Sr'=f/mm².

Note: Unless noted otherwise, samples are received in fair condition but may not account for fibers lost through transportation. Field blanks having greater than 7 fibers per 100 graticule fields, and/or box blanks having greater than 5 fibers per 100 graticule fields may indicate contamination bias of samples drawn within/from the same batch. When blanks are not provided the laboratory assumes a blank count of zero to complete necessary calculations. The laboratory uses volume related calculations when provided by the customer and is not responsible for the accuracy of those calculations. The base calculation for the limit of detection at 5.5 fibers counted (or less) per 100 FOV in a dust/debris-free environment is:

$$\text{Fibers/mm}^2 = [(5.5 \text{ fibers}/100 \text{ FOV}) - (\text{field blank fibers}/\text{Field Blank FOV Counts})] / \text{Afov}; \text{ where Afov} = 0.00785 \text{ mm}^2.$$

$$\text{Fibers/cc} = [(\text{fibers/mm}^2 \times \text{Ac}) / (\text{Sample volume} \times 1000)]; \text{ where Ac} = \text{collectable area of the filter.}$$

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Certificate of Analysis
Lead in Air
 SOP IV.6.1c/IV.5c

tel - 714-607-5227
 free - 855-968-7522
 OCLab@patriotlab.com
 1041 S. Placentia Avenue, Fullerton, CA 92831



NorthStar Contracting Group, Inc.
 13320 Cambridge Street
 Santa Fe Springs, CA 90670

Report Number: 918568
 Project Number: 6622021
 Project Name: 2299 Pacific Ave
 Project Location: 2299 Pacific Ave
 LB, CA

Date Collected: 6/22/2022
 Date Received: 6/24/2022
 Date Analyzed: 6/24/2022
 Date Reported: 6/25/2022

Collected By: Phillip Walker
 Claim Number:
 PO Number:
 Number of Samples: 3

Lab/Client ID	Location	Material Description	Volume (m ³)	Result (µg/m ³)
918568-001 1	Teodosio Zaldivar 661085 Half Face South Curb Abate Paint Mech	Lead Air Sample	0.693	<8.7
918568-002 2	Blank	Lead Air Sample		<6.0
918568-003 3	Blank	Lead Air Sample		<6.0

8hr TWA for Teodosio Zaldivar = 4.0 µg/m³

Ian Reyes - Analyst

Kwin Sheena Legaspi - Approved By

Reporting Limit: 6 µg/filter or 6µg/m³ for a 1000L sample under normal preparatory conditions. Reporting limit may change depending on the volume of air sampled and/or final preparatory dilution. OSHA 8hr-Action Level 30µg/m³, OSHA 8hr-PEL 50µg/m³ (Reference OSHA 1910.1025). Results for samples lacking volume of air drawn or sampling time and flow rate information are reported as µg/filter. Condition of samples as received is fair unless otherwise noted. The results reported may not be representative of other locales and time frames, and pertain only to the items tested. Test data are accurate to two significant figures. Data have not been corrected with instrument or process blanks. Unless otherwise noted, the reported test results have passed necessary quality control requirements. Reference Method: NIOSH 7082/EPA 7420. This report was issued by a DOHS ELAP (Lab No-2540) accredited laboratory and may not be reproduced, except in full, without the expressed written consent of Patriot Environmental Laboratory Services, Inc. This report must not be used to claim product certification, approval or endorsement by DOHS ELAP or any government agency.

Certificate of Analysis

Lead in Air

SOP IV.6.1c/IV.5c

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 free - 855-968-7522
 OCLab@patriotlab.com
 1041 S. Placentia Avenue, Fullerton, CA 92831



NorthStar Contracting Group, Inc.
 13320 Cambridge Street
 Santa Fe Springs, CA 90670

Report Number: 918571
 Project Number: 6622021
 Project Name: 2299 Pacific Ave
 Project Location: 2299 Pacific Ave
 LB, CA

Date Collected: 6/23/2022
 Date Received: 6/24/2022
 Date Analyzed: 6/24/2022
 Date Reported: 6/25/2022

Collected By: Phillip Walker
 Claim Number:
 PO Number:
 Number of Samples: 5

Lab/Client ID	Location	Material Description	Volume (m ³)	Result (µg/m ³)
918571-001 1	Jose Lopez 661170 Half Face SW Exterior Bldg Abate LBP Mech	Lead Air Sample	0.410	<15
918571-002 2	Jose Lopez 661170 Half Face NW Interior Bldg Chemical Removal	Lead Air Sample	0.236	<25
918571-003 3	Jose Lopez 661170 Half Face Restrooms Ceramic Tile	Lead Air Sample	0.315	<19
918571-004 4	Blank	Lead Air Sample		<6.0
918571-005 5	Blank	Lead Air Sample		<6.0

8hr TWA for Jose Lopez = 12 µg/m³

Ian Reyes - Analyst

Kwin Sheena Legaspi - Approved By

Reporting Limit: 6 µg/filter or 6µg/m³ for a 1000L sample under normal preparatory conditions. Reporting limit may change depending on the volume of air sampled and/or final preparatory dilution. OSHA 8hr-Action Level 30ug/m³, OSHA 8hr-PEL 50ug/m³ (Reference OSHA 1910.1025). Results for samples lacking volume of air drawn or sampling time and flow rate information are reported as µg/filter. Condition of samples as received is fair unless otherwise noted. The results reported may not be representative of other locales and time frames, and pertain only to the items tested. Test data are accurate to two significant figures. Data have not been corrected with instrument or process blanks. Unless otherwise noted, the reported test results have passed necessary quality control requirements. Reference Method: NIOSH 7082/EPA 7420. This report was issued by a DOHS ELAP (Lab No-2540) accredited laboratory and may not be reproduced, except in full, without the expressed written consent of Patriot Environmental Laboratory Services, Inc. This report must not be used to claim product certification, approval or endorsement by DOHS ELAP or any government agency.

Certificate of Analysis
Phase Contrast Microscopy
SOP IV.2/IV.3

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 free - 855-968-7522
 OCLab@patriotlab.com
 1041 S. Placentia Avenue, Fullerton, CA 92831



NorthStar Contracting Group, Inc.
 13320 Cambridge Street
 Santa Fe Springs, CA 90670

Report Number: 918830
 Project Number: 6622021
 Project Name: 2299 Pacific Ave
 Project Location: 2299 Pacific Ave
 LB, CA

Date Collected: 6/23/2022
 Date Received: 6/25/2022
 Date Analyzed: 6/25/2022
 Date Reported: 6/25/2022

Collected By: Phillip Walker
 Claim Number:
 PO Number:
 Number of Samples: 4
 Job Type: ACM Roof Abate Mastic

Lab/ Client ID	Sample Activity	Flow Rate	Volume	Fiber Count	Field Count	Blank Count	Result f/cc	Result f/mm ²
918830-001	1 Teodosio Zaldivar 661083 Half Face Roof	2.00	60.0				NA- OLD	
918830-002	2 Teodosio Zaldivar 661083 Half Face Roof	1.64	311.6				NA- OLD	
918830-003	3 Field Blank			1.0	100			
918830-004	4 Field Blank			1.5	100			
918830-001	Overloaded with Debris							
918830-002	Overloaded with Debris							

Anna Portillo - Analyst

Kwin Sheena Legaspi - Approved By

Reference method NIOSH 7400-A rules. Units of Measurement: Flow rate = Liters/min; Volume = Liters; OLD = Overloaded; For laboratory, Sr' Values: Range 1 = .71, Range 2 = .37, Range 3 = .28 where Sr=f/mm².

