1. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
2. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with A60 (ZF180) zinc-iron, alloy (galvannealed) coating designation.
3. Expanded Metal: ASTM F 1267, Type II (flattened), Class I, 3/4-inch (19-mm) steel mesh, with at least 70 percent open area.
4. Stainless-Steel Sheet: ASTM A 666, Type 304.
5. Plastic Laminate: NEMA LD 3, Grade HGP.
6. Extruded Aluminum: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated.
7. Steel Tube: ASTM A 500, cold rolled.
8. Particleboard: ANSI A208.1, Grade M-2.
9. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.
10. Anchors: Material, type, and size required for secure anchorage to each substrate.
    a. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls, and elsewhere as indicated, for corrosion resistance.
    b. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

B. Standard Metal Lockers
1. Locker Arrangement: Single tier **OR** Double tier **OR** Triple tier **OR** Box **OR** Two person **OR** Duplex **OR** 16 person **OR** As indicated on Drawings, **as directed**.
2. Material: Cold-rolled **OR** Metallic-coated, **as directed**, steel sheet.
3. Body: Assembled by riveting or bolting body components together. Fabricate from unperforated steel sheet as follows:
    a. Tops, Bottoms, and Intermediate Dividers: 0.024-inch (0.61-mm) nominal thickness, with single bend at sides.
    b. Backs and Sides: 0.024-inch (0.61-mm) nominal thickness, with full-height, double-flanged connections.
    c. Shelves: 0.024-inch (0.61-mm) nominal thickness, with double bend at front and single bend at sides and back.
4. Frames: Channel formed; fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral door strike full height on vertical main frames.
    a. Cross Frames between Tiers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.
    b. Frame Vents: Fabricate face frames with vents.
5. Doors: One piece; fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.
    a. Doors less than 12 inches (305 mm) wide may be fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.
    b. Doors for box lockers less than 15 inches (381 mm) wide may be fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.
    c. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches (381 mm) wide; welded to inner face of doors.
    d. Stiffeners: Manufacturer's standard full-height stiffener fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet; welded to inner face of doors.
    e. Sound-Dampening Panels: Manufacturer's standard, designed to stiffen doors and reduce sound levels when doors are closed, of die-formed metal with full perimeter flange and sound-dampening material; welded to inner face of doors.
    f. Door Style: Unperforated panel. **OR** Vented panel as follows:, **as directed**,
        1) Louvered Vents: No fewer than six louver openings at top and bottom for single-tier **OR** three louver openings at top and bottom for double-tier **OR** two louver openings

at top and bottom, or three louver openings at top or bottom, for triple-tier, **as directed**, lockers.

2) Security Vents: Manufacturer's standard, stamped horizontal or vertical.

3) Perforated Vents: Manufacturer's standard shape and configuration.

4) Concealed Vents: Slotted perforations in top and bottom horizontal return flanges of doors.

6. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees; self-closing, **as directed**.

   a. Knuckle Hinges: Steel, full loop, five or seven knuckles, tight pin; minimum 2 inches (51 mm) high. Provide no fewer than three hinges for each door more than 42 inches (1067 mm) high.

   b. Continuous Hinges: Manufacturer's standard, steel, full height.

7. Projecting Door Handle and Latch: Finger-lift latch control designed for use with either built-in combination locks or padlocks; positive automatic latching, chromium plated; pry and vandal resistant.

   a. Latch Hooks: Equip doors 48 inches (1219 mm) and higher with three latch hooks and doors less than 48 inches (1219 mm) high with two latch hooks; fabricated from 0.105-inch (2.66-mm) nominal-thickness steel sheet; welded or riveted to full-height door strikes; with resilient silencer on each latch hook.

   b. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.

8. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond face of door; pry and vandal resistant.

   a. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks, built-in key locks, or padlocks; positive automatic latching and prelocking.

      1) Latch Hooks: Equip doors 48 inches (1219 mm) and higher with three latch hooks and doors less than 48 inches (1219 mm) high with two latch hooks; fabricated from 0.105-inch (2.66-mm) nominal-thickness steel sheet; welded or riveted to full-height door strikes; with resilient silencer on each latch hook.

      2) Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated with vinyl or nylon to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.

   b. Single-Point Latching: Nonmoving latch hook designed to engage bolt of built-in combination or cylinder lock **OR** with steel padlock loop that projects through recessed cup and is finished to match metal locker body, **as directed**.

      1) Latch Hook: Equip each door with one latch hook, fabricated from 0.105-inch (2.66-mm) nominal-thickness steel sheet; welded midway up full-height door strike; with resilient silencer.

9. Door Handle and Latch for Box **OR** 16-Person, **as directed**, Lockers: Stainless-steel strike plate with integral pull; with steel padlock loop that projects through metal locker door.

10. Combination Padlocks: Key-controlled, three-number dialing combination locks; capable of five combination changes **OR** Provided by Owner, **as directed**.

11. Built-in Combination Locks: Key-controlled, three-number dialing combination locks; capable of at least five combination changes made automatically with a control key.

    a. Bolt Operation: Manually locking deadbolt **OR** automatically locking spring bolt, **as directed**.

12. Cylinder Locks: Built-in, flush, cam locks with five-pin tumbler keyway, keyed separately and master keyed. Furnish two change keys for each lock and two, **as directed**, master keys.

    a. Key Type: Flat **OR** Grooved, **as directed**, with minimum 2- by 2.68-inch (51- by 68.3-mm) key head for accessible lockers, **as directed**.

    b. Bolt Operation: Manually locking deadbolt **OR** automatically locking spring bolt, **as directed**.

13. Equipment: Equip each metal locker with identification plate and the following unless otherwise indicated:
    a. Single-Tier Units: Shelf, one double-prong ceiling hook, and two single-prong wall hooks.
    b. Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.
    c. Triple-Tier **OR** Box, **as directed**, Units: One double-prong ceiling hook.
    d. Coat Rods: As indicated on Drawings **OR** For each compartment of single-tier, double-tier, and triple-tier metal lockers **OR** In lieu of ceiling hook for metal lockers 24 inches (610 mm) high or more **OR** In lieu of ceiling hook for metal lockers 18 inches (457 mm) deep or more, **as directed**.
14. Accessories:
    a. Legs: 6 inches (152 mm) high; formed by extending vertical frame members, or fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet; welded to bottom of locker.
        1) Closed Front and End Bases: Fabricated from 0.036-inch (0.91-mm) nominal-thickness steel sheet.
    b. Continuous Zee Base: Fabricated from 0.060-inch (1.52-mm) **OR** 0.075-inch (1.90-mm) **OR** manufacturer's standard thickness, but not less than 0.060-inch (1.52-mm), **as directed**, nominal-thickness steel sheet.
        1) Height: 4 inches (102 mm).
    c. Continuous Sloping Tops: Fabricated from 0.036-inch (0.91-mm) **OR** 0.048-inch (1.21-mm) **OR** manufacturer's standard thickness, but not less than 0.036-inch (0.91-mm), **as directed**, nominal-thickness steel sheet.
        1) Closures: Vertical-end **OR** Hipped-end, **as directed**, type.
        2) Sloping-top corner fillers, mitered.
    d. Individual Sloping Tops: Fabricated from 0.024-inch (0.61-mm) nominal-thickness steel sheet.
    e. Recess Trim: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.
    f. Filler Panels: Fabricated from 0.036-inch (0.91-mm) **OR** 0.048-inch (1.21-mm) **OR** manufacturer's standard thickness, but not less than 0.036-inch (0.91-mm), **as directed**, nominal-thickness steel sheet.
    g. Boxed End Panels: Fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet.
    h. Finished End Panels: Fabricated from 0.024-inch (0.61-mm) nominal-thickness steel sheet.
    i. Center Dividers: Fabricated from 0.024-inch (0.61-mm) nominal-thickness steel sheet.
15. Finish: Baked enamel **OR** Powder coat, **as directed**.
    a. Color(s): As selected from manufacturer's full range **OR** Two colors, with door one color and frame and body another color; as selected from manufacturer's full range, **as directed**.

C. Heavy-Duty Metal Lockers
1. Locker Arrangement: Single tier **OR** Double tier **OR** Triple tier **OR** As indicated on Drawings, **as directed**.
2. Material: Cold-rolled steel sheet.
3. Body: Assembled by welding body components together. Fabricate from unperforated steel sheet with thicknesses as follows:
    a. Tops, Bottoms, and Sides: 0.060-inch (1.52-mm) nominal thickness.
    b. Backs: 0.048-inch (1.21-mm) nominal thickness.
    c. Shelves: 0.060-inch (1.52-mm) nominal thickness, with double bend at front and single bend at sides and back.
4. Frames: Channel formed; fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral door strike full height on vertical main frames.
    a. Cross Frames between Tiers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.
5. Doors: One piece; fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.

a. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches (381 mm) wide; welded to inner face of doors.
b. Door Style:
1) Louvered Vents: No fewer than six louver openings at top and bottom for single-tier **OR** three louver openings at top and bottom for double-tier **OR** two louver openings at top and bottom, or three louver openings at top or bottom, for triple-tier, **as directed**, lockers.
2) Security Vents: Manufacturer's standard, stamped horizontal or vertical.
3) Perforated Vents: Manufacturer's standard shape and configuration.

6. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees; self-closing, **as directed**.
a. Knuckle Hinges: Steel, full loop, five or seven knuckles, tight pin; minimum 2 inches (51 mm) high. Provide no fewer than three hinges for each door more than 42 inches (1067 mm) high.
b. Continuous Hinges: Manufacturer's standard, steel, full height.

7. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond face of door; pry and vandal resistant.
a. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks or padlocks; positive automatic latching and prelocking.
1) Latch Hooks: Equip doors 48 inches (1219 mm) and higher with three latch hooks and doors less than 48 inches (1219 mm) high with two latch hooks; fabricated from 0.120-inch (3.04-mm) nominal-thickness steel sheet; welded to full-height door strikes; with resilient silencer on each latch hook.
2) Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.
b. Single-Point Latching: Nonmoving latch hook designed to engage bolt of built-in combination or cylinder lock **OR** with steel padlock loop that projects through recessed cup and is finished to match metal locker body, **as directed**.
1) Latch Hook: Equip each door with one latch hook, fabricated from 0.120-inch (3.04-mm) nominal-thickness steel sheet; welded midway up full-height door strike; with resilient silencer.

8. Combination Padlocks: Key-controlled, three-number dialing combination locks; capable of five combination changes **OR** Provided by Owner, **as directed**.

9. Built-in Combination Locks: Key-controlled, three-number dialing combination locks; capable of at least five combination changes made automatically with a control key.
a. Bolt Operation: Manually locking deadbolt **OR** automatically locking spring bolt, **as directed**.

10. Equipment: Equip each metal locker with identification plate and the following unless otherwise indicated:
a. Single-Tier Units: Shelf, one double-prong ceiling hook, and two single-prong wall hooks.
b. Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.
c. Triple-Tier Units: One double-prong ceiling hook.
d. Coat Rods: As indicated on Drawings **OR** For each compartment of single-tier, double-tier and triple-tier metal lockers **OR** In lieu of ceiling hook for metal lockers 24 inches (610 mm) high or more **OR** In lieu of ceiling hook for metal lockers 18 inches (457 mm) deep or more.

11. Accessories:
a. Legs: 6 inches (152 mm) high; formed by extending vertical frame members, or fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet; welded to bottom of locker.
1) Closed Front and End Bases: Fabricated from 0.036-inch (0.91-mm) nominal-thickness steel sheet.
b. Continuous Zee Base: Fabricated from, 0.060-inch (1.52-mm) **OR** 0.075-inch (1.90-mm) **OR** manufacturer's standard thickness, but not less than 0.060-inch (1.52-mm), **as directed**, nominal-thickness steel sheet.

1) Height: 4 inches (102 mm).

c. Continuous Sloping Tops: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet, with a pitch of approximately 20 degrees.

1) Closures: Vertical-end **OR** Hipped-end, **as directed**, type.

d. Recess Trim: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.

e. Filler Panels: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.

f. Boxed End Panels: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.

12. Finish: Baked enamel **OR** Powder coat, **as directed**.

a. Color(s): As selected from manufacturer's full range **OR** Two colors, with door one color and frame and body another color; as selected from manufacturer's full range, **as directed**.