Note: Unless noted otherwise, samples are received in fair condition but may not account for fibers lost through transportation. Field blanks having greater than 7 fibers per 100 graticule fields, and/or box blanks having greater than 5 fibers per 100 graticule fields may indicate contamination bias of samples drawn within/from the same batch. When blanks are not provided the laboratory assumes a blank count of zero to complete necessary calculations. The laboratory uses volume related calculations when provided by the customer and is not responsible for the accuracy of those calculations. The base calculation for the limit of detection at 5.5 fibers counted (or less) per 100 FOV in a dust/debris-free environment is:

$$\text{Fibers/mm}^2 = [(5.5\text{fibers}/100\text{FOV}) - (\text{field blank fibers}/\text{Field Blank FOV Counts})] / \text{Afov}; \text{ where Afov} = 0.00785 \text{ mm}^2.$$

$$\text{Fibers/cc} = [(\text{fibers/mm}^2 \times \text{Ac}) / (\text{Sample volume} \times 1000)]; \text{ where Ac} = \text{collectable area of the filter.}$$

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Manifest

Attachment F



UNIFORM HAZARDOUS WASTE MANIFEST		1. Generator ID Number CAC003183875	2. Page 1 of 1	3. Emergency Response Phone 866-437-3684	4. Manifest Tracking Number 024261291 JJK		
5. Generator's Name and Mailing Address 2299 PACIFIC AVE LLC 2600 INDUSTRY WAY LYNWOOD CA 90262			Generator's Site Address (if different than mailing address) 2299 PACIFIC AVE LLC 2299 PACIFIC AVE LONG BEACH CA 90806				
Generator's Phone: 510 537 4610							
6. Transporter 1 Company Name IDR ENVIRONMENTAL SERVICES			U.S. EPA ID Number CAD981377864				
7. Transporter 2 Company Name VLS SAN DIEGO LLC			U.S. EPA ID Number CAR000327627				
8. Designated Facility Name and Site Address US ECOLOGY NEVADA, INC HWY 95, 11 MILES SOUTH OF BEATTY BEATTY NV 89003			U.S. EPA ID Number NVT330010000				
Facility's Phone: 800 293 3043							
9a. HM	9b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	10. Containers		11. Total Quantity	12. Unit Wt./Vol.	13. Waste Codes	
		No.	Type				
X	NA3077, Hazardous waste, solid, n.o.s. (Lead), 9, PGIII	1	DM	125	P	D008	181
14. Special Handling Instructions and Additional Information 1) ERG#171 Lead Paint Chips & PPE (1, x55DM) 070128303-14938							
15. GENERATOR'S/OFFEROR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. If export shipment and I am the Primary Exporter, I certify that the contents of this consignment conform to the terms of the attached EPA Acknowledgment of Consent. I certify that the waste minimization statement identified in 40 CFR 262.27(a) (if I am a large quantity generator) or (b) (if I am a small quantity generator) is true.							
Generator's/Offeror's Printed/Typed Name On behalf of ERC Helio Escobedo						Signature <i>[Signature]</i>	
						Month Day Year 17 12 22	
16. International Shipments <input type="checkbox"/> Import to U.S. <input type="checkbox"/> Export from U.S. Port of entry/exit: _____ Date leaving U.S.: _____							
17. Transporter Acknowledgment of Receipt of Materials							
Transporter 1 Printed/Typed Name Albert Matute			Signature <i>[Signature]</i>			Month Day Year 17 27 22	
Transporter 2 Printed/Typed Name Miguel Gutierrez			Signature <i>[Signature]</i>			Month Day Year 18 16 22	
18. Discrepancy							
18a. Discrepancy Indication Space <input type="checkbox"/> Quantity <input type="checkbox"/> Type <input type="checkbox"/> Residue <input type="checkbox"/> Partial Rejection <input type="checkbox"/> Full Rejection							
Manifest Reference Number:						U.S. EPA ID Number	
18b. Alternate Facility (or Generator)						U.S. EPA ID Number	
Facility's Phone:							
18c. Signature of Alternate Facility (or Generator)						Month Day Year	
19. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)							
H132		2		3		4	
20. Designated Facility Owner or Operator: Certification of receipt of hazardous materials covered by the manifest except as noted in item 18a							
Printed/Typed Name Stephanie Collins						Signature <i>[Signature]</i>	
						Month Day Year 18 12 22	

NON-HAZARDOUS WASTE MANIFEST

1. Generator ID Number
CAC003183875

2. Page 1 of
1

3. Emergency Response Phone
866-437-3684

4. Waste Tracking Number
71859

5. Generator's Name and Mailing Address
2299 PACIFIC AVE LLC
2600 INDUSTRY WAY
LYNWOOD DC 90262

Generator's Site Address (if different than mailing address)
2299 PACIFIC AVE LLC
2299 PACIFIC AVE
LONG BEACH CA 90806

Generator's Phone: 310 537-4610

6. Transporter 1 Company Name
IDR ENVIRONMENTAL SERVICES

U.S. EPA ID Number
CAD981377864

7. Transporter 2 Company Name

U.S. EPA ID Number

8. Designated Facility Name and Site Address
SOUTH YUMA COUNTY LANDFILL
19536 S. AVE IE
YUMA AZ 85366

U.S. EPA ID Number

Facility's Phone: 928 341-9300

AZR000506980

9. Waste Shipping Name and Description

10. Containers

11. Total Quantity

12. Unit WL/Vol.

No. Type

1. Non- Hazardous waste, solid (Non-Friable Asbestos)

3.

CF

1,500.

P

2.

3.

4.

13. Special Handling Instructions and Additional Information
1) Non-Friable Asbestos-C-4615 (3 xCF)

14. GENERATOR'S/OFFEROR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations.

Generator's/Offeror's Printed/Typed Name

Signature

Month Day Year

Koncha HOFERL Melitona Escarido

INT'L

15. International Shipments Import to U.S. Export from U.S.

Port of entry/exit:

Date leaving U.S.:

Transporter Signature (for exports only):

TRANSPORTER

16. Transporter Acknowledgment of Receipt of Materials

Transporter 1 Printed/Typed Name

Signature

Month Day Year

Albert Matazo

Signature

Month Day Year

Transporter 2 Printed/Typed Name

DESIGNATED FACILITY

17. Discrepancy

17a. Discrepancy Indication Space

Quantity

Type

Residue

Partial Rejection

Full Rejection

Manifest Reference Number:

U.S. EPA ID Number

Facility's Phone:

17c. Signature of Alternate Facility (or Generator)

Month Day Year

18. Designated Facility Owner or Operator: Certification of receipt of materials covered by the manifest except as noted in item 17a

Printed/Typed Name

Signature

Month Day Year

Comerich Bowers

[Signature]

8/10/22

Worker Documentation

Attachment G



EPA ACCREDITED

Nº 54334
AHERA APPROVED



OCCUPATIONAL TRAINING INSTITUTE, INC.

BE IT KNOWN TO ALL THAT

Salvador Garcia Sanchez

HAS SUCCESSFULLY COMPLETED A 1 DAY COURSE AND, AFTER PASSING

THE REQUIRED EXAMINATION, IS AWARDED THIS CERTIFICATE

ON
January 15, 2022

FOR
ASBESTOS ABATEMENT
WORKER TRAINING - ANNUAL REFRESHER
(SPANISH INSTRUCTION)

COURSE DATES: January 15, 2022

EXAM DATE: January 15, 2022

AAWT-R-13566-22

Nubia Ayala-Director

ACCREDITATION NO.

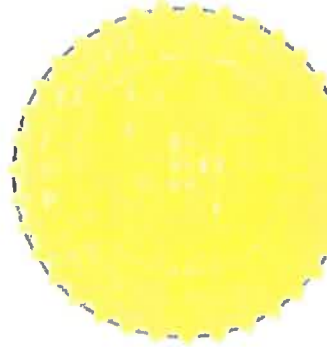
AUTHORIZED SIGNATURE

January 15, 2023

Nubia Ayala

EXPIRATION DATE

EXAM ADMINISTRATOR
DOSH APPROVAL #CA-017-12



For purposes of accreditation required under the provisions of the Toxic Substances Control Act (TSCA)
Occupational Training Institute, Inc. OCCUTRAIN, 621 Atlantic Ave. Ste. E. Long Beach, CA 90803 TEL: # 562-612-3109

BELLA MEDICAL GROUP INC
9916 SAN JUAN AVE.
SOUTH GATE, CA 90280
TEL (323)564-1100 FAX (323) 564-1133
FITNESS FOR DUTY FORM

DATE OF EXAM: 01/24/2022

NAME: SAAVEDRA RICARDO DOB: 01/29/1983 AGE: 38 YEARS OLD SSN: XXX-XX-XXXX

TYPE OF EXAMINATION: (X) Pre-Employment (X) Periodic () DOT Overseas () Return to Work
(X) Pulmonary Function (X) Asbestos () others _____

RECOMMENDATIONS:

The following medical recommendation are based on a review of the health history examination finding related tests or studies and the specific physical capacities required for the position applied for or currently held by the examinee.

- (X) The examination indicates no significant pathological condition. Can be assigned to any work consistent with skills training.
- () The examination indicates no-occupational pathological conditions. Can be followed by the personal physician. Can be assigned to any work consistent with skills and training.
- () The examination indicates non- occupational pathological conditions, to be followed by the personal physician. Acceptable for work, but should not be assigned without a review from Medical Department.
- () The examination indicates that a pathological condition exist which work assigned as follows:
 - (X) Medically qualified w/no restrictions / no x-ray needed

- | | |
|------------------------|---------------------------------------|
| () Lifting over _____ | () Use of hearing protection devices |
| () Walking | () Use of correction lenses |
| () Climbing | () Work above ground |
| () Bending | () Shift/Overtime work |
| () Driving | () Operating machinery |
| () Temp Limits | () Operating machinery |
| () others _____ | |

- () Eligible for expatriate assignment or overseas travel.
- () Results of audiometric exam indicates significant threshold shift since baseline audiogram. Advised to wear hearing protection. Audiogram () to be () not to be repeated
- () Results of audiometric exam indicated moderate hearing loss. Advised to wear hearing protection
- () Does not meet criteria for employment at this time

CERTIFICATION:

- (X) Approved for work with hazardous material
- (X) Approved for use of respirators
- (X) Approved for use of personal protective equipment
- (X) Medical qualified test completed.
- () Audiometric test completed.
- () Mechanical visual screening completed.
- (X) No pathological condition has been detected in the above name individual that place him at risk material impairment form exposure to: _____
- (X) The patient has been informed of this physical examination

Bella Medical Group
9916 San Juan Ave
South Gate CA 90280
(323) 564-1100

Maria Lourdes De Leon M.D
Sergio Sandoval PA-C

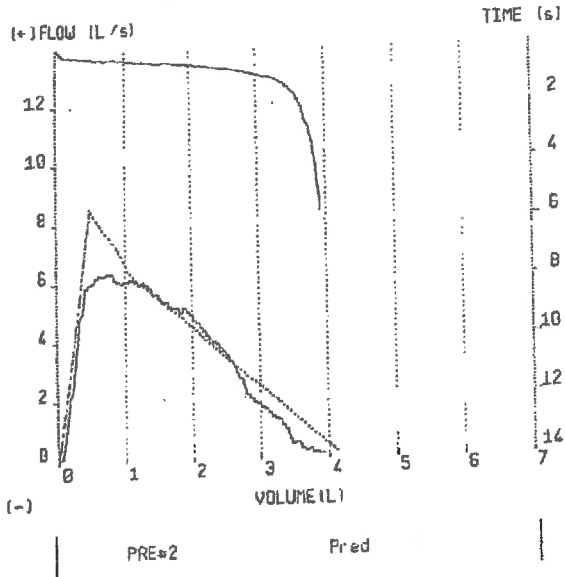
Maria Lourdes De Leon

MARIA LOURDES C DE LEON M.D

BELLA MEDICAL GROUP

Test Date 01/27/2022 15:13 RIPS 1 092 NHANES
 Name SARVEDRA RICARDO
 Birth Date 01/29/1983 #ID 01821
 Age 38 Height in 63 Weight lb 157 Gender M
 Origin Mexican-American Predicted NHANES
 PRE File N° 182

FLOW-VOLUME & VOLUME-TIME curves



PARAMETER	Predicted	PRE #2	ZPred
FEV6	L 4.05	3.92	97
FEV1	L 3.38	3.40	101
FEV1/FEV6	% 83.6	86.7	104
PEF	L/s 8.60	6.39	74
FEF25-75	L/s 3.55	4.02	113
FVC	L 4.20	3.92	93
FEV1/FVC	% 81.7	86.7	106

INTERPRETATION:
 Normal Spirometry

QUALITY CONTROL GRADE: D

REPEATABILITY: FVC, FEV1

Made by spirolab Ver 4.6

SN J05951

MARIA LOURDES C. DE LEON M.D.

Bella Medical Group
 9916 San Juan Ave
 South Gate CA 90280
 (323) 564-1100
 Maria Lourdes De Leon M.D.
 Sergio Sandoval PA-C

RESPIRATOR FIT-TEST AND TRAINING RECORD

Employee's Name:

Salvador Garcia

Social Security No.: **Last 4 Digits:

6517

RESPIRATOR FIT-TEST SUMMARY

(A separate Fit-Test must be performed for each Negative Pressure Respirator used)

Fit-Test Date:	<u>6-16-2022</u>	Person Conducting Fit-Test:	<u>Ramon Rivera</u>
Respirator Selected for Test:	<u>1/2 Face</u>		
Manufacturer:	<input checked="" type="checkbox"/> North <input type="checkbox"/> 3M <input type="checkbox"/> Survive Air <input type="checkbox"/> Other	Model:	<input type="checkbox"/> 3100 <input type="checkbox"/> 5200 <input type="checkbox"/> 5400 <input type="checkbox"/> 6800 <input type="checkbox"/> 6900 <input type="checkbox"/> 7000 <input checked="" type="checkbox"/> 7700 <input type="checkbox"/> Optim Air <input type="checkbox"/> Other: _____
Respirator Size:	<input type="checkbox"/> Small <input checked="" type="checkbox"/> Medium <input type="checkbox"/> Large	Was Rainbow Passage Used:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Type of Fit-Test:	<input checked="" type="checkbox"/> Qualitative (Odor) <input type="checkbox"/> Quantitative (Machine)		
Type of Agent Used:	<u>Irritant Smoke</u>	FIT-TEST: <input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed	

Signature of Person Performing Fit-Test:

Ramon Rivera

RESPIRATOR TRAINING RECORD

Your signature on this Respirator Training Record will attest to your having received and understood the following respirator training information which both OSHA and Northstar require as a part of their Respiratory Protection Program.