D. Athletic Metal Lockers

1. Locker Arrangement: Single tier **OR** Double tier **OR** Triple tier **OR** Box **OR** As indicated on Drawings, **as directed**.
2. Material: Cold-rolled **OR** Metallic-coated, **as directed**, steel sheet.
3. Body: Assembled by welding **OR** riveting or bolting, **as directed**, body components together. Fabricate from unperforated steel sheet with thicknesses as follows:
   a. Tops and Bottoms: 0.060-inch (1.52-mm) nominal thickness, with single bend at edges.
   b. Backs: 0.048-inch (1.21-mm) nominal thickness.
   c. Shelves: 0.060-inch (1.52-mm) nominal thickness, with double bend at front and single bend at sides and back.
4. Unperforated Sides: Fabricated from 0.048-inch (1.21-mm) **OR** 0.060-inch (1.52-mm), **as directed**, nominal-thickness steel sheet.
5. Perforated Sides: Fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet with manufacturer's standard diamond perforations.
6. Expanded-Metal Sides: Fabricated from 0.090-inch (2.28-mm) nominal-thickness expanded metal; welded to 0.105-inch (2.66-mm) nominal-thickness steel angles or 0.060-inch (1.52-mm) nominal-thickness steel channel frames.
7. Frames: Channel formed; fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet or 0.097-inch (2.45-mm) nominal-thickness steel angles; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral door strike full height on vertical main frames.
   a. Cross Frames for Double-Tier **OR** Triple-Tier, **as directed**, Lockers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.
8. Reinforced Bottoms: Structural channels, formed from 0.060-inch (1.52-mm) **OR** 0.075-inch (1.90-mm), **as directed**, nominal-thickness steel sheet; welded to front and rear of side-panel frames.
9. Perforated Doors: One piece; fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet with manufacturer's standard diamond perforations; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges and latch point (bottom) and right-angle single bend at remaining edges for box lockers.
   a. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches (381 mm) wide; welded to inner face of doors.
10. Expanded-Metal Doors: Fabricated from 0.090-inch (2.28-mm) nominal-thickness expanded metal; welded to 0.105-inch (2.66-mm) nominal-thickness steel angle frame; with 0.090-inch (2.28-mm) nominal-thickness, steel sheet lock panel backed by 0.060-inch (1.52-mm) nominal-thickness steel sheet retainer welded to door frame.
11. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees; self-closing, **as directed**.
   a. Knuckle Hinges: Steel, full loop, five or seven knuckles, tight pin; minimum 2 inches (51 mm) high. Provide no fewer than three hinges for each door more than 42 inches (1067 mm) high.
   b. Continuous Hinges: Manufacturer's standard, steel; side or top mounted as required by locker configuration.

c. Hinges: Manufacturer's standard, steel continuous or knuckle type.

12. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond face of door; pry and vandal resistant.
    a. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks, built-in cylinder locks, or padlocks; positive automatic latching and prelocking.
        1) Latch Hooks: Equip doors 48 inches (1219 mm) and higher with three latch hooks and doors less than 48 inches (1219 mm) high with two latch hooks; fabricated from 0.120-inch (3.04-mm) nominal-thickness steel sheet; welded to full-height door strikes; with resilient silencer on each latch hook.
        2) Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.
    b. Single-Point Latching: Nonmoving latch hook designed to engage bolt of built-in combination or cylinder lock **OR** with steel padlock loop that projects through recessed cup and is finished to match metal locker body, **as directed**.
        1) Latch Hook: Equip each door with one latch hook, fabricated from 0.120-inch (3.04-mm) nominal-thickness steel sheet; welded midway up full-height door strike; with resilient silencer.
13. Projecting Turn-Handle and Latch: Steel handle welded to manufacturer's standard, three-point, cremone-type latching mechanism consisting of steel rods or bars that engage main locker frame at top and bottom of door, and center latch that engages strike jamb; with steel padlock loop.
14. Door Handle and Latch for Box Lockers: Stainless-steel strike plate with integral pull; with steel padlock loop that projects through metal locker door.
15. Combination Padlocks: Key-controlled, three-number dialing combination locks; capable of five combination changes **OR** Provided by Owner, **as directed**.
16. Built-in Combination Locks: Key-controlled, three-number dialing combination locks; capable of at least five combination changes made automatically with a control key.
    a. Bolt Operation: Manually locking deadbolt **OR** automatically locking spring bolt, **as directed**.
17. Cylinder Locks: Built-in, flush, cam locks with five-pin tumbler keyway, keyed separately and master keyed. Furnish two change keys for each lock and two, **as directed**, master keys.
    a. Key Type: Flat **OR** Grooved, **as directed**, with minimum 2- by 2.68-inch (51- by 68.3-mm) key head for accessible lockers, **as directed**.
    b. Bolt Operation: Manually locking deadbolt **OR** automatically locking spring bolt, **as directed**.
18. Equipment: Equip each metal locker with identification plate and the following unless otherwise indicated:
    a. Single-Tier Units: Shelf, one double-prong ceiling hook, and two single-prong wall hooks.
    b. Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.
    c. Triple-Tier Units: One double-prong ceiling hook.
    d. Coat Rods: As indicated on Drawings **OR** For each compartment of single-tier, double-tier and triple-tier metal lockers **OR** In lieu of ceiling hook for metal lockers 24 inches (610 mm) high or more **OR** In lieu of ceiling hook for metal lockers 18 inches (457 mm) deep or more, **as directed**.
19. Accessories:
    a. Legs: 6 inches (152 mm) high; formed by extending vertical frame members, or fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet; welded to bottom of locker.
        1) Closed Front and End Bases: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.
    b. Continuous Zee Base: 4 inches (102 mm) high; fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet.
    c. Continuous Sloping Tops: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet, with a pitch of approximately 20 degrees.
        1) Closures: Vertical-end **OR** Hipped-end, **as directed**, type.
    d. Recess Trim: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.

e. Filler Panels: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.
f. Boxed End Panels: Fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet.

20. Finish: Baked enamel **OR** Powder coat, **as directed**.
    a. Color(s): As selected from manufacturer's full range **OR** Two colors, with door one color and frame and body another color; as selected from manufacturer's full range, **as directed**.

E. Open-Front Athletic Metal Lockers

1. Locker Arrangement: Open front, with seat/shelf **OR** seat/footlocker, upper shelf **OR** upper shelf with security box **OR** full-width security compartment **OR** configuration as indicated on Drawings, **as directed**.
2. Material: Cold-rolled **OR** Metallic-coated, **as directed**, steel sheet.
3. Body: Assembled by welding **OR** riveting or bolting, **as directed**, body components together. Fabricate from unperforated steel sheet with thicknesses as follows:
    a. Tops and Bottoms: 0.060-inch (1.52-mm) nominal thickness, with single bend at edges.
    b. Backs: 0.048-inch (1.21-mm) nominal thickness.
    c. Shelves: 0.060-inch (1.52-mm) nominal thickness, with double bend at front and single bend at sides and back.
4. Unperforated Sides: Fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet.
5. Perforated Sides: Fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet with manufacturer's standard diamond perforations. Perforations shall not occur above upper shelf **OR** at security compartment **OR** at seat/footlocker, **as directed**.
6. Expanded-Metal Sides: Fabricated from 0.090-inch (2.28-mm) nominal-thickness expanded metal; welded to 0.105-inch (2.66-mm) nominal-thickness steel angles or 0.060-inch (1.52-mm) nominal-thickness steel channel frames.
7. Frames: Channel formed; fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet or 0.105-inch (2.66-mm) nominal-thickness steel angles; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames.
8. Reinforced Bottoms: Structural channels, formed from 0.075-inch (1.90-mm) nominal-thickness steel sheet; welded to front and rear of side-panel frames.
9. Seats/Shelves: Full width of metal locker; channel formed; fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet; with stiffeners for reinforcement.
10. Seats/Footlockers: Enclosure full width of bottom of metal locker; fabricated from cold-rolled steel sheet.
    a. Seat/Lid: 0.075-inch (1.90-mm) nominal-thickness steel sheet; channel formed and reinforced with stiffeners; with manufacturer's standard, steel continuous hinge that is completely concealed and tamper resistant when seat/lid is closed; with padlock hasp.
    b. Front Panel: 0.075-inch (1.90-mm) nominal-thickness steel sheet; channel formed at top edge; with minilouvers for ventilation; recessed for padlock loop.
    c. Sides: Integral part of unperforated **OR** Unperforated bottom portions of perforated **OR** 0.060-inch (1.52-mm) nominal-thickness steel sheet inside expanded-metal, **as directed**, sides.
11. Security Boxes: Consisting of partition extending from upper shelf to top of metal locker, fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet; with channel-formed, 0.060-inch (1.52-mm) nominal-thickness, steel sheet door frame, and door fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet with right-angle single bend at edges; with manufacturer's standard, steel continuous hinge that is completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.
    a. Single-Point Latching: Stainless-steel strike plate with integral pull; with steel, nonmoving latch hook designed to engage bolt of built-in combination or cylinder lock **OR** with steel padlock loop that projects through door and is finished to match metal locker body, **as directed**.
12. Security Compartments: Full width of metal locker, with door fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet.
13. Combination Padlocks: Key-controlled, three-number dialing combination locks; capable of five combination changes **OR** Provided by Owner, **as directed**.

14. Built-in Combination Locks: Key-controlled, three-number dialing combination locks; capable of at least five combination changes made automatically with a control key.
    a. Bolt Operation: Manually locking deadbolt **OR** automatically locking spring bolt, **as directed**.
15. Cylinder Locks: Built-in, flush, cam locks with five-pin tumbler keyway, keyed separately and master keyed. Furnish two change keys for each lock and two, **as directed**, master keys.
    a. Key Type: Flat **OR** Grooved, **as directed**, with minimum 2- by 2.68-inch (51- by 68.3-mm) key head for accessible lockers, **as directed**.
    b. Bolt Operation: Manually locking deadbolt **OR** automatically locking spring bolt, **as directed**.
16. Equipment: Equip each metal locker with identification plate and the following unless otherwise indicated:
    a. Two single-prong wall hooks bolted to locker back.
    b. Coat rod and two rod holders.
17. Accessories:
    a. Continuous Sloping Tops: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet, with a pitch of approximately 20 degrees.
        1) Closures: Vertical-end **OR** Hipped-end, **as directed**, type.
    b. Recess Trim: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.
    c. Filler Panels: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.
    d. Boxed End Panels: Fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet.
18. Finish: Baked enamel **OR** Powder coat, **as directed**.
    a. Color(s): As selected from manufacturer's full range **OR** Two colors; as selected from manufacturer's full range, **as directed**.

F. Coin-Operated Metal Lockers
1. Steel Lockers: Fabricated from cold-rolled steel sheet with thicknesses as follows:
    a. Tops, Bottoms, Sides, and Shelves: 0.024-inch (0.61-mm) nominal thickness.
    b. Backs: 0.036-inch (0.91-mm) nominal thickness.
    c. Frames: 0.060-inch (1.52-mm) nominal thickness.
    d. Doors: 0.060-inch (1.52-mm) nominal thickness.
    e. Exposed Ends of Nonrecessed Lockers: 0.060-inch (1.52-mm) nominal thickness.
2. Stainless-Steel Lockers: Fabricated from stainless-steel sheet with thicknesses and finishes as follows:
    a. Tops, Bottoms, Sides, Backs, and Shelves: 0.025 inch (0.64 mm) thick, with No. 2B finish.
    b. Frames: 0.062 inch (1.59 mm) thick, with No. 3 or No. 4 finish.
    c. Doors: 0.062 inch (1.59 mm) thick, with manufacturer's standard patterned finish.
    d. Exposed Ends of Nonrecessed Lockers: 0.062 inch (1.59 mm) thick, with No. 3 or No. 4 finish.
3. Body: Assembled by welding or riveting body components to frames using manufacturer's standard aluminum or stainless-steel rivets; flanged for double thickness at back vertical corners; back ventilated.
4. Frames: Channel formed; lapped and welded at corners; with top, bottom, and cross frames welded into vertical main frames. Form continuous, integral door strike full height on vertical main frames, and equip frames with resilient bumpers to cushion door closing.
    a. Cross Frames between Tiers: Channel formed and fabricated from same material as main frames; welded to vertical main frame.
5. Doors: One piece; formed into channel shape at vertical edges and flanged at right angles at horizontal edges; fabricated to swing 180 degrees. Brace or reinforce inner face of doors with manufacturer's standard reinforcing angles, channels, or stiffener panels.
6. Hinges: Manufacturer's standard, full-loop, five- or seven-knuckle type; tight pin; minimum 2-1/2 inches (64 mm) high or continuous type, of same material as door; self-closing, **as directed**. Weld hinge to inside of door frame and attach hinge to door with factory-installed fasteners that are completely concealed and tamper resistant when door is closed.
    a. Provide at least three hinges for each door more than 42 inches (1067 mm) high.
7. Projecting Door Handle: Manufacturer's standard; stainless steel; pry and vandal resistant.

8. Built-in, Coin-Operated Locks: Self-contained units mounted on interior of door with replaceable lock cylinders keyed separately and master keyed. Mount instruction decals on both faces of door. Furnish one change key for each lock and one master key.
   a. Bolt Operation: Manually locking deadbolt **OR** automatically locking spring bolt, **as directed**.
   b. Lock Type: Fee return/deposit **OR** collect/pay, **as directed**.
   c. Fee Type: Token **OR** Coin, one quarter **OR** Coin, two quarters, **as directed**.
   d. Coin Box: Manufacturer's standard housing or stainless-steel cash box with stainless-steel flanged cover set into base of lock channel frame. Furnish with removable cylinder and key, and master code changer key.
9. Finish: Baked enamel **OR** Powder coat, **as directed**.
   a. Color(s): As selected from manufacturer's full range **OR** Two colors, with door one color and frame and body another color; as selected from manufacturer's full range, **as directed**.

G. Keyless Locks
1. Built-in, Card-Operated Locks: Self-contained units mounted on interior of door with replaceable lock cylinders keyed separately and master keyed. Mount instruction decals on both faces of door. Furnish one change card key for each lock and one master card key.
   a. Bolt Operation: Manually locking deadbolt **OR** automatically locking spring bolt, **as directed**.
2. Digital Keypad Locks: Battery-powered electronic keypad with reprogrammable manager and owner codes that override access. Three consecutive incorrect code entries shall disable lock for three minutes.
   a. Designed for permanently assigned access via entry of user's four-digit code.
   b. Designed for shared or temporary access by multiple users, with user-defined code to lock and unlock. Provide LED indicator to show when lock is in use.

H. Locker Benches
1. Provide bench units with overall assembly height of 17-1/2 inches (445 mm).
2. Bench Tops: Manufacturer's standard one-piece units, with rounded corners and edges.
   a. Size: Minimum 9-1/2 inches wide by 1-1/4 inches thick (241 mm wide by 32 mm thick) except provide minimum 20-inch- (508-mm-) wide tops where accessible benches are indicated.
   b. Laminated clear hardwood with one coat of clear sealer on all surfaces and one coat of clear lacquer on top and sides.
   c. Plastic laminate over particleboard core, with two steel tubes running full length of top and positioned to receive pedestal fasteners.
      1) Color: As selected from manufacturer's full range.
   d. Extruded aluminum with clear anodic finish.
3. Fixed Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top and anchoring to floor, complete with fasteners and anchors, and as follows:
   a. Tubular Steel: 1-1/2-inch- (38-mm-) diameter steel tubing threaded on both ends, with standard pipe flange at top and bell-shaped cast-iron base; with baked-enamel or powder-coat finish; anchored with exposed fasteners.
      1) Color: As selected from manufacturer's full range.
   b. Tubular Steel: 1-1/4-inch- (32-mm-) diameter steel tubing, with 0.1265-inch- (3.2-mm-) thick steel flanges welded at top and base; with baked-enamel **OR** zinc-plated, **as directed**, finish; anchored with exposed fasteners.
      1) Color: As selected from manufacturer's full range.
4. Freestanding Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top, complete with fasteners, and as follows:
   a. Aluminum: 1/8-inch-thick by 3-inch-wide (3-mm-thick by 76-mm-wide) channel or 1/4-inch-thick by 3-inch-wide (6-mm-thick by 76-mm-wide) bar stock, shaped into trapezoidal **OR** inverted-T, **as directed**, form; with nonskid pads at bottom.
      1) Finish: Clear **OR** Black **OR** Gold, **as directed**, anodic finish.

b. Stainless Steel: 1/8-inch-thick by 3-inch-wide (3-mm-thick by 76-mm-wide) channel or 1/4-inch-thick by 3-inch-wide (6-mm-thick by 76-mm-wide) bar stock, shaped into trapezoidal form; with nonskid pads at bottom. Add finish.

I. Fabrication

1. Fabricate metal lockers square, rigid, and without warp and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.
   a. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
   b. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.
2. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments. Factory weld frame members of each metal locker together to form a rigid, one-piece assembly.
3. Knocked-Down Construction: Fabricate metal lockers using nuts, bolts, screws, or rivets for nominal assembly at Project site **OR** preassembly at plant prior to shipping, **as directed**.
4. All-Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections; with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds flush.
5. Accessible Lockers: Fabricate as follows:
   a. Locate bottom shelf no lower than 15 inches (381 mm) above the floor.
   b. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches (1219 mm) above the floor.
6. Hooks: Manufacturer's standard ball-pointed type, aluminum or steel; zinc plated.
7. Coat Rods: Fabricated from 1-inch- (25-mm-) **OR** 3/4-inch- (19-mm-), **as directed**, diameter steel, chrome finished **OR** nickel plated, **as directed**.
8. Identification Plates: Manufacturer's standard, etched, embossed, or stamped aluminum **OR** plastic, **as directed**, plates, with numbers and letters at least 3/8 inch (9 mm) high.
9. Continuous Base: Formed into channel or zee profile for stiffness, and fabricated in lengths as long as practical to enclose base and base ends of metal lockers; finished to match lockers.
10. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations; finished to match lockers.
    a. Sloping-top corner fillers, mitered.
11. Individual Sloping Tops: Fabricated in width to fit one locker frame in lieu of flat locker tops; with integral back; finished to match lockers. Provide wedge-shaped divider panels between lockers.
12. Recess Trim: Fabricated with minimum 2-1/2-inch (64-mm) face width and in lengths as long as practical; finished to match lockers.
13. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.
14. Boxed End Panels: Fabricated with 1-inch- (25-mm-) wide edge dimension, and designed for concealing fasteners and holes at exposed ends of nonrecessed metal lockers; finished to match lockers.
    a. Provide one-piece panels for double-row (back-to-back) locker ends.
15. Finished End Panels: Designed for concealing unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.
    a. Provide one-piece panels for double-row (back-to-back) locker ends.
16. Center Dividers: Full-depth, vertical partitions between bottom and shelf; finished to match lockers.

J. Steel Sheet Finishes

1. Factory finish steel surfaces and accessories except stainless-steel and chrome-plated surfaces.
2. Baked-Enamel Finish: Immediately after cleaning, pretreating, and phosphatizing, apply manufacturer's standard thermosetting baked-enamel finish. Comply with paint manufacturer's written instructions for application, baking, and minimum dry film thickness.

3. Powder-Coat Finish: Immediately after cleaning and pretreating, electrostatically apply manufacturer's standard, baked-polymer, thermosetting powder finish. Comply with resin manufacturer's written instructions for application, baking, and minimum dry film thickness.

K. Stainless-Steel Finishes
1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
   a. Run grain of directional finishes with long dimension of each piece.
   b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

1.3 EXECUTION

A. Installation
1. General: Install level, plumb, and true; shim as required, using concealed shims.
   a. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches (910 mm) o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
   b. Anchor single rows of metal lockers to walls near top and bottom of lockers **OR** of lockers and to floor, **as directed**.
   c. Anchor back-to-back metal lockers to floor.
2. Knocked-Down Metal Lockers: Assemble with standard fasteners, with no exposed fasteners on door faces or face frames.
3. All-Welded Metal Lockers: Connect groups together with standard fasteners, with no exposed fasteners on face frames.
4. Equipment and Accessories: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
   a. Attach hooks with at least two fasteners.
   b. Attach door locks on doors using security-type fasteners.
   c. Identification Plates: Identify metal lockers with identification indicated on Drawings.
      1) Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
      2) Attach plates to upper shelf of each open-front metal locker, centered, with a least two aluminum rivets.
   d. Attach recess trim to recessed metal lockers with concealed clips.
   e. Attach filler panels with concealed fasteners. Locate filler panels where indicated on Drawings.
   f. Attach sloping-top units to metal lockers, with closures at exposed ends.
   g. Attach boxed end panels with concealed fasteners to conceal exposed ends of nonrecessed metal lockers.
   h. Attach finished end panels with fasteners only at perimeter to conceal exposed ends of nonrecessed metal lockers.
5. Fixed Locker Benches: Provide no fewer than two pedestals for each bench, uniformly spaced not more than 72 inches (1830 mm) apart. Securely fasten tops of pedestals to undersides of bench tops, and anchor bases to floor.
6. Freestanding Locker Benches: Place benches in locations indicated on Drawings.

B. Adjusting, Cleaning, And Protection
1. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding. Verify that integral locking devices operate properly.
2. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.

3. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 10503

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Task	Specification	Specification Description
10503	01352	No Specification Required
10504	10503	Metal Lockers

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SECTION 10505 - SOLID PLASTIC LOCKERS

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for solid plastic lockers. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Submittals
1. Shop Drawings: Submitted shop drawings showing individual locker construction and overall dimensions, including complete installation instructions.

C. Product Handling
1. Store locker components flat until assembly. Protect all finishes from soiling and damage during handling.

D. Warranty
1. Manufacturer shall warranty lockers for a period of 10 years against rust and other types of corrosion, delamination, or breakage of any of the plastic panels, doors, and shelves under normal use.

1.2 PRODUCTS

A. Materials: Sides, tips, bottoms, rears, doors, and shelves shall be made from high impact, high density polyethylene (HDPE) formed under high pressure into solid plastic components 3/8" thick with homogeneous color throughout. All panels, doors, and shelves will match in color.
1. Material testing: All solid plastic components shall resist deterioration and discoloration when subjected to any of the following:
Acetic Acid 80%
Acetone
Ammonia Liquid
Ammonium Phosphate
Bleach 12%
Borax
Brine
Caustic Soda
Chlorine Water
Citric Acid
Copper Chloride
Core Oils
Hydrochloric Acid 40%
Hydrogen Peroxide 30%
Isopropyl Alcohol
Lactic Acid 25%
Lime Sulfur
Nicotine
Potassium Bromide
Soaps
Sodium Bicarbonate
Trisodium Phosphate
Urea and Urine

Vinegar
(Testing in accordance with corrosion testing procedure established by the United States Plastic Corporation)

2. Continuous latch, capable of accepting various locking mechanisms, shall be securely fastened to the entire length of the door, providing a continuous security latch.
3. Door hinge shall be made from plastic with no steel or metal parts. Door hinge shall be continuous and integrated into the full length of the door and main locker body.
4. Coat hooks shall be made from chrome plated steel and attached with tempered screws.
5. All components shall have a smooth "orange peel" finish. All components shall be of the same color and selected from the manufacturer's full color line.

B. Fabrication
1. Locker components shall be fabricated square and rigid with a finish free of scratches and chips. All sides, tops, bottoms, backs, doors, and shelves shall be coated on both sides with a protective masking.
2. Solid plastic locker components shall snap together for easy assembly and shall provide a solid and secure construction. Adjacent lockers shall share a common side panel. Locker units shall be manufactured for assembly in a group of no more than five adjacent lockers.

1.3 EXECUTION

A. Installation
1. Install lockers at the location shown in accordance with the manufacturer's instructions for plumb, level, rigid, and flush installations.
2. Anchor the units to wall studs through the locker back and to the floor using #8 pan head wood screws. Furring must be installed between lockers and wall of installations.
3. Lockers can be either floor-mounted or installed on a 4" high base. Hardware and instructions for either method shall be provided by the manufacturer.
4. Number plates shall be available for field or factory mounting.

END OF SECTION 10505

SECTION 10506 - WIRE BASKET LOCKERS

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for wire basket lockers. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Submittals
1. Shop Drawings: Submitted shop drawings showing individual locker construction and overall dimensions, including complete installation instructions.

C. Product Handling
1. Store locker components flat until assembly. Protect all finishes from soiling and damage during handling.

D. Warranty
1. Manufacturer shall warranty lockers for a period of 10 years against rust and other types of corrosion, or breakage of any of the baskets and shelves under normal use.

1.2 PRODUCTS

A. Materials
1. Wire Basket Racks:
a. Shelving: Shelving units shall consist of minimum 13 ga. steel angle posts punched for bolting shelves.
b. Sway Braces: Minimum 12 ga. steel for back and sides of unit.
c. Shelves: Minimum 20 ga. formed steel, with down turned flanges at the back to act as backstop and to prevent removal from rear.
d. Dividers: Minimum 20 ga., 3-inches in height, with an attaching flange formed at right angles. Dividers shall be bolted to shelves.
e. Padlock Attachment: Provide minimum 14 ga. padlock staple attachment at the front edge of each shelf located to match the locking loop formed in the basket rim.
f. Casters (Option): 3-inch dia., swivel-type mobility casters bolted to each corner post.
g. Number Plates: Aluminum number plates with 3/8" high black letters. Rivet plates to shelf face at each basket opening.
2. Baskets:
a. Baskets shall be 12" x 13" x 8" **OR** 9" x 13" x 8", **as directed**, all wire or wire mesh or perforated steel front type. Provide number plates specified above on the front of each basket.
b. Pilfer Guards (Option): Provide sheet steel pilfer guard designed for field attachment to the top of the basket to cover the first 3" of depth.
3. Finish:
a. Baskets and pilfer guards: electroplating with bright zinc chromate.
b. Basket rack posts, shelves, and braces: In color selected from manufacturer's standard colors.

B. Fabrication
1. Locker components shall be fabricated square and rigid with a finish free of scratches and chips. All sides, tops, bottoms, and shelves shall be coated on both sides with a protective masking.

1.3 EXECUTION

A. Installation
   1. Install lockers at the location shown in accordance with the manufacturer's instructions for plumb, level, rigid, and flush installations.
   2. Anchor the units to wall studs through the locker back and to the floor using #8 pan head wood screws. Furring must be installed between lockers and wall of installations.