The required respirator training consists of the following information:

- o An explanation of the problems involved in misusing or inter-changing parts of the respirator.
- o A discussion of why engineering controls could not prevent the use of respiratory protection.
- o How and why this make and model respirator was chosen for this specific project.
- o The limitations of this make and model respirator.
- o How to put on this respirator and properly adjust the facepiece and tension straps.
- o How to wear this respirator properly.
- o What the essential points of the care and maintenance of this respirator are.
- o How to recognize and handle emergencies which may occur while using this respirator.
- o How to properly inspect, clean and disinfect this respirator.
- o How to properly use an Air-Purifying Respirator.
- o When a Powered Air-Purifying Respirator is required.
- o When a Type-C supplied-air respirator is required.
- o The purpose of the medical evaluation.
- o How Northstar performs a proper respirator fit-test.
- o That this fit-test must be performed annually.
- o That you will be permitted to leave the work area to wash your face and respirator whenever necessary.
- o That filter elements may be changed whenever an increase in breathing resistance is detected.
- o That a Powered Air-Purifying Respirator (PAPR) is available to you upon request, as long as it meets the protection factor for the hazard involved.

Employee Signature:

Salvador Garcia

Date:

6-16-22



Certificate of Attendance

CERTIFICATE NUMBER
87314

This is to Certify that

JOSE LOPEZ

Has Completed the Course of

AHERA ASBESTOS ABATEMENT WORKER 8 HR. REFRESHER COURSE (SPANISH) CA-014-12

UNDER TSCA 206 FOR PURPOSES OF COMPLIANCE WITH 29 CFR 1926.101 AND
TITLE 8, 3279 AND TITLE 8, 32720.

ARMANDO DUCCING
Director

May 14, 2022
Completion Date

F051422SWR 051422
Class Number / Starting Date

May 14, 2023
Certificate Expires

Ecologics Training Institute

Concentra Occupational Med Ctrs-CA

1313 W 8th St Ste 100 Los Angeles, CA 90017 Service Date: 05/13/2022
 Phone: (213) 401-1970 Fax: (213) 401-1980

WRITTEN MEDICAL OPINION (SINGLE OR MULTI-EXPOSURE)

To be maintained in patient's medical chart with copy to employer and patient.

EMPLOYEE NAME: Lopez, Jose EMPLOYER NAME: LIUNA Local 300-Los Angeles
 DOB: 11/26/1970 EMPLOYER CONTACT: _____
 Last 4 SSN: _____ CONTACT PHONE: _____
 JOB TITLE: _____

NOTES:

This document does not replace mandated state forms where applicable.
 Employer form shall not be substituted for this written medical opinion that is determined to be OSHA and/or EPA compliant for listed exposures.
 If requested or preferred by employer, exposure specific WMO forms available to print on MyConcentra may be used alternatively.

29 CFR 1926 Construction 29 CFR 1910 General & Maritime Other _____

Check applicable exposure(s) for Written Opinion: (check all that apply)

This form does not replace Silica or Beryllium Written Medical Opinions or Reports that print from Concentra OccuSource at registration for those exposures.

<input checked="" type="checkbox"/> Asbestos	<input type="checkbox"/> Pesticides	<input type="checkbox"/> Cadmium	<input type="checkbox"/> Lead	<input type="checkbox"/> Hazwoper/Hazmat
<input type="checkbox"/> Acrylonitrile	<input type="checkbox"/> Benzene	<input type="checkbox"/> Manganese	<input type="checkbox"/> Zinc Oxide	<input type="checkbox"/> Inorganic Mercury
<input type="checkbox"/> Arsenic	<input type="checkbox"/> Diesel Exhaust	<input type="checkbox"/> Ethylene Oxide	<input type="checkbox"/> Formaldehyde	<input type="checkbox"/> Methylene Chloride
<input type="checkbox"/> Polychlorinated biphenyls	<input type="checkbox"/> 1,3- Butadiene	<input type="checkbox"/> Hexavalent Chromium	<input type="checkbox"/> Xylene/Toluene	<input type="checkbox"/> Metal Working Fluid
<input type="checkbox"/> Other (specify): _____				

The following were performed: (check all that apply)

- Medical examination, including a medical and work history with special emphasis on body symptoms related to the above marked exposure(s).
- Completion and review of the OSHA questionnaire(s) (asbestos, benzene, cadmium, formaldehyde, methylene chloride, cotton dust, and 1,3 -butadiene, vinyl chloride).
- Pulmonary function test, including forced vital capacity (FVC) and forced expiratory volume at one second (FEV1) in accordance with NIOSH and ATS standards. Monitor for 10-15% decline in FEV1.

1 view PA chest x-ray. (B read using ILO standards required for asbestos)

Periodic chest x-ray schedules: Arsenic- annually; Cadmium- baseline and clinician's discretion; Asbestos - see chart below:

Years since first exposure	Age 15-35	Age 36-45	Age 45+
0 to 10	Every 5 years	Every 5 years	Every 5 years
10 +	Every 5 years	Every 2 years	Every 1 year

- All medical examinations and procedures were performed by or under the supervision of a licensed physician.
- The employee has been informed of the results of the medical examination and/or biologic monitoring and any medical conditions which require further examination or treatment.
- The employee has been informed of the increased risk of lung cancer attributable to the combined effect of smoking and asbestos exposure if indicated.

The content of medical examination was determined by the physician or licensed health care provider (PLHCP) based on the following information provided by the employer (check only items available or provided):

- Description of employee's duties
- Information from previous medical examinations dated _____ not performed at Concentra
- Description of personal protective equipment used or to be used
- Employee's exposure levels or anticipated levels

WRITTEN MEDICAL OPINION (SINGLE OR MULTI-EXPOSURE)

To be maintained in patient's medical chart with copy to employer and patient.