END OF SECTION 10506

Task	Specification	Specification Description
10507	01352	No Specification Required
10508	01352	No Specification Required

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SECTION 10521 - FIRE EXTINGUISHER CABINETS

1.1 GENERAL

A. Description Of Work:
1. This specification covers the furnishing and installation of materials for fire extinguisher cabinets. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section Includes:
a. Fire protection cabinets for the following:
1) Portable fire extinguishers.
2) Fire hose valves.
3) Fire hoses and racks.

C. Submittals
1. Product Data: For each type of product indicated.
2. Show location of knockouts for hose valves.
3. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
4. Samples: For each type of fire protection cabinet indicated.
5. Maintenance Data.

D. Quality Assurance
1. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.
2. 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. Coordination
1. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
2. Coordinate size of fire protection cabinets to ensure that type and capacity of fire hoses, hose valves, and hose racks indicated are accommodated.
3. Coordinate sizes and locations of fire protection cabinets with wall depths.

F. Sequencing
1. Apply decals **OR** vinyl lettering, **as directed**, on field-painted, fire protection cabinets after painting is complete.

1.2 PRODUCTS

A. Materials
1. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
2. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
a. Sheet: ASTM B 209 (ASTM B 209M).
b. Extruded Shapes: ASTM B 221 (ASTM B 221M).
3. Stainless-Steel Sheet: ASTM A 666, Type 304.
4. Copper-Alloy Brass Sheet: ASTM B 36/B 36M, alloy UNS No. C26000 (cartridge brass, 70 percent copper).

5. Copper-Alloy Bronze Sheet: ASTM B 36/B 36M, alloy UNS No. C28000 (muntz metal, 60 percent copper).
6. Clear Float Glass: ASTM C 1036, Type I, Class 1, Quality q3, 3 **OR** 6, **as directed**, mm thick.
7. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear) **OR** Class 2 (tinted, heat absorbing, and light reducing), bronze tint, **as directed**.
8. Break Glass: Clear annealed float glass, ASTM C 1036, Type I, Class 1, Quality q3, 1.5 mm thick, single strength.
9. Tempered Break Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 1.5 mm thick.
10. Wire Glass: ASTM C 1036, Type II, Class 1, Form 1, Quality q8, Mesh m1 (diamond), 6 mm thick.
11. Transparent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), 1.5 **OR** 3 **OR** 6, **as directed**, mm thick, with Finish 1 (smooth or polished) **OR** Finish 2 (patterned, textured), **as directed**.
12. Acrylic Bubble: One piece.

B. Fire Protection Cabinet
1. Cabinet Type: Suitable for fire extinguisher **OR** extinguisher and hose valve **OR** hose, rack, valve, and extinguisher **OR** hose, rack, and valve **OR** hose valve, **as directed**.
2. Cabinet Construction: Nonrated **OR** 1-hour fire rated **OR** 2-hour fire rated, **as directed**.
   a. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.0428-inch- (1.1-mm-) thick, cold-rolled steel sheet lined with minimum 5/8-inch- (16-mm-) thick, fire-barrier material. Provide factory-drilled mounting holes.
3. Cabinet Material: Steel **OR** Aluminum **OR** Stainless-steel, **as directed**, sheet.
   a. Shelf: Same metal and finish as cabinet.
4. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.
   a. Trimless with Concealed Flange: Surface of surrounding wall finishes flush with exterior finished surface of cabinet frame and door, without overlapping trim attached to cabinet. Provide recessed flange, of same material as box, attached to box to act as plaster stop **OR** drywall bead, **as directed**.
   b. Trimless with Hidden Flange: Flange of same metal and finish as box overlaps surrounding wall finish and is concealed from view by an overlapping door.
   c. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
5. Semirecessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.
   a. Square-Edge Trim: 1-1/4- to 1-1/2-inch (32- to 38-mm) backbend depth.
   b. Rolled-Edge Trim: 2-1/2-inch (64-mm) **OR** 4-inch (102-mm) **OR** 4-1/2-inch (114-mm), **as directed**, backbend depth.
6. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim. Provide where walls are of insufficient depth for semirecessed cabinet installation.
7. Cabinet Trim Material: Steel sheet **OR** Aluminum sheet **OR** Extruded-aluminum shapes **OR** Stainless-steel sheet **OR** Copper-alloy brass sheet **OR** Copper-alloy bronze sheet **OR** Same material and finish as door, **as directed**.
8. Door Material: Steel sheet **OR** Aluminum sheet **OR** Extruded-aluminum shapes **OR** Stainless-steel sheet **OR** Copper-alloy brass sheet **OR** Copper-alloy bronze sheet, **as directed**.
9. Door Style: Fully glazed, frameless, backless, acrylic panel **OR** Fully glazed panel with frame **OR** Full bubble, frameless **OR** Full bubble with frame **OR** Full bubble with frameless, rotating turntable **OR** Horizontal duo panel with frame **OR** Vertical duo panel with frame **OR** Center glass panel with frame **OR** Solid opaque panel with frame **OR** Flush opaque panel, frameless, with no exposed hinges, **as directed**.

10. Door Glazing: Clear float glass **OR** Tempered float glass (clear) **OR** Tempered float glass (bronze tint) **OR** Break glass **OR** Tempered break glass **OR** Wire glass **OR** Mirror glass **OR** Acrylic sheet **OR** Break acrylic bubble **OR** Molded acrylic bubble, **as directed**.
    a. Acrylic Sheet Color: Clear **OR** Bronze, **as directed**, transparent acrylic sheet.
    b. Acrylic Sheet Color: Clear transparent acrylic sheet painted white **OR** red **OR** black, **as directed**, on unexposed side.
    c. Acrylic Bubble Color: Clear **OR** Bronze **OR** Red, **as directed**, transparent.
11. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
    a. Provide projecting lever handle with cam-action latch **OR** projecting door pull and friction latch **OR** recessed door pull and friction latch **OR** manufacturer's standard, **as directed**.
    b. Provide continuous hinge, of same material and finish as trim, **OR** concealed hinge **OR** pivot hinge **OR** manufacturer's standard hinge, **as directed,** permitting door to open 180 degrees.
12. Accessories:
    a. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
    b. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
    c. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
    d. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle **OR** Cylinder lock, keyed alike to other cabinets, **as directed**.
    e. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed.
        1) Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."
            a) Location: Applied to cabinet door **OR** cabinet glazing **OR** location indicated on Drawings, **as directed**.
            b) Application Process: Silk-screened **OR** Engraved **OR** Etched **OR** Decals **OR** Pressure-sensitive vinyl letters, **as directed**.
            c) Lettering Color: Red **OR** Black **OR** White, **as directed**.
            d) Orientation: Vertical **OR** Horizontal **OR** As indicated on Drawings, **as directed**.
    f. Alarm: Manufacturer's standard alarm that actuates when fire protection cabinet door is opened and that is powered by batteries **OR** low voltage, complete with transformer, **as directed**.
13. Finishes:
    a. Manufacturer's standard baked-enamel paint for the following:
        1) Exterior of cabinet door **OR** trim, **OR** door, and trim, **as directed,** except for those surfaces indicated to receive another finish.
        2) Interior of cabinet and door, **as directed**.
    b. Aluminum: Clear anodic **OR** Color anodic **OR** Baked enamel or powder coat, **as directed**.
    c. Steel: Factory primed for field painting **OR** Baked enamel or powder coat, **as directed**.
    d. Stainless Steel: No. 2B **OR** No. 4 **OR** No. 6 **OR** No. 7 **OR** No. 8, **as directed**.
    e. Copper Alloy, Brass: Buffed **OR** Hand rubbed **OR** Hand rubbed, lacquered **OR** Medium satin **OR** Fine matte **OR** Statuary conversion **OR** Patina conversion, **as directed**.
    f. Copper Alloy, Bronze: Buffed **OR** Hand rubbed **OR** Hand rubbed, lacquered **OR** Medium satin **OR** Fine matte **OR** Statuary conversion **OR** Patina conversion, **as directed**.

C. Security Fire Protection Cabinet
    1. Cabinet Type: Suitable for fire extinguisher **OR** extinguisher and hose valve **OR** hose, rack, valve, and extinguisher **OR** hose, rack, and valve **OR** hose valve, **as directed**.
    2. Cabinet Construction: Nonrated **OR** 1-hour fire rated **OR** 2-hour fire rated, **as directed**.

a. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls lined with minimum 5/8-inch- (16-mm-) thick, fire-barrier material.

3. Cabinet Material: 0.0677-inch- (1.7-mm-) thick steel **OR** 0.0966-inch- (2.5-mm-) thick steel **OR** 0.0781-inch- (2.0-mm-) thick, stainless-steel, **as directed,** sheet.
   a. Shelf: Same metal and finish as cabinet.
4. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.
   a. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
5. Semirecessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.
   a. Square-Edge Trim: 1-1/4- to 1-1/2-inch (32- to 38-mm) backbend depth.
   b. Rolled-Edge Trim: 2-1/2-inch (64-mm) backbend depth.
6. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall; with no trim. Provide where walls are of insufficient depth for semirecessed cabinet installation.
7. Cabinet Trim Material: Steel sheet **OR** Stainless-steel sheet **OR** Same material and finish as door, **as directed**.
8. Door Material: 0.0966-inch- (2.5-mm-) thick steel **OR** 0.0781-inch- (2.0-mm-) thick, stainless-steel **OR** 0.1094-inch- (2.8-mm-) thick, stainless-steel, **as directed,** sheet.
9. Door Style: Solid opaque panel with frame.
10. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated, and as follows:
    a. Recessed door pull.
    b. Continuous Hinge: Same material and finish as trim, permitting door to open 180 degrees.
    c. Mechanical Deadlock: Lockbolt retracted and extended by five-tumbler paracentric **OR** mogul, **as directed,** cylinder; keyed one side.
       1) Lockbolt: 1-1/2 inches high by 3/4 inch (38 mm high by 19 mm) thick; 5/8-inch (16-mm) throw.
    d. Mechanical Deadlock: As specified in Division 08 Section "Detention Door Hardware".
    e. Mechanical Snaplatch: Automatic snaplatch when closed; latchbolt retracted by five-tumbler paracentric **OR** mogul, **as directed,** cylinder; keyed one side.
       1) Lockbolt: 1 inch high by 7/16 inch (25 mm high by 11 mm) thick; 5/16-inch (8-mm) throw.
    f. Mechanical Snaplatch: As specified in Division 08 Section "Detention Door Hardware".
11. Accessories:
    a. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to security fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
    b. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed.
       1) Identify fire extinguisher in security fire protection cabinet with the words "FIRE EXTINGUISHER."
          a) Location: Applied to cabinet door **OR** location indicated on Drawings, **as directed**.
          b) Application Process: Silk-screened **OR** Engraved **OR** Etched **OR** Decals **OR** Pressure-sensitive vinyl letters, **as directed**.
          c) Lettering Color: Red **OR** Black **OR** White, **as directed**.
          d) Orientation: Vertical **OR** Horizontal **OR** As indicated on Drawings, **as directed**.
    c. Keys to Door Locks: Three per lock.
12. Finishes:
    a. Manufacturer's standard baked-enamel paint for the following:

1) Exterior of cabinet door **OR** trim, **OR** door, and trim, **as directed,** except for those surfaces indicated to receive another finish.
2) Interior of cabinet and door, **as directed**.

b. Steel: Factory primed for field painting **OR** Baked enamel or powder coat, **as directed**.
c. Stainless Steel: No. 4 finish.

D. Fabrication
1. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
   a. Weld joints and grind smooth.
   b. Provide factory-drilled mounting holes.
   c. Prepare doors and frames to receive locks.
   d. Install door locks at factory.
2. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
   a. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
   b. Fabricate door frames of one-piece construction with edges flanged.
   c. Miter and weld perimeter door frames.
3. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

E. General Finish Requirements
1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
2. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
3. Finish fire protection cabinets after assembly.
4. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

F. Aluminum Finishes
1. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm **OR** AA-M12C22A31, Class II, 0.010 mm, **as directed,** or thicker.
2. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm **OR** AA-M12C22A32/A34, Class II, 0.010 mm, **as directed,** or thicker.
   a. Color: Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Black, **as directed**.
   b. Color: As selected from full range of industry colors and color densities, **as directed**.
3. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
   a. Color and Gloss: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.

G. Steel Finishes
1. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning" **OR** SSPC-SP 8, "Pickling", **as directed**. After cleaning, apply a conversion coating suited to the organic coating to be applied over it, **as directed**.
2. Factory Prime Finish: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
3. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).

a. Color and Gloss: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.

H. Stainless-Steel Finishes
1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
   a. Run grain of directional finishes with long dimension of each piece.
   b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
   c. Directional Satin Finish: No. 4.
   d. Dull Satin Finish: No. 6.
   e. Reflective, Directional Polish: No. 7.
   f. Mirrorlike Reflective, Nondirectional Polish: No. 8.
3. Bright, Cold-Rolled, Unpolished Finish: No. 2B.

I. Copper-Alloy Finishes
1. Buffed Finish, Lacquered: M21-O6x (Mechanical Finish: buffed, smooth specular; Coating: clear organic, air drying, as specified below).
   a. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in 2 coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).
2. Hand-Rubbed Finish, Lacquered: M31-M34-O6x (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed; Coating: clear organic, air drying, as specified below).
   a. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in 2 coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).
3. Statuary Conversion Coating over Satin Finish: M31-C55 (Mechanical Finish: directionally textured, fine satin; Chemical Finish: conversion coating, sulfide).
   a. Color: Match sample.
4. Patina Conversion Coating: CDA-M36-C12-C52 (Mechanical Finish: directionally textured, uniform; Chemical Finish: nonetched cleaned, degreased; Chemical Finish: conversion coating, ammonium sulfate).
   a. Color: Match sample.

1.3 EXECUTION

A. Preparation
1. Prepare recesses for recessed and semirecessed fire protection cabinets as required by type and size of cabinet and trim style.

B. Installation
1. General: Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights indicated below: or, if not indicated, at heights acceptable to authorities having jurisdiction.
   a. Fire Protection Cabinets: 54 inches (1372 mm) above finished floor to top of cabinet.
2. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.
   a. Unless otherwise indicated, provide recessed fire protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semirecessed fire protection cabinets.
   b. Provide inside latch and lock for break-glass panels.
   c. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.
   d. Fire-Rated, Hose and Valve **OR** Hose-Valve, **as directed**, Cabinets:
      1) Install cabinet with not more than 1/16-inch (1.6-mm) tolerance between pipe OD and knockout OD. Center pipe within knockout.

2) Seal through penetrations with firestopping sealant as specified in Division 07 Section "Through-penetration Firestop Systems".

3. Identification: Apply decals **OR** vinyl lettering, **as directed**, at locations indicated.

C. Adjusting And Cleaning

1. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
2. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
3. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
4. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.
5. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10521

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SECTION 10522 - FIRE EXTINGUISHERS

1.1 GENERAL

A. Description Of Work:
1. This specification covers the furnishing and installation of materials for fire extinguishers. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section includes portable, hand-carried and wheeled fire extinguishers and mounting brackets for fire extinguishers.
2. Owner-Furnished Material: Hand-carried **OR** Wheeled, **as directed**, fire extinguishers.

C. Submittals
1. Product Data: For each type of product indicated.
2. Operation and maintenance data.
3. Warranty: Sample of special warranty.

D. Quality Assurance
1. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
2. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
3. Preinstallation Conference: Conduct conference at Project site.
4. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

E. Warranty
1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within six years from date of Substantial Completion.
   a. Failures include, but are not limited to, the following:
      1) Failure of hydrostatic test according to NFPA 10.
      2) Faulty operation of valves or release levers.

1.2 PRODUCTS

A. Portable, Hand-Carried Fire Extinguishers
1. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet **OR** mounting bracket **OR** fire protection cabinet and mounting bracket, **as directed**, indicated.
   a. Valves: Manufacturer's standard **OR** Nickel-plated, polished brass body, **as directed**.
   b. Handles and Levers: Manufacturer's standard **OR** Stainless steel, **as directed**.
   c. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.
2. Stored-Pressure Water Type: UL-rated 2-A, 2.5-gal. (9.5-L) nominal capacity, with water in stainless-steel container; with pressure-indicating gage.
3. Stored-Pressure Antifreeze Water Type: UL-rated 2-A, 2.5-gal. (9.5-L) nominal capacity, with water and approved antifreeze solution mixed for temperatures as low as minus 40 deg F (minus 40 deg C) in stainless-steel container; with pressure-indicating gage.

4. Stored-Pressure Water-Mist Type: UL-rated 2-A:C, 2.5-gal. (9.5-L) nominal capacity, with water in enameled-steel container; with pressure-indicating gage.
5. Pressurized, AFFF-Foam Type: UL-rated 2-A:10-B, 1.6-gal. (6-L) **OR** 3-A:20-B, 2.5-gal. (9.5-L), **as directed**, nominal capacity, with AFFF foam in stainless-steel container; with pressure-indicating gage.
6. Pressurized, FFFP-Foam Type: UL-rated 3-A:20-B, 2.5-gal. (9.5-L) nominal capacity, with FFFP foam in stainless-steel container; with pressure-indicating gage.
7. Wet-Chemical Type: UL-rated 2-A:1-B:C:K, 1.6-gal. (6-L) **OR** 2.5-gal. (9.5-L), **as directed**, nominal capacity, with potassium acetate-based **OR** citrate-based **OR** carbonate-based, **as directed**, chemical in stainless-steel container; with pressure-indicating gage.
8. Regular Dry-Chemical Type: UL-rated <**Insert capacity**> nominal capacity, with sodium bicarbonate-based dry chemical in manufacturer's standard enameled container.
9. Regular Dry-Chemical Type in Steel Container: UL-rated 2-B:C, 1-lb (0.4-kg) **OR** 10-B:C, 2.5-lb (1.1-kg) **OR** 10-B:C, 5-lb (2.3-kg) **OR** 40-B:C, 5.5-lb (2.5-kg) **OR** 40-B:C, 6-lb (2.7-kg) **OR** 60-B:C, 10-lb (4.5-kg) **OR** 120-B:C, 20-lb (9.1-kg), **as directed**, nominal capacity, with sodium bicarbonate-based dry chemical in enameled-steel container.
10. Regular Dry-Chemical Type in Aluminum Container: UL-rated 2-B:C, 1-lb (0.4-kg) **OR** 10-B:C, 2.5-lb (1.1-kg) **OR** 10-B:C, 5-lb (2.3-kg) **OR** 40-B:C, 5.5-lb (2.5-kg) **OR** 60-B:C, 10-lb (4.5-kg) **OR** 120-B:C, 20-lb (9.1-kg), **as directed**, nominal capacity, with sodium bicarbonate-based dry chemical in enameled-aluminum container.
11. Regular Dry-Chemical Type in Brass Container: UL-rated 40-B:C, 6-lb (2.7-kg) **OR** 60-B:C, 10-lb (4.5-kg) **OR** 120-B:C, 20-lb (9.1-kg), **as directed**, nominal capacity, with sodium bicarbonate-based dry chemical in chrome-plated brass container.
12. Multipurpose Dry-Chemical Type: UL-rated <**Insert capacity**> nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.
13. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 1-A:10-B:C, 2.5-lb (1.1-kg) **OR** 2-A:10-B:C, 5-lb (2.3-kg) **OR** 3-A:40-B:C, 5-lb (2.3-kg) **OR** 3-A:40-B:C, 6-lb (2.7-kg) **OR** 4-A:60-B:C, 10-lb (4.5-kg) **OR** 20-A:120-B:C, 20-lb (9.1-kg), **as directed**, nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.
14. Multipurpose Dry-Chemical Type in Aluminum Container: UL-rated 1-A:10-B:C, 2.5-lb (1.1-kg) **OR** 2-A:10-B:C, 5-lb (2.3-kg) **OR** 3-A:40-B:C, 5-lb (2.3-kg) **OR** 3-A:40-B:C, 6-lb (2.7-kg) **OR** 4-A:60-B:C, 10-lb (4.5-kg) **OR** 20-A:120-B:C, 20-lb (9.1-kg), **as directed**, nominal capacity, with monoammonium phosphate-based dry chemical in enameled-aluminum container.
15. Multipurpose Dry-Chemical Type in Brass Container: UL-rated 2-A:10-B:C, 5-lb (2.3-kg) **OR** 3-A:40-B:C, 6-lb (2.7-kg) **OR** 4-A:60-B:C, 10-lb (4.5-kg) **OR** 4-A:80-B:C, 10-lb (4.5-kg) **OR** 20-A:120-B:C, 20-lb (9.1-kg), **as directed**, nominal capacity, with monoammonium phosphate-based dry chemical in chrome-plated brass container.
16. Purple-K Dry-Chemical Type in Aluminum Container: UL-rated 10-B:C, 2.5-lb (1.1-kg) **OR** 30-B:C, 5-lb (2.3-kg) **OR** 120-B:C, 20-lb (9.1-kg), **as directed**, nominal capacity, with potassium bicarbonate-based dry chemical in enameled-aluminum container.
17. Purple-K Dry-Chemical Type in Brass Container: UL-rated 80-B:C, 10-lb (4.5-kg) **OR** 120-B:C, 20-lb (9.1-kg), **as directed**, nominal capacity, with potassium bicarbonate-based dry chemical in chrome-plated brass container.
18. Carbon Dioxide Type: UL-rated 5-B:C, 5-lb (2.3-kg) **OR** 10-B:C, 10-lb (4.5-kg) **OR** 10-B:C, 15-lb (6.8-kg) **OR** 10-B:C, 20-lb (9.1-kg), **as directed**, nominal capacity, with carbon dioxide in manufacturer's standard enameled-metal **OR** enameled-steel **OR** enameled-aluminum, ,**as directed** container.
19. Dry-Powder Type: FMG-approved, **as directed**, UL-rated Class D, 30-lb (13.6-kg) nominal capacity, with sodium chloride-based **OR** copper-based, **as directed**, powder in enameled-steel container; with pressure-indicating gage.
20. Halon Type: UL-rated 5-B:C, 2.5-lb (1.1-kg) **OR** 10-B:C, 5-lb (2.3-kg), **as directed**, nominal capacity, in enameled-steel container; with pressure-indicating gage.
21. Clean-Agent Type in Aluminum Container: UL-rated 1-B:C, 1.4-lb (0.6-kg) **OR** 2-B:C, 2.5-lb (1.1-kg) **OR** 5-B:C, 5-lb (2.3-kg), **as directed**, nominal capacity, with HCFC Blend B agent and inert material in enameled-aluminum container; with pressure-indicating gage.

22. Clean-Agent Type in Brass Container: UL-rated 1-A:10-B:C, 11-lb (5-kg) **OR** 2-A:10-B:C, 15.5-lb (7-kg), **as directed**, nominal capacity, with HCFC Blend B agent and inert material in chrome-plated brass container; with pressure-indicating gage.
23. Clean-Agent Type in Steel Container: UL-rated 5-B:C, 4.75-lb (2.2-kg) **OR** 1-A:10-B:C, 10-lb (4.5-kg) **OR** 2-A:10-B:C, 14-lb (6.4-kg), **as directed**, nominal capacity, with HFC blend agent and inert material in enameled-steel container; with pressure-indicating gage.

B. Mounting Brackets
1. Mounting Brackets: Manufacturer's standard galvanized, **as directed**, steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red **OR** black, **as directed**, baked-enamel finish.
2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
   a. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
      1) Orientation: Vertical **OR** Horizontal, **as directed**.

C. Wheeled Fire Extinguishers
1. Wheeled Fire Extinguishers: Type, size, and capacity for locations indicated, complete with carriage.
   a. Carriage: Fabricated from enameled-steel pipe, complete with hanger assembly, long-range nozzle, hose, and semipneumatic solid-rubber tires **OR** wide-rim wheels, **as directed**.
      1) Hose: 15 feet (4.6 m) **OR** 50 feet (15.2 m) **OR** 100 feet (30.5 m), **as directed**.
2. Pressurized, FFFP-Foam Type: UL-rated 20-A:160-B, 33-gal. (125-L) nominal capacity, with FFFP foam in stainless-steel container.
3. Regular Dry-Chemical Type: UL-rated 160-B:C, 50-lb (23-kg) **OR** 240-B:C, 150-lb (68-kg) **OR** 160-B:C, 250-lb (113-kg), **as directed**, nominal capacity, with sodium bicarbonate-based dry chemical in regulated-pressure **OR** stored-pressure **OR** direct-pressure, **as directed**, enameled-steel container.
4. Multipurpose Dry-Chemical Type: UL-rated 20-A:160-B:C, 30-lb (13.6-kg) **OR** 30-A:160-B:C, 50-lb (23-kg) **OR** 40-A:240-B:C, 125-lb (57-kg) **OR** 40-A:160-B:C, 250-lb (113-kg), **as directed**, nominal capacity, with monoammonium phosphate-based dry chemical in regulated-pressure **OR** stored-pressure **OR** direct-pressure, **as directed**, enameled-steel **OR** enameled-aluminum, **as directed**, container.
5. Purple-K Dry-Chemical Type: UL-rated 160-B:C, 50-lb (23-kg) **OR** 320-B:C, 125-lb (57-kg) **OR** 160-B:C, 250-lb (113-kg), **as directed**, nominal capacity, with potassium bicarbonate-based dry chemical in regulated-pressure **OR** stored-pressure **OR** direct-pressure, **as directed**, enameled-steel container.
6. Carbon Dioxide Type: UL-rated 20-B:C, 50-lb (23-kg) **OR** 20-B:C, 100-lb (45-kg), **as directed**, nominal capacity, with carbon dioxide in manufacturer's standard enameled-metal **OR** enameled-steel **OR** enameled-aluminum, **as directed**, container.
7. Dry-Powder Type: FMG-approved, **as directed**, UL-rated Class D, sodium chloride-based powder, 150-lb (68-kg) **OR** copper-based powder, 250-lb (113-kg), **as directed**, nominal capacity, in regulated-pressure, enameled-steel container; with pressure-indicating gage.
8. Clean-Agent Type: UL-rated 4-A:40-B:C, 65-lb (29-kg) **OR** 10-A:80-B:C, 150-lb (68-kg), **as directed**, nominal capacity, with HCFC Blend B agent and inert material in stored-pressure, enameled-steel container; with pressure-indicating gage.