EMPLOYEE NAME: Lopez, Jose EMPLOYER NAME: LiUNA Local 300-Los Angeles
 DOB: 11/26/1970 EMPLOYER CONTACT: _____
 Last 4 SSN: _____ CONTACT PHONE: _____
 JOB TITLE: _____

Biologic Monitoring:

Blood Lead Level/ZPP ⁱ _____/_____	<input type="checkbox"/> Was performed and results are normal <input type="checkbox"/> Was not done <input type="checkbox"/> Results indicate: _____ <input type="checkbox"/> Reevaluation date: _____
Urine Mercury Testing ⁱⁱ Benzene CBC Testing ⁱⁱⁱ Other _____	<input type="checkbox"/> Was performed and results are normal <input type="checkbox"/> Was not done <input type="checkbox"/> Results indicate: _____ <input type="checkbox"/> Reevaluation date: _____
Cadmium ^{iv} _____/_____/_____	<input type="checkbox"/> Was performed and results are normal <input type="checkbox"/> Was not done <input type="checkbox"/> Results indicate: _____ <input type="checkbox"/> Reevaluation date: _____
Acetylcholinesterase(RBC and plasma) ^v _____/_____	<input type="checkbox"/> Was performed and results are normal <input type="checkbox"/> Was not done <input type="checkbox"/> Results indicate: _____ <input type="checkbox"/> Reevaluation date: _____

Other Labs: _____

This medical monitoring evaluation indicates (check all that apply):

- There are no detected medical conditions which would place the employee at an increased risk of material health impairment from exposure to the marked exposures.
- There is/are detected medical condition(s) which would place the employee at an increased risk of material health impairment from exposure to the above marked exposures.
- There are no limitations upon the employee's use of personal protective clothing or equipment, including respirators. *For methylene chloride, this includes the use of a supplied-air respirator in the negative-pressure mode, or a gas mask with an organic-vapor canister for emergency escape.*
- The following restrictions or limitations are indicated: *(do not include PHI)* _____

Brenda Barth [Signature] 5/13/20
 Clinician's Name (printed) Signature of Examining Clinician Date

Physician signature cosign: _____ Date: _____

ⁱ OSHA: if BLL <40, every 6 months; if >40, <60 repeat every 2 months, until less than 40 for 2 draws; >60 (Repeat in 2 weeks to confirm) or if avg of last 3 samples is >50 mandatory removal until testing <40. ACOEM/Concentra: BLL > 10 no exposure if pregnant; BLL >20 x2 or >30 no exposure. See Concentra's Lead Exposure Clinical Guidance
ⁱⁱ Every 6 months if <PEL, every 3 months if > PEL; test weekly if total mercury level > 0.200 mg of mercury/liter of urine, or 0.02 mg of elemental mercury/liter of urine. If not decreasing in 2-4 weeks, advise specialist consult
ⁱⁱⁱ Required repeat at 2 week if H/H and Platelet count 20% of prior testing or abnormal, WBC 4,000 mm³ or abn diff
^{iv} Beta 2 microglobulin, cadmium blood and random urine with creatinine. See Concentra's Cadmium ESPS for bio monitoring frequency
^v Baseline prior to handling pesticides (2 separate draws). Follow-up testing within 3 days for pesticide use >6 days in any 30 day period beginning on the first day of handling, for total of three consecutive qualifying periods. Follow-up testing at 60 day intervals after three qualifying periods, unless otherwise specified. Baseline values every 2 years. CAL-OSHA. EPA.

RESPIRATOR FIT-TEST AND TRAINING RECORD

Employee's Name:

Jose M. Lopez

Social Security No.: **Last 4 Digits:

9642

RESPIRATOR FIT-TEST SUMMARY

(A separate Fit-Test must be performed for each Negative Pressure Respirator used)

Fit-Test Date:	<u>7-5-2022</u>	Person Conducting Fit-Test:	<u>Ramon Rivera</u>
Respirator Selected for Test:	<u>1/2 Face</u>		
Manufacturer:	<input checked="" type="checkbox"/> North <input type="checkbox"/> 3M <input type="checkbox"/> Survive Air <input type="checkbox"/> Other	Model:	<input type="checkbox"/> 3100 <input type="checkbox"/> 5200 <input type="checkbox"/> 5400 <input type="checkbox"/> 6800 <input type="checkbox"/> 6900 <input type="checkbox"/> 7000 <input checked="" type="checkbox"/> 7700 <input type="checkbox"/> Optim Air <input type="checkbox"/> Other: _____
Respirator Size:	<input type="checkbox"/> Small <input checked="" type="checkbox"/> Medium <input type="checkbox"/> Large	Was Rainbow Passage Used:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Type of Fit-Test:	<input checked="" type="checkbox"/> Qualitative (Odor) <input type="checkbox"/> Quantitative (Machine)		
Type of Agent Used:	<u>Irritant Smoke</u>	FIT-TEST: <input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed	

Signature of Person Performing Fit-Test:

Ramon Rivera

RESPIRATOR TRAINING RECORD

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- o That this fit-test must be performed annually.
- o That you will be permitted to leave the work area to wash your face and respirator whenever necessary.
- o That filter elements may be changed whenever an increase in breathing resistance is detected.
- o That a Powered Air-Purifying Respirator (PAPR) is available to you upon request, as long as it meets the protection factor for the hazard involved.

Employee Signature:

[Signature]

Date:

7-5-22

Certificate of Completion

Asbestos Contractor/Supervisor Refresher Course

DOSH #:CA-015-04

Octavio Olivares

Last 4 digits of SSN: 1955

ASR0818210008N27089

Guillermo Renteria

Principal Instructor

8/18/2021

Course Start Date

8/18/2021

Course End Date

8/18/2021

Exam Date

8/18/2022

Expiration Date

This course satisfies the education requirements for Asbestos accreditation under the Toxic Substances Control Act, Title II. This course has been approved by the Department of Industrial Relations, Division of Occupational Safety and Health of the State of California



Michael W. Horner

Training Director



NATEC International, Inc.

National Association of Training and Environmental Consulting

1100 Technology Circle- Suite A, Anaheim, CA 92805 • www.natecintl.com • 800-969-3228

Important Industry Contacts

CAL-OSHA: Ph# (916) 574-2993
(916) 483-0572 Fax Notification
web: www.dir.ca.gov or calosha.com

CDPH/CLPPB: Ph# (510) 620-5600
web: www.cdph.ca.gov/programs/CLPPB

SCAQMD: Ph# (909) 396-3739
Fax#(909) 396-3342

BAAQMD: Ph# (415) 749-4762

NATEC International, Inc.

National Association of Training and Environmental Consulting
Anaheim, CA • Oakland, CA • Fresno, CA • Sacramento, CA

Asbestos • Lead • Mold • HAZWOPER

P.O. Box 25205 Anaheim, CA 92825-5205
(714) 678-2750, (800) 969-3228, Fax (714) 678-2757

www.natecintl.com

NATEC International, Inc.

National Association of Training and Environmental Consulting
*Note: Card is not suitable substitute for certificate and is not accepted by SCAQMD as proof of certification

This Card Acknowledges That
Octavio Olivares

Holds Training Certification For
Asbestos Contractor/Supervisor Refresher Course

Expiration: 8/18/2022

8/18/2021

Training Date ASR0818210008N27089
Certificate No.

Michael W. Horner

Training Director



STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC HEALTH



LEAD-RELATED CONSTRUCTION CERTIFICATE

INDIVIDUAL:	CERTIFICATE TYPE:	NUMBER:	EXPIRATION DATE:
	Lead Worker	LR-00001600	6/18/2022

Octavio Olivares

Disclaimer: This document alone should not be relied upon to confirm certification status. Compare the individual's photo and name to another valid form of government issued photo identification. Verify the individual's certification status by searching for Lead-Related Construction Professionals at www.cdph.ca.gov/programs/lepb or calling (800) 597-LEAD.

LEAD SAFETY FOR RENOVATION, REPAIR & PAINTING INITIAL - ENGLISH

Octavio Olivares

CERT #: R-I-19157-20-00884

Training Date: 12/05/2020

Exam Date: 12/05/2020

Expiration: 12/05/2025

Address: 8799 Grove Ave, Rancho Cucamonga CA 91730



Michael W. Horner
Michael W. Horner, Training Director

This course meets or exceeds the requirements in 40 CFR Section 745.225



NATEC International, Inc.

1100 Technology Circle, Suite A, Anaheim, CA 92805 | 8390 Capwell Drive, Oakland, CA 94621

800-969-3228 | www.NATECIntl.com



34-003350065

This card acknowledges that the recipient has successfully completed a
10-hour Occupational Safety and Health Training Course in
Construction Safety and Health

OCTAVIO OLIVARES

PAUL R ZAMBRANO

09/12/2013

(Trainer name – print or type)

(Course end date)

OSHA recommends Outreach Training courses as an orientation to occupational safety and health for workers. Participation is voluntary. Workers must receive additional training on specific hazards of their job. This course completion card does not expire.

- *Introduction to OSHA-*
- *Fall Protection, Subpart M.-*
- *Electrical, Subpart K-*
- Lockout/Tagout.
- *Struck by (e.g.-Falling objects) Caught in/between (e.g.-trench hazards, equipment).*
- Personal Protective Equipment- Subpart E.-*
- Health Hazards in Construction/Demolition Activities-
- *Noise Hazards.-*
- Tools: Hand/Power, Subpart I.
- *Scaffolds, Subpart L.-*
- Excavations, Subpart P.-*
- Stairways and Ladders Subpart X.
- *Forklift and Aerial Lift Operator Safety Procedures-*
- Cutting Torch Safety-Hot Work Permit-
- * I.I.P-Program Procedures-*
- Confined Spaces -Enter Permit-*
- Hazard Communication- M.S.D.S.-Instructions.

For further information see our web site at www.osha.gov/outreach.html

Concentra Occupational Med Ctrs-CA
2171 S Grove Ave Ste A Ontario, CA 91761
Phone: (909) 923-4080 Fax: (909) 930-0704

Written Medical Opinion for Respirator Use

(Provide a copy to employee and employer, store in chart)

Medical evaluation for respirator use was completed in accordance with 29 CFR 1910.134.

(La evaluación médica y opinión para el uso de respiradores se completó de acuerdo con 29 CFR 1910.134)

This evaluation indicates employee may wear the type(s) of respirator(s) checked below. There are no recommended limitations upon the workplace conditions in which the respirator will be used unless remarked in Comments section. Please note: If additional/new types of respirator(s) are utilized in the future, a new respirator medical clearance is required. (Esta evaluación indica que el empleado puede usar el tipo (s) de respirador (es) que se muestra a continuación. No hay limitaciones recomendadas sobre las condiciones del lugar de trabajo en las que se usará el respirador, a menos que se indique lo contrario en la sección Comentarios. Tenga en cuenta: Si en el futuro se utilizan más / nuevos tipos de respiradores, se requiere una nueva autorización médica para respiradores.)

- Disposable N, P or R. 95, 99 or 100 filtering face piece (Desechable pieza facial filtrante)
- Half face respirator with particulate gas/vapor cartridges (Respirador de media cara con cartuchos de partículas de gas / vapor)
- Full face respirator with particulate gas/vapor cartridges (Respirador de cara completa con cartuchos de gas / vapor de partículas)
- Self-contained breathing apparatus (SCBA) (Un equipo de respiración autónomo)
- Supplied air (loose fitting) (Aire suministrado (ajuste suelto))

The employee may not wear a respirator. (El empleado no puede usar un respirador.)

Employee must schedule a medical examination prior to respirator approval and usage. (Programar un examen médico antes de la aprobación del respirador)

The following restrictions or limitations are indicated (Se indican las siguientes restricciones o limitaciones):

- Positive air purifying respirator (PAPR) (Respirador purificador de aire positivo)
- No emergency response or immediately dangerous to life and health (IDLH) work (Trabajo sin respuesta de emergencia o peligro inmediato para la vida y la salud)
- Other (otro): _____

The employee has been informed of the results of this evaluation and any medical conditions which require further examination or treatment and they were provided with a copy of this written statement: (El empleado ha sido informado de los resultados de esta evaluación y de cualquier condición médica que requiera un examen o tratamiento adicional y se les proporcionó una copia de esta declaración por escrito.)

- In person (En persona)
- In writing (Questionnaire review only, without the employee present) (escrito solo una revisión del Cuestionario, empleado no presente)

This medical evaluation expires on (Esta evaluación médica expira el): 8/12/22

Employees are to report any difficulties in respirator use or change in health status to their supervisor, physician or licensed health care provider. (Los empleados deben informar cualquier dificultad en el uso del respirador o cambio en el estado de salud.)

Comments: (Comentarios)

- Eyewear conversion kit needed. (Se necesita un kit de conversión de gafas.)
- Facial hair needs to be shaved to assure a tight seal on tight fitting masks. (El vello facial debe afeitarse para asegurar un cierre hermético en las máscaras ajustadas.)
- Other (otro): _____

Clinician Name: Tiana Adams Clinician Signature: [Signature] Date: 8/12/22

RESPIRATOR FIT-TEST AND TRAINING RECORD

Employee's Name: Octavio Olivares Social Security No.: **Last 4 Digits: 1995

RESPIRATOR FIT-TEST SUMMARY

(A separate Fit-Test must be performed for each Negative Pressure Respirator used)

Fit-Test Date:	<u>5-13-2022</u>	Person Conducting Fit-Test:	<u>Ramon Rivera</u>
Respirator Selected for Test:	<u>1/2 Face</u>		
Manufacturer:	<input checked="" type="checkbox"/> North <input type="checkbox"/> 3M <input type="checkbox"/> Survive Air <input type="checkbox"/> Other	Model:	<input type="checkbox"/> 3100 <input type="checkbox"/> 5200 <input type="checkbox"/> 5400 <input type="checkbox"/> 6800 <input type="checkbox"/> 6900 <input type="checkbox"/> 7000 <input checked="" type="checkbox"/> 7700 <input type="checkbox"/> Optim Air <input type="checkbox"/> Other: _____
Respirator Size:	<input type="checkbox"/> Small <input checked="" type="checkbox"/> Medium <input type="checkbox"/> Large	Was Rainbow Passage Used:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Type of Fit-Test:	<input checked="" type="checkbox"/> Qualitative (Odor) <input type="checkbox"/> Quantitative (Machine)		
Type of Agent Used:	<u>Irritant Smoke</u>	FIT-TEST: <input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed	

Signature of Person Performing Fit-Test: Ramon Rivera

RESPIRATOR TRAINING RECORD

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- o What the essential points of the care and maintenance of this respirator are.
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- o How Northstar performs a proper respirator fit-test.
- o That this fit-test must be performed annually.
- o That you will be permitted to leave the work area to wash your face and respirator whenever necessary.
- o That filter elements may be changed whenever an increase in breathing resistance is detected.
- o That a Powered Air-Purifying Respirator (PAPR) is available to you upon request, as long as it meets the protection factor for the hazard involved.