1.3 EXECUTION

A. Installation
1. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

a. Mounting Brackets: 54 inches (1372 mm) above finished floor to top of fire extinguisher. If NFPA 10 is the governing code, maximum mounting height for fire extinguishers weighing 40 lb (18 kg) or less shall be 60 inches (1524 mm); for those weighing more, maximum mounting height shall be 42 inches (1067 mm).

2. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 10522

Task	Specification	Specification Description
10522	01352	No Specification Required

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SECTION 10531 - EXTRUDED ALUMINUM WALKWAY COVER

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of mesh or netting for extruded aluminum walkway cover. Products shall be as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Submittals
1. Product Data: Submit manufacturer's product information, specifications and installation instructions for building components and accessories.
2. Shop Drawings: Submit complete shop drawings including all necessary plan dimensions, elevations and details. Contractor shall verify all dimensions and provide elevations at each column, finish floor, and related soffit prior to manufacturer for fabrication.
3. Certification: Submit design calculations signed by a Registered Professional Engineer, licensed in the project state. Design calculations shall state that the walkway cover system design complies with the wind requirements of ASCE 7-95, the stability criteria of applicable building code, and all other governing criteria.

C. Quality Assurance
1. Walkway cover shall be wholly produced by a recognized manufacturer with at least 5 years experience in the design and fabrication of extruded aluminum walkway cover systems. Components shall be assembled in shop to the greatest extent possible to minimize field assembly. Walkway system shall be installed by manufacturer. Walkway system, including material and workmanship, shall be warranted from defects for a period of one year from substantial completion of installation.

1.2 PRODUCTS

A. Design
1. Walkway cover shall be all welded extruded aluminum system complete with internal drainage. Non-welded systems are not acceptable. Roll formed deck is not acceptable. Expansion joints shall be included to accommodate temperature changes of 120 degrees F. Expansion joints shall have no metal to metal contact.

B. Materials
1. Aluminum Members: Extruded aluminum 6063 alloy, heat treated to T-6 temper.
2. Fasteners: Aluminum, 18-8 stainless steel or 300 series stainless steel.
3. Protective coating: Aluminum columns embedded in concrete shall be protected with clear acrylic coating.
4. Grout: 2000 psi compressive strength, 1 part Portland cement to 3 parts masonry sand. Add water to grout mixture to produce pouring consistency.
5. Gaskets: Dry seal santoprene or neoprene, pressure type.

C. Components
1. Columns: Radius-cornered tubular extrusion of size indicated with cutout and internal diverter for drainage where indicated. Circular downspout openings in columns are not acceptable.
2. Beams: Open-top tubular extrusion of size and shape indicated, top edges thickened for strength and designed to receive deck members in self-flashing manner. Structural ties shall be installed in tops of beams.

3. Deck: Extruded self-flashing sections interlocking into a composite unit. Closures at deck ends shall be welded plates.
4. Fascia: Manufacturer's standard shape. Size as directed.
5. Flashing: Minimum 0.040-inch thick aluminum.

D. Fabrication
1. Internal Drainage: Water flow shall be directed from deck to beams to columns, as indicated by the shop drawings, for discharge out "weepholes" at ground level. Should underground drainage be required, proper coordination of trades shall be by Contractor.
2. Bent Construction: Beams and columns shall be factory welded with neatly mitered corners into rigid, one-piece units. All welds shall be smooth and uniform using an inert gas shielded arc. Suitable edge preparation shall be provided to assure 100 percent penetration. Grind welds only where interfering with adjoining structure to allow for flush connection. Field welding is not permitted. When size of bent does not permit shipment as a welded unit, rigid mechanical joints may be utilized.
3. Deck Construction: Extruded self-flashing deck sections shall interlock into a composite unit, spanning double-bays. Interlocking joints shall be positively fastened at 8-inches on centers, creating a monolithic structural unit capable of developing the full strength of the sections. The fastenings shall have minimum shear strength of 350 pounds each. Deck shall be assembled with sufficient camber to offset dead load deflection.

E. Finish
1. Clear anodized 204-R1, per AA-M10C22A21 (AAMA 607.1) **OR** bronze, amber or black anodizing per AA-M10C22A42 (AAMA 606.1), **as directed**, color to be selected,
OR
Painted finish shall be baked acrylic enamel (AAMA 603.8) over chromate conversion pretreatment or wash-etch primer **OR** polyester powder coating **OR** high-performance fluoropolymer coating (AAMA 605.2), **as directed**, on deck and fascia.

F. Light Fixture
1. Surface mounted to roof deck as shown on the drawings. Construction shall be of a welded weatherproof, extruded housing, high impact FR grade white acrylic diffuser tethered to housing by wire cables, including 1/2-inch conduit coupling and "Weldnuts" for attachment to roof deck. Finish shall match the extruded roof deck. Ballast shall be class P of voltage required, 0 degree F start. Sockets shall receive dual lamps. Fixtures shall occur at each bay of deck. All penetrations will be covered with a bed of silicone caulking. Caulking shall be applied to a clean and dry surface.

G. Accessories
1. Provide all accessories, fasteners, flashings and other items as necessary for a complete installation.

1.3 EXECUTION

A. Erection
1. Concrete Footings: Provide manufacturer's standard column sleeves (styrofoam block-outs).
2. Surface Mount: Bents shall be anchored to top of existing walks. In canopy runs where lengths exceed 100 ft., the next proceeding bent shall be set into a concrete footing.

B. Installation
1. Walkway cover shall be erected true to line, level, and plumb. Aluminum columns embedded in concrete shall be protected with clear acrylic. Downspout columns shall be filled with grout to the discharge level to prevent standing water. Non-draining columns shall have weep holes installed at top of concrete to remove condensation.

C. Cleaning
   1. All walkway cover components shall be cleaned promptly after installation.

D. Protection
   1. Extreme care shall be taken to protect materials during and after installation.

END OF SECTION 10531

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Task	Specification	Specification Description
10531	01352	No Specification Required

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SECTION 10535 - AWNINGS

1.1 GENERAL

A. Description Of Work:
1. This specification covers the furnishing and installation of materials for awnings. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. This Section includes the following:
a. Fixed awnings.
b. Retractable awnings, manually operated and motorized.

C. Definitions
1. Awning: An architectural projection that provides weather protection, identity, or decoration and is wholly supported by the building to which it is attached. An awning is comprised of a lightweight, rigid skeleton structure over which a rigid covering is attached.
2. Retractable Awning: A cover with a frame that retracts against a building or other structure to which it is entirely supported.

D. Performance Requirements
1. General: Design, fabricate, and install awnings to withstand loads from gravity, wind, snow, ponding, drift, seismic, and structural movement, including thermally induced movement; and to resist, without failure, other conditions of in-service use, including exposure to weather.
2. Structural Performance: Provide awnings capable of withstanding the effects of gravity loads and loads and stresses within limits and under conditions required for the location of the Work.
3. Seismic Performance: Provide awnings capable of withstanding the effects of earthquake motions determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures."
4. Thermal Movements: Provide awnings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, tearing of fabric, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
a. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

E. Submittals
1. Product Data: Include styles, material descriptions, construction details, fabrication details, dimensions of individual components and profiles, hardware, fittings, mounting accessories, features, finishes, and operating instructions for awnings.
a. Motorized Awning Operators: Include operating instructions.
b. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.
2. Shop Drawings: Show location and extent of awnings. Include elevations, sections, and details not shown in Product Data. Show materials, fabrication, dimensions, mounting heights, connections, anchorages, installation details, attachments to other work, operational clearances, and relationship to adjoining work. Show colors and graphic layout and content.
3. Samples: For each of the following products and for the full range of color, texture, and pattern variations required, prepared on Samples of size indicated below. If finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
a. Awning Fabric: 12-inch- (300-mm-) square section of fabric from dye lot to be used for the Work, with specified treatments applied. Mark face of fabric.

b. Graphics: Not less than 12-inch- (300-mm-) square section showing graphics application method.
c. Seam, Edge, and Corner Condition: Not less than 12-inch- (300-mm-) long section showing seam, edge, and corner treatment.
d. Valance: Full-size unit, not less than 12 inches (300 mm) long.
e. Frame Finish: Not less than 6-inch (150-mm) lengths.
f. Frame Corner and Three **OR** Four, **as directed**,-Way Truss Intersection: Not less than 12-inch (300-mm) sections showing finished joint construction and fabric and valance attachment to awning frame.
g. Exposed Hardware Finishes: Manufacturer's standard-size unit, not less than 3 inches (76 mm) square.
h. Accessories: Manufacturer's full-size unit.

4. Welding certificates.
5. Maintenance Data: For awnings to include in maintenance manuals.

F. Quality Assurance
1. Welding: Qualify procedures and personnel according to the following:
a. AWS D1.1/D1.1M, "Structural Welding Code--Steel."
b. AWS D1.2, "Structural Welding Code--Aluminum."
2. Regulatory Requirements: Provide awnings complying with or exceeding requirements of authorities having jurisdiction>.
3. Fire-Test-Response Characteristics: Provide awning fabrics with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
a. Flame-Resistance Ratings: Passes NFPA 701 **OR** California Code of Regulations, Title 19, **as directed**.
b. Permanently attach label to each awning fabric indicating whether fabric is inherently and permanently flame resistant, or treated with flame-retardant chemicals, and whether it will require retreatment after designated time period or cleaning.
4. 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.

G. Warranty: Manufacturer's standard form in which manufacturer and fabricator agree to repair or replace components of awnings that fail in materials or workmanship within specified warranty period.
1. Awning Warranty Period: Five years from date of Substantial Completion.
2. Fabric Warranty Period: Three **OR** Five **OR** Eight **OR** 12, **as directed**, years from date of Substantial Completion.
3. Thread Warranty Period: Five **OR** Eight, **as directed**, years from date of Substantial Completion.
4. Graphics Warranty Period: Outdoor durability not less than five **OR** three, **as directed**, years from date of Substantial Completion.

1.2 PRODUCTS

A. Awning Fabrics
1. Fabric Fiber Content: Vinyl-laminated or -coated polyester mesh **OR** Vinyl-laminated or -coated polyester **OR** Acrylic-coated polyester **OR** Resin-coated polyester **OR** Vinyl-coated polyester/cotton blend **OR** Acrylic-coated polyester/cotton blend **OR** Resin-coated polyester/cotton blend **OR** Solution-dyed acrylic **OR** Solution-dyed modacrylic, **as directed**.
2. Style:
a. Bottom Hem: Straight **OR** Scalloped, evenly spaced pattern **OR** As indicated by manufacturer's designation **OR** As indicated in an awning schedule, **as directed**.

b. Trim: As indicated by manufacturer's designation for style and color **OR** As indicated in a window treatment schedule, **as directed**.
c. Fringe: As indicated by manufacturer's designation for style and color **OR** As indicated in an awning schedule, **as directed**.
d. Color: Match samples **OR** As selected from manufacturer's full range **OR** As indicated in an awning schedule, **as directed**.
e. Applied Treatment: Stain resistant **OR** Mildew resistant **OR** Polymer, flame resistant **OR** Water repellent **OR** Lamination, **as directed**.
f. Performance Characteristics: As follows:
1) Mildew Resistance: Showing no growth when tested per ASTM G 21.
2) Shrinkage: Not greater than 0.1 **OR** 0.5 **OR** 1, **as directed**, percent per ASTM D 1204.
3) Stretch Factor: Not less than 0.4 **OR** 1 **OR** 4, **as directed**, percent per ASTM D 4851.

3. Graphic Application: Hand painting **OR** Silk-screen printing **OR** Heat color transfer **OR** Vinyl film with pressure-sensitive adhesive backing **OR** PVDF film with pressure-sensitive adhesive backing **OR** PVF film with pressure-sensitive adhesive backing **OR** Radio-frequency, heat-sealed vinyl film **OR** Eradication **OR** Cut-out lettering, **as directed**.
a. Text Message: As indicated on Drawings **OR** As indicated in an awning schedule, **as directed**.
1) Text Font: Arial, **unless directed otherwise**.
2) Character Size: Minimum 1-inch- (25.4-mm-) **OR** 1-foot- (0.3048-m-), **as directed**, high characters.
b. Vinyl Film: Calendered-vinyl film, not less than 3 mils (0.076 mm) thick, with pressure-sensitive adhesive backing **OR** Cast-vinyl film, not less than 2 mils (0.051 mm) thick, with pressure-sensitive adhesive backing **OR** Cast-vinyl reflective film, not less than 2 mils (0.051 mm) thick, with pressure-sensitive adhesive backing, **as directed**.

4. Inset Fabric: Heat-sealed **OR** Sewn-in, **as directed**, process, and as follows:
a. Colors: Match samples **OR** As selected from manufacturer's full range **OR** As indicated in an awning schedule, **as directed**.
b. Applied Treatment: Stain resistant **OR** Mildew resistant **OR** Polymer, flame resistant **OR** Water repellent, **as directed**.

B. Thread: 100 percent expanded PTFE **OR** 100 percent bonded polyester, **as directed**, UV-light, mildew, and rot resistant.

C. Awning Frames
1. Steel Frames:
a. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
b. Cold-Formed Steel Tubing: ASTM A 500, grade as required by structural loads.
c. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless another weight is indicated or required by structural loads.
d. Steel Mechanical Tubing: Cold-rolled, electric-resistance-welded carbon or alloy steel tubing complying with ASTM A 513 or steel tubing fabricated from steel complying with ASTM A 1011/A 1011M and complying with dimensional tolerances in ASTM A 500.
e. Steel Finish: Manufacturer's standard galvanized and corrosion-resistant mill **OR** Manufacturer's standard decorative **OR** Baked-enamel **OR** Powder-coat, **as directed**, finish complying with finish manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.
2. Aluminum Frames: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated and with not less than the strength and durability properties of alloy and temper required by structural loads.
a. Aluminum Plate and Sheet: ASTM B 209 (ASTM B 209M).
b. Aluminum Extrusions: ASTM B 221 (ASTM B 221M).
c. Extruded Structural Pipe and Round Tubing: ASTM B 429, standard weight (Schedule 40) unless another weight is indicated or required by structural loads.

d. Drawn Seamless Tubing: ASTM B 210 (ASTM B 210M).
e. Aluminum Finish: Mill **OR** Manufacturer's standard decorative **OR** Baked-enamel **OR** Powder-coat, **as directed**, finish complying with finish manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

3. Anchors, Fasteners, Fittings, Hardware, and Installation Accessories: Complying with performance requirements indicated and suitable for exposure conditions, supporting structure, anchoring substrates, and installation methods indicated. Corrosion-resistant or noncorrodible units; weather-resistant, tamperproof, vandal- and theft-resistant, compatible, nonstaining materials. Provide as required for awning assembly, mounting, and secure attachment. Number as needed to comply with performance requirements and to maximize appearance; evenly spaced. Where exposed to view, with finish and color as selected by Architect from manufacturer's full range.
   a. Wood Screws: ASME B18.6.1.
   b. Lag Bolts: ASME B18.2.1. (ASME B18.2.3.8M).
   c. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.
   d. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
      1) Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).
   e. Adhesive-Bonded Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 1512 conducted by a qualified independent testing and inspecting agency.
      1) Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).
   f. Grommets: Zinc-coated brass, No. 2 **OR** Stainless steel, No. 2, **as directed**.
      1) Grommet Spacing: 6-inch (150-mm) o.c.
   g. Lacing: 100 percent polyester, braided No. 4.
4. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
5. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

D. Awning Fabrication
1. Fabrics: Reinforce wear points and hardware attachment points with nonwoven **OR** mesh **OR** polypropylene mesh, **as directed**, webbing.
   a. Fabric Edges and Seams:
      1) Fold and stitch selvedge, and cut fabric edges.
      2) Hot cut and sealed.
      3) Radio-frequency welded.
      4) Adhesively bonded.
      5) Manufacturer's standard hemming and seaming methods.
2. Decorative Trims: Borders **OR** Braid and bindings **OR** Cords **OR** Fringe **OR** Patterned edge; scalloped **OR** Patterned edge; V-shaped **OR** Streamers **OR** Tassels **OR** Welting, **as directed**.
   a. Colors: As indicated by manufacturer's designations **OR** Match samples **OR** Matching or coordinating with awning fabric color **OR** As selected from manufacturer's full range **OR** As indicated in an awning schedule, **as directed**.

3. Frames: Preassemble awning frames in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
   a. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
   b. Form exposed work true to line and level with accurate angles and surfaces and straight edges.
   c. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Fabricate slip-fit connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
   d. Weld corners and connections continuously. Obtain fusion without undercut or overlap. Remove welding flux immediately. At exposed corners and connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
   e. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications in place and to properly transfer loads.
4. Colors of Metal and Plastic Components Exposed to View: As indicated by manufacturer's designations **OR** Match samples **OR** Matching or coordinating with awning fabric color **OR** As selected from manufacturer's full range **OR** As indicated in an awning schedule, **as directed**.

E. Retractable Awning Operators
1. Manual Operation: With gear and crank operator.
   a. Manual Operation Assist Mechanism: Manufacturer's standard spring assist for operating heavy awnings.
   b. Crank Handle: One **OR** Two, **as directed**, detachable.
   c. Awning Coupler System: Designed for simultaneously operating two **OR** three, **as directed**, awnings with a single crank. Provide system for each group of awnings **OR** where indicated on Drawings **OR** where indicated in an awning schedule, **as directed**.
   d. Operating Function: Stop and hold awning at any position in ascending or descending travel **OR** Stop and hold awning at either fully open or fully closed positions only, **as directed**.
2. Motorized Operation: Provide factory-assembled motorized retractable awning operation systems designed for retracing awnings of type, size, weight, construction, use, and operation frequency indicated. Provide operation systems of size and capacity and with features, characteristics, and accessories suitable for Project conditions and recommended by awning manufacturer, complete with electric motors and factory-prewired motor controls, remote-control stations, remote-control devices, power disconnect switches, enclosures protecting controls and all operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
3. Comply with NFPA 70.
4. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6 with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.
5. Electric Motors: UL-approved or -recognized, totally enclosed, insulated motor, complying with NEMA MG 1, with thermal-overload protection and internal limit switches; sized by awning manufacturer to start and operate size and weight of awning considering service factor or considering Project's service conditions without exceeding nameplate ratings.
   a. Service Factor: According to NEMA MG 1, unless otherwise indicated.
   b. Motor Characteristics: Single phase, 24 **OR** 110 **OR** 220, **as directed**, V, 60 Hz.
   c. Coordinate wiring requirements and electrical characteristics of motors with building electrical system.
   d. Motor Mounting: Within manufacturer's standard roller enclosure.
6. Remote Controls: Electric controls with NEMA ICS 6, Type 1 **OR** 4, **as directed**, enclosure for surface **OR** recessed or flush, **as directed**, mounting. Provide the following devices for remote-control activation of awnings:
   a. Control Stations:

1) Keyed, maintained **OR** momentary, **as directed**,-contact, three-position, switch-operated control station with open, close, and off functions. Provide two keys per station.
OR
Maintained **OR** Momentary, **as directed**,-contact, three-position, toggle **OR** rocker, **as directed**,-style, wall switch-operated control station with open, close, and center off functions.
2) Color: Ivory **OR** White **OR** As indicated in an awning schedule, **as directed**.

b. Group Control Stations: Maintained **OR** Momentary, **as directed**,-contact, three-position, rocker-style, wall switch-operated control station with open, close, and center-off functions for single-switch group control.
1) Color: Ivory **OR** White **OR** As indicated in an awning schedule, **as directed**.

c. Individual/Group Control Stations: Maintained **OR** Momentary, **as directed**,-contact, three-position, rocker-style, wall switch-operated control station with open, close, and center-off functions for individual and group control.
1) Color: Ivory **OR** White **OR** As indicated in an awning schedule, **as directed**.

d. Sun Sensor Controls: Programmable system activated by LEDs detecting daylight intensity and responding by automatically adjusting awnings.

e. Radio Controls: Digital system consisting of code-compatible universal coaxial receiver, one per awning **OR** where indicated on Drawings, **as directed**, and two portable single-channel transmitters for operating a single motor with a single button to open and close awning.

f. Radio Controls: Digital system consisting of code-compatible universal coaxial receiver, one per awning **OR** where indicated on Drawings **OR** where indicated in an awning schedule, **as directed**, and two portable multiple-channel transmitters for operating two **OR** four **OR** up to 12, **as directed**, awnings individually, each with a single button to open and close awnings.

g. Timer Controls: Clock timer, 24-hour **OR** seven-day, **as directed**, programmable for regular events.

h. Microprocessor Controls: Electronic programmable means for setting, changing, and adjusting control features. Provide unit isolated from voltage spikes and surges.

7. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop awning at fully raised and fully lowered positions.

8. Operating Function: Stop and hold awning at any position **OR** Stop and hold awning at three predetermined positions including open, closed, and one user-programmed position, **as directed**.

9. Operating Features: Include the following:
a. Group switching with integrated switch control; single face plate for multiple switch cut-outs.
b. Capable of accepting input from building automation control system.
c. Override switch.
d. Backup gear and crank operator for manual operation during power failures with detachable handle, 6 feet (1.8 m) long **OR** manufacturer's standard length **OR** length required to make operation convenient from ground level **OR** length as indicated on Drawings, **as directed**.

10. Awning Hood: Sheet metal enclosure sized to fit awning roller and operating hardware inside and designed for UV-light, dust, weather, and vandal protection. Finish and color to match awning framing **OR** as indicated on Drawings **OR** as indicated in an awning schedule, **as directed**.

1.3 EXECUTION

A. Installation, General
1. General: Install awnings and motor controls at locations and in position indicated, securely connected to supports, free of rack, and in proper relation to adjacent construction. Use

mounting methods of types described and in compliance with Shop Drawings and fabricator's written instructions.

2. Install awnings after other finishing operations, including joint sealing and painting, have been completed.
3. Attach fabric to frames as recommended by fabricator, by stapling into slotted track in frame **OR** using lacing method as required to conceal ends of lacing OR using fabric hem pockets, **as directed**, to ensure tight, wrinkle-free fit of fabric to frame.
4. Slip fit frame connections accurately together to form hairline joints and tighten to secure.
5. Weld frame connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
   a. Field Welding: Comply with the following requirements:
      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) At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
6. Anchoring to In-Place Construction: Use anchors, fasteners, fittings, hardware, and installation accessories where necessary for securing awnings to structural support and for properly transferring load to in-place construction.
7. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.
8. Coordinate awning installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed exterior wall and roof assemblies.
9. Connections: Connect motorized operators to building electrical system.

B. Adjusting
   1. Adjust awnings to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

C. Cleaning And Protection
   1. Clean awning surfaces after installation, according to manufacturer's written instructions.
   2. Touchup Painting: Immediately after erection, clean field welds, connections, and abraded areas. Paint uncoated and abraded areas with same or compatible material as used for shop-applied finish painting.
      a. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
   3. Galvanized Surfaces: Clean field welds, connections, and abraded areas and repair galvanizing to comply with ASTM A 780.
   4. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that awnings are without damage or deterioration at time of Substantial Completion.
   5. Replace damaged awnings that cannot be repaired, in a manner approved, before time of Substantial Completion.

END OF SECTION 10535

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SECTION 10552 - POSTAL SPECIALTIES

1.1 GENERAL

A. Description Of Work:
1. This specification covers the furnishing and installation of materials for postal specialties. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section Includes:
a. USPS-approved horizontal mail receptacles.
b. Private-delivery horizontal mail receptacles.
c. Private postal-facility horizontal mail receptacles.
d. Vertical mail receptacles.
e. USPS-approved cluster box units (CBUs).
f. Neighborhood delivery and collection box units (NDCBUs).
g. USPS-approved parcel lockers.
h. USPS-approved collection boxes.
i. Private collection boxes.
j. Data distribution boxes.
k. Mail chutes.
l. Accessories:
1) Directory for mail receptacles.
2) Key keeper.
3) Key cabinet.
4) Mail-sorting collection unit.
5) Letter drops.
6) Package depository.

C. Submittals
1. Product Data: For each type of product indicated.
2. Shop Drawings: For postal specialties. Include plans, elevations, sections, details, identification sequence for compartments, and attachments to other work.
3. Samples: For each exposed product and for each color and texture specified.
4. Product certificates, including written approval by Postmaster General, as applicable.
5. Maintenance data.
6. Other Informational Submittals: Final USPS local postmaster approval for installed postal specialties to be served by USPS.

D. Quality Assurance
1. Source Limitations for Each Type of Postal Specialty: For USPS-approved products, use only those included on current lists of USPS manufacturers and models.
2. Preinstallation Conference: Conduct conference at Project site.

E. Delivery, Storage, And Handling
1. Deliver lock keys to Owner by registered mail or overnight package service with a record of each corresponding lock and key number.
2. Deliver combination-lock combinations to Owner by registered mail or overnight package service with a record of each corresponding lock and combination.

F. Warranty

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of postal specialties that fail in materials or workmanship within five years from date of Substantial Completion.