Employee Signature: Octavio Olivares

Date: 5/13/22

Certificate of Completion

Asbestos Contractor/Supervisor Refresher Course

DOSH #:CA-015-04

Phillip T. Walker

Last 4 digits of SSN: 4527

ASR0807210009N27087

Guillermo Renteria



Michael W. Horner
Training Director

Principal Instructor

8/7/2021

8/7/2021

8/7/2021

8/7/2022

Course Start Date

Course End Date

Exam Date

Expiration Date

This course satisfies the education requirements for Asbestos accreditation under the Toxic Substances Control Act, Title II. This course has been approved by the Department of Industrial Relations, Division of Occupational Safety and Health of the State of California



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Important Industry Contacts

CAL-OSHA: Ph# (916) 574-2993
 (916) 483-0572 Fax Notification
 web: www.dir.ca.gov or calosha.com

CDPH/CLPPS: Ph# (510) 620-5600
 web: www.cdph.ca.gov/programs/CLPPS

SCAQMD: Ph# (909) 396-3739
 Fax# (909) 396-3342

BAAQMD: Ph# (415) 749-4762

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(714) 678-2750, (800) 969-3228, Fax (714) 678-2757

www.natecintl.com

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National Association of Training and Environmental Consulting
*Note: Card is not suitable substitute for certificate and is not accepted by SCAQMD as proof of certification

This Card Acknowledges That
Phillip T. Walker

Holds Training Certification For
Asbestos Contractor/Supervisor Refresher Course

Expiration: 8/7/2022

8/7/2021
Training Date ASR0807210009N27087
Certificate No.

Michael W. Horner
Training Director



STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC HEALTH



LEAD-RELATED CONSTRUCTION CERTIFICATE

INDIVIDUAL:



Phillip Walker

CERTIFICATE TYPE:

Lead Supervisor

NUMBER:

LRC-00007887

EXPIRATION DATE:

11/19/2022

Disclaimer: This document alone should not be relied upon to confirm certification status. Compare the individual's photo and name to another valid form of government issued photo identification. Verify the individual's certification status by searching for Lead-Related Construction Professionals at www.cdph.ca.gov/programs/clppb or calling (800) 597-LEAD.

OSHA

600182786



U.S. Department of Labor
Occupational Safety and Health Administration

Phillip Walker

has successfully completed a 30-hour Occupational Safety and Health
Training Course in

Construction Safety & Health

Larry Ferguson

(Trainer)

3/31/07

(Date)

Concentra Occupational Med Ctrs-CA
1101 S Milliken Ave Ste C Ontario, CA 91761
Phone: (909) 390-2799 Fax: (909) 390-0929

Written Medical Opinion for Respirator Use

(Provide a copy to employee and employer, store in chart)

Medical evaluation for respirator use was completed in accordance with 29 CFR 1910.134.

(La evaluación médica y opinión para el uso de respiradores se completó de acuerdo con 29 CFR 1910.134)

This evaluation indicates employee may wear the type(s) of respirator(s) checked below. There are no recommended limitations upon the workplace conditions in which the respirator will be used unless remarked in *Comments* section. Please note: If additional/new types of respirator(s) are utilized in the future, a new respirator medical clearance is required. *(Esta evaluación indica que el empleado puede usar el tipo (s) de respirador (es) que se muestra a continuación. No hay limitaciones recomendadas sobre las condiciones del lugar de trabajo en las que se usará el respirador, a menos que se indique lo contrario en la sección Comentarios. Tenga en cuenta: Si en el futuro se utilizan más / nuevos tipos de respiradores, se requiere una nueva autorización médica para respiradores.)*

- Disposable N, P or R, 95, 99 or 100 filtering face piece** *(Desechable pieza facial filtrante)*
- Half face respirator with particulate gas/vapor cartridges** *(Respirador de media cara con cartuchos de partículas de gas / vapor)*
- Full face respirator with particulate gas/vapor cartridges** *(Respirador de cara completa con cartuchos de gas / vapor de partículas)*
- Self-contained breathing apparatus (SCBA)** *(Un equipo de respiración autónomo)*
- Supplied air (loose fitting)** *(Aire suministrado (ajuste suelto))*

The employee may not wear a respirator. *(El empleado no puede usar un respirador.)*

Employee must schedule a medical examination prior to respirator approval and usage.
(Programar un examen médico antes de la aprobación del respirador)

The following restrictions or limitations are indicated *(Se indican las siguientes restricciones o limitaciones):*

- Positive air purifying respirator (PAPR)** *(Respirador purificador de aire positivo)*
- No emergency response or immediately dangerous to life and health (IDLH) work**
(Trabajo sin respuesta de emergencia o peligro inmediato para la vida y la salud)
- Other (otro):** _____

The employee has been informed of the results of this evaluation and any medical conditions which require further examination or treatment and they were provided with a copy of this written statement: *(El empleado ha sido informado de los resultados de esta evaluación y de cualquier condición médica que requiera un examen o tratamiento adicional y se le proporcionó una copia de esta declaración por escrito:)*

- In person** *(En persona)*
- In writing** *(Questionnaire review only, without the employee present)*
(escrito solo una revisión del Cuestionario, empleado no presente)

This medical evaluation expires on *(Esta evaluación médica expira el):* 1/25/23

Employees are to report any difficulties in respirator use or change in health status to their supervisor, physician or licensed health care provider. *(Los empleados deben informar cualquier dificultad en el uso del respirador o cambio en el estado de salud.)*

Comments: *(Comentarios)*

- Eyewear conversion kit needed.** *(Se necesita un kit de conversión de gafas.)*
- Facial hair needs to be shaved to assure a tight seal on tight fitting masks.**
(El vello facial debe afeitarse para asegurar un cierre hermético en las máscaras ajustadas.)
- Other (otro):** _____

Clinician Name: ARuss PA Clinician Signature: [Signature] Date: 1/25/22
RESPCLEARWMO -1

RESPIRATOR FIT-TEST AND TRAINING RECORD

Employee's Name:

Phillip Walker

Social Security No.: **Last 4 Digits:

4527

RESPIRATOR FIT-TEST SUMMARY

(A separate Fit-Test must be performed for each Negative Pressure Respirator used)

Fit-Test Date:	<u>5-13-2022</u>	Person Conducting Fit-Test:	<u>Ramon Rivera</u>
Respirator Selected for Test:	<u>1/2 Face</u>		
Manufacturer:	<input checked="" type="checkbox"/> North <input type="checkbox"/> 3M <input type="checkbox"/> Survive Air <input type="checkbox"/> Other	Model:	<input type="checkbox"/> 3100 <input type="checkbox"/> 5200 <input type="checkbox"/> 5400 <input type="checkbox"/> 6800 <input type="checkbox"/> 6900 <input type="checkbox"/> 7000 <input checked="" type="checkbox"/> 7700 <input type="checkbox"/> Optim Air <input type="checkbox"/> Other: _____
Respirator Size:	<input type="checkbox"/> Small <input checked="" type="checkbox"/> Medium <input type="checkbox"/> Large	Was Rainbow Passage Used:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Type of Fit-Test:	<input checked="" type="checkbox"/> Qualitative (Odor) <input type="checkbox"/> Quantitative (Machine)		
Type of Agent Used:	<u>Irritant Smoke</u>	FIT-TEST: <input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed	

Signature of Person Performing Fit-Test:

Ramon Rivera

RESPIRATOR TRAINING RECORD

Your signature on this Respirator Training Record will attest to your having received and understood the following respirator training information which both OSHA and Northstar require as a part of their Respiratory Protection Program.

The required respirator training consists of the following information:

- o An explanation of the problems involved in misusing or inter-changing parts of the respirator.
- o A discussion of why engineering controls could not prevent the use of respiratory protection.
- o How and why this make and model respirator was chosen for this specific project.
- o The limitations of this make and model respirator.
- o How to put on this respirator and properly adjust the facepiece and tension straps.
- o How to wear this respirator properly.
- o What the essential points of the care and maintenance of this respirator are.
- o How to recognize and handle emergencies which may occur while using this respirator.
- o How to properly inspect, clean and disinfect this respirator.
- o How to properly use an Air-Purifying Respirator.
- o When a Powered Air-Purifying Respirator is required.
- o When a Type-C supplied-air respirator is required.
- o The purpose of the medical evaluation.
- o How Northstar performs a proper respirator fit-test.
- o That this fit-test must be performed annually.
- o That you will be permitted to leave the work area to wash your face and respirator whenever necessary.
- o That filter elements may be changed whenever an increase in breathing resistance is detected.
- o That a Powered Air-Purifying Respirator (PAPR) is available to you upon request, as long as it meets the protection factor for the hazard involved.

Employee Signature:

Phillip Walker

Date:

5/13/22

Certificate of Completion

Asbestos Worker Refresher Course (Sp)

DOSH #: CA-015-12

Teodosio Zaldivar

Last 4 digits of SSN: 0568

AWRSP0828210005N27241

Mauro Arias

Principal Instructor

8/28/2021

Course Start Date

8/28/2021

Course End Date

8/28/2021

Exam Date

8/28/2022

Expiration Date

This course satisfies the education requirements for Asbestos accreditation under the Toxic Substances Control Act, Title II. This course has been approved by the Department of Industrial Relations, Division of Occupational Safety and Health of the State of California



Michael W. Horner

Training Director



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*Note: Card is not suitable substitute for certificate and is not accepted by SCAQMD as proof of certification

This Card Acknowledges That
Teodosio Zaldivar

Holds Training Certification For

Asbestos Worker Refresher Course (Sp)

Expiration: 8/28/2022

8/28/2021

Training Date AWRSP0828210005N27241
Certificate No.

Michael W. Horner

Training Director

Concentra Occupational Med Ctrs-CA

1313 W 8th St Ste 100 Los Angeles, CA 90017 Service Date: 07/16/2021
 Phone: (213) 401-1970 Fax: (213) 401-1980

WRITTEN MEDICAL OPINION (SINGLE OR MULTI-EXPOSURE)

To be maintained in patient's medical chart with copy to employer and patient.

EMPLOYEE NAME: Zaldivar, Teodosio EMPLOYER NAME: LIUNA Local 300-Los Angeles
 DOB: 11/29/1979 EMPLOYER CONTACT: _____
 Last 4 SSN: _____ CONTACT PHONE: _____
 JOB TITLE: _____

NOTES:

This document does not replace mandated state forms where applicable.
 Employer form shall not be substituted for this written medical opinion that is determined to be OSHA and/or EPA compliant for listed exposures.
 If requested or preferred by employer, exposure specific WMO forms available to print on MyConcentra may be used alternatively.

___ 29 CFR 1926 Construction ___ 29 CFR 1910 General & Maritime Other _____

Check applicable exposure(s) for Written Opinion: (check all that apply)

This form does not replace Silica or Beryllium Written Medical Opinions or Reports that print from Concentra OccuSource at registration for those exposures.

<input checked="" type="checkbox"/> Asbestos	<input type="checkbox"/> Pesticides	<input type="checkbox"/> Cadmium	<input type="checkbox"/> Lead	<input type="checkbox"/> Hazwoper/Hazmat
<input type="checkbox"/> Acrylonitrile	<input type="checkbox"/> Benzene	<input type="checkbox"/> Manganese	<input type="checkbox"/> Zinc Oxide	<input type="checkbox"/> Inorganic Mercury
<input type="checkbox"/> Arsenic	<input type="checkbox"/> Diesel Exhaust	<input type="checkbox"/> Ethylene Oxide	<input type="checkbox"/> Formaldehyde	<input type="checkbox"/> Methylene Chloride
<input type="checkbox"/> Polychlorinated biphenyls	<input type="checkbox"/> 1,3- Butadiene	<input type="checkbox"/> Hexavalent Chromium	<input type="checkbox"/> Xylene/Toluene	<input type="checkbox"/> Metal Working Fluid
<input type="checkbox"/> Other (specify): _____				

The following were performed: (check all that apply)

- Medical examination, including a medical and work history with special emphasis on body symptoms related to the above marked exposure(s).
- Completion and review of the OSHA questionnaire(s) (asbestos, benzene, cadmium, formaldehyde, methylene chloride, cotton dust, and 1,3 -butadiene, vinyl chloride).
- Pulmonary function test, including forced vital capacity (FVC) and forced expiratory volume at one second (FEV1) in accordance with NIOSH and ATS standards. Monitor for 10-15% decline in FEV1.
- 1 view PA chest x-ray. (B read using ILO standards required for asbestos)

Periodic chest x-ray schedules: Arsenic- annually; Cadmium- baseline and clinician's discretion;
 Asbestos - see chart below:

Years since first exposure	Age 15-35	Age 36-45	Age 45+
0 to 10	Every 5 years	Every 5 years	Every 5 years
10 +	Every 5 years	Every 2 years	Every 1 year

- All medical examinations and procedures were performed by or under the supervision of a licensed physician.
- The employee has been informed of the results of the medical examination and/or biologic monitoring and any medical conditions which require further examination or treatment.
- The employee has been informed of the increased risk of lung cancer attributable to the combined effect of smoking and asbestos exposure if indicated.

The content of medical examination was determined by the physician or licensed health care provider (PLHCP) based on the following information provided by the employer (check only items available or provided):

- Description of employee's duties
- Information from previous medical examinations dated _____ not performed at Concentra
- Description of personal protective equipment used or to be used
- Employee's exposure levels or anticipated levels

RESPIRATOR FIT-TEST AND TRAINING RECORD

Employee's Name:

Teodosio Zaldivar

Social Security No.: **Last 4 Digits:

0568

RESPIRATOR FIT-TEST SUMMARY

(A separate Fit-Test must be performed for each Negative Pressure Respirator used)

Fit-Test Date:	<u>7-15-2021</u>	Person Conducting Fit-Test:	<u>Ramon Rivera</u>
Respirator Selected for Test:	<u>1/2 Face</u>		
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Respirator Size:	<input type="checkbox"/> Small <input checked="" type="checkbox"/> Medium <input type="checkbox"/> Large	Was Rainbow Passage Used:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Type of Fit-Test:	<input checked="" type="checkbox"/> Qualitative (Odor) <input type="checkbox"/> Quantitative (Machine)		
Type of Agent Used:	<u>Irritant Smoke</u>	FIT-TEST: <input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed	

Signature of Person Performing Fit-Test:

Ramon Rivera

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Employee Signature:

Teo Zaldivar

Date:

7-15-21

*Offering turn-key environmental and
demolition services nationwide.*