1.2 PRODUCTS

A. Materials
1. Aluminum: Manufacturer's standard alloy and temper for type of use and finish indicated, and as follows:
   a. Sheet and Plate: ASTM B 209 (ASTM B 209M).
   b. Extruded Shapes: ASTM B 221 (ASTM B 221M).
2. Steel Sheet: Cold rolled, ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, exposed matte finish where exposed.
3. Metallic-Coated Steel Sheet: Galvanized-steel sheet, ASTM A 653/A 653M, G60 (Z180) coating designation, extra smooth where exposed; or electrolytic zinc-coated steel sheet, ASTM A 879/A 879M, Coating Designation 08Z (24G).
4. Stainless-Steel Sheet: ASTM A 666, Type 304.
5. Brass Sheet: ASTM B 36/B 36M, manufacturer's standard copper alloy.
6. Zinc Sheet or Plate: ASTM B 69, manufacturer's standard sheet or plate and zinc alloy.
7. Die-Cast Aluminum: ASTM B 85, manufacturer's standard aluminum alloy.
8. Die-Cast Brass: ASTM B 176, manufacturer's standard copper alloy.
9. Die-Cast Zinc: ASTM B 86, manufacturer's standard zinc alloy.
10. Steel Anchor Bolts, Nuts, and Washers: ASTM F 1554, Grade 36 or 55, hot-dip galvanized.
11. Stainless-Steel Anchor Bolts, Nuts, and Washers: ASTM A 193/A 193M, Grade B8M, Type 316.
12. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

B. USPS-Approved Horizontal Mail Receptacles
1. Front-Loading, USPS-Approved Horizontal Mail Receptacles: Consisting of multiple compartments with fixed, solid compartment backs, enclosed within recessed wall box. Provide access to compartments for distributing incoming mail from front of unit by unlocking master lock and swinging side-hinged master door to provide accessibility to entire group of compartments. Provide access to each compartment for removing mail by swinging compartment door. Comply with USPS-STD-4C **OR** USPS-STD-4B+, **as directed**.
   a. Mail Delivery: USPS **OR** Private, **as directed**.
   b. Compartments: Number and size as follows: **OR** As indicated on Drawings, of the following sizes: **OR** As indicated on Drawings, **as directed**.
      1) Type I: A group of mail receptacles in single-column configuration with single master door, three – eight mail compartments not less than 3 inches high by 12 inches wide by 15 inches deep (76 mm high by 305 mm wide by 381 mm deep), one outgoing mail collection compartment prepared for master-door lock, and one parcel compartment 15 inches high by 12 inches wide by 15 inches deep (381 mm high by 305 mm wide by 381 mm deep).
      2) Type II: A group of mail receptacles in double-column configuration with double master door, three - sixteen mail compartments not less than 3 inches high by 12 inches wide by 15 inches deep (76 mm high by 305 mm wide by 381 mm deep), one outgoing mail collection compartment prepared for master-door lock, and one **OR** two, **as directed**, parcel compartment(s): 15 inches high by 12 inches wide by 15 inches deep (381 mm high by 305 mm wide by 381 mm deep) and 18 inches high by 12 inches wide by 15 inches deep (457 mm high by 305 mm wide by 381 mm deep).
      3) Type III: A group of mail receptacles in double-column configuration with single master door, three - sixteen mail compartments not less than 3 inches high by 12 inches wide by 15 inches deep (76 mm high by 305 mm wide by 381 mm deep), one outgoing mail collection compartment prepared for master-door lock, and one **OR** two, **as directed**, parcel compartment(s): 15 inches high by 12 inches wide by 15

inches deep (381 mm high by 305 mm wide by 381 mm deep) and 18 inches high by 12 inches wide by 15 inches deep (457 mm high by 305 mm wide by 381 mm deep).

4) Type VI (No Parcel Compartment): A group of mail receptacles in single-column configuration with single master door, three – ninemail compartments not less than 3 inches high by 12 inches wide by 15 inches deep (76 mm high by 305 mm wide by 381 mm deep), and one outgoing mail collection compartment prepared for master-door lock.

5) Type VIII (No Parcel Compartment): A group of mail receptacles in double-column configuration with double master door, three – nineteen mail compartments not less than 3 inches high by 12 inches wide by 15 inches deep (76 mm high by 305 mm wide by 381 mm deep), and one outgoing mail collection compartment prepared for master-door lock.

c. Compartments: Number and size as follows: **OR** Number as indicated on Drawings, of the following sizes: **OR** Number and size as indicated on Drawings, **as directed**.

1) Type A: Provide compartments with inside dimensions not less than 5 inches high by 6 inches wide by 15 inches deep (127 mm high by 152 mm wide by 381 mm deep).

2) Type B: Provide compartments with inside dimensions not less than 5 inches high by 12-1/2 inches wide by 15 inches deep (127 mm high by 318 mm wide by 381 mm deep).

3) Type C: Provide compartments with inside dimensions not less than 10-1/2 inches high by 6 inches wide by 15 inches deep (267 mm high by 152 mm wide by 381 mm deep).

4) Type D: Provide compartments with inside dimensions not less than 10-1/2 inches high by 12-1/2 inches wide by 15 inches deep (267 mm high by 318 mm wide by 381 mm deep).

5) Type E: Provide compartments with inside dimensions not less than 16 inches high by 12-1/2 inches wide by 15 inches deep (406 mm high by 318 mm wide by 381 mm deep).

d. Front-Loading Master Door: Fabricated from extruded aluminum and braced and framed to hold compartment doors; prepared to receive master-door lock.

1) Master-Door Lock: Door prepared to receive lock provided by local postmaster, for units served by USPS.

OR

Master-Door Lock: Cylinder lock keyed to building keying system; with two **OR** three, **as directed**, keys. Provide cylinders specified in Division 08 Section "Door Hardware".

e. Compartment Doors: Fabricated from extruded aluminum. Equip each with lock and tenant identification as required by cited standard. Provide mail slot in the compartment with master-door lock, **as directed**.

1) Compartment-Door Locks (for units served by USPS): Comply with USPS-L-1172C, PSIN O910, for locks and keys, or equivalent as approved by USPS; with three keys for each compartment door. Key each compartment differently.

2) Compartment-Door Locks: Five-pin tumbler, cylinder cam **OR** spring-latch-type, **as directed**, locks capable of at least 1000 key changes; with two **OR** three, **as directed**, keys for each compartment door. Key each compartment differently.

3) Compartment-Door Locks: Removable core locks, furnished by Owner and installed as Work of this Section.

4) Compartment-Door Locks: Spring-latch-type lock designed to accommodate cylinders keyed to building keying system; with two **OR** three, **as directed**, keys for each compartment door. Provide cylinders specified in Division 08 Section "Door Hardware".

5) Compartment-Door Locks: Three-digit, single-dial, combination locks with spring latch and automatic throw off. Set each compartment with different combination.

f. Frames: Fabricated from extruded aluminum or aluminum sheet; ganged and nested units, with cardholder and blank cards for tenant's identification within each compartment.

g. Snap-on Trim: Fabricated from same material and finish as compartment doors.
h. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
i. Exposed Aluminum Finish: Finish surfaces exposed to view as follows:
   1) Anodic Finish: Clear **OR** Brass **OR** Dark bronze **OR** As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
   2) Baked-Enamel or Powder-Coated Finish: Silver **OR** Black **OR** Medium bronze **OR** Dark bronze **OR** Gold **OR** Color as indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.

2. Rear-Loading, USPS-Approved Horizontal Mail Receptacles: Consisting of multiple compartments enclosed within recessed wall box. Provide access to compartments for distributing incoming mail from rear of unit with accessibility to entire group of compartments. Provide access to each compartment for removing mail by swinging compartment door. Comply with USPS-STD-4C **OR** USPS-STD-4B+, **as directed**.
   a. Mail Delivery: USPS **OR** Private, **as directed**.
   b. Compartments: Number and size as follows: **OR** As indicated on Drawings, of the following sizes: **OR** As indicated on Drawings, **as directed**.
      1) Type IV: A group of mail receptacles in single-column configuration with a rear-access cover, three - eight mail compartments not less than 3 inches high by 12 inches wide by 15 inches deep (76 mm high by 305 mm wide by 381 mm deep), one outgoing mail collection compartment, and one parcel compartment 15 inches high by 12 inches wide by 15 inches deep (381 mm high by 305 mm wide by 381 mm deep).
      2) Type V: A group of mail receptacles in double-column configuration with a rear-access cover, three - sixteen mail compartments not less than 3 inches high by 12 inches wide by 15 inches deep (76 mm high by **OR** 305 mm wide by 381 mm deep), one outgoing mail collection compartment, and one **OR** two, **as directed**, parcel compartment(s) 15 inches high by 12 inches wide by 15 inches deep (381 mm high by 305 mm wide by 381 mm deep) and 18 inches high by 12 inches wide by 15 inches deep (457 mm high by 305 mm wide by 381 mm deep).
      3) Type VII (No Parcel Compartment): A group of mail receptacles in single-column configuration with a rear-access cover, three - nine mail compartments not less than 3 inches high by 12 inches wide by 15 inches deep (76 mm high by 305 mm wide by 381 mm deep), and one outgoing mail collection compartment.
      4) Type IX (No Parcel Compartment): A group of mail receptacles in double-column configuration with a rear-access cover, three - nineteen mail compartments not less than 3 inches high by 12 inches wide by 15 inches deep (76 mm high by 305 mm wide by 381 mm deep), and one outgoing mail collection compartment.
   c. Compartments: Number and size as follows: **OR** Number as indicated on Drawings, of the following sizes: **OR** Number and size as indicated on Drawings, **as directed**.
      1) Type A: Provide compartments with inside dimensions not less than 5 inches high by 6 inches wide by 15 inches deep (127 mm high by 152 mm wide by 381 mm deep).
      2) Type B: Provide compartments with inside dimensions not less than 5 inches high by 12-1/2 inches wide by 15 inches deep (127 mm high by 318 mm wide by 381 mm deep).
      3) Type C: Provide compartments with inside dimensions not less than 10-1/2 inches high by 6 inches wide by 15 inches deep (267 mm high by 152 mm wide by 381 mm deep).
      4) Type D: Provide compartments with inside dimensions not less than 10-1/2 inches high by 12-1/2 inches wide by 15 inches deep (267 mm high by 318 mm wide by 381 mm deep).
      5) Type E: Provide compartments with inside dimensions not less than 16 inches high by 12-1/2 inches wide by 15 inches deep (406 mm high by 318 mm wide by 381 mm deep).

d. Rear-Loading Cover: Not required **OR** Lift-off rear cover fabricated from extruded aluminum or aluminum sheet, finished to match front of unit, **as directed**.
OR
Rear-Loading Door: Side hinged, fabricated from extruded aluminum or aluminum sheet, finished to match front of unit; with full-length, stainless-steel piano hinge on one side and positive-latching **OR** locking, **as directed**, mechanism on the other.
1) Rear-Door Lock (for units served by USPS if lock is required): Door prepared to receive lock provided by local postmaster.
OR
Rear-Door Lock: Cylinder lock keyed to building keying system; with two **OR** three, **as directed**, keys. Provide cylinders specified in Division 08 Section "Door Hardware".

e. Compartment Doors: Fabricated from extruded aluminum. Equip each with lock and tenant identification as required by cited standard. Provide one compartment with outgoing mail slot, **as directed**.
1) Compartment-Door Locks (for units served by USPS): Comply with USPS-L-1172C, PSIN O910, for locks and keys, or equivalent as approved by USPS; with three keys for each compartment door. Key each compartment differently.
2) Compartment-Door Locks: Five-pin tumbler, cylinder cam **OR** spring-latch-type, **as directed**, locks capable of at least 1000 key changes; with two **OR** three, **as directed**, keys for each compartment door. Key each compartment differently.
3) Compartment-Door Locks: Removable core locks, furnished by Owner and installed as Work of this Section.
4) Compartment-Door Locks: Spring-latch-type lock designed to accommodate cylinders keyed to building keying system; with two **OR** three, **as directed**, keys for each compartment door. Provide cylinders specified in Division 08 Section "Door Hardware".
5) Compartment-Door Locks: Three-digit, single-dial, combination locks with spring latch and automatic throw off. Set each compartment with different combination.

f. Frames: Fabricated from extruded aluminum or aluminum sheet; ganged and nested units, with cardholder and blank cards for tenant's identification behind each compartment.

g. Snap-on Trim: Fabricated from same material and finish as compartment doors.

h. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.

i. Exposed Aluminum Finish: Finish surfaces exposed to view as follows:
1) Anodic Finish: Clear **OR** Brass **OR** Dark bronze **OR** As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
2) Baked-Enamel or Powder-Coated Finish: Silver **OR** Black **OR** Medium bronze **OR** Dark bronze **OR** Gold **OR** Color as indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.

C. Private-Delivery Horizontal Mail Receptacles

1. Front-Loading, Private-Delivery Horizontal Mail Receptacles: Consisting of multiple compartments with fixed, solid compartment backs, enclosed within recessed wall box. Provide access to compartments for distributing incoming mail from front of unit by unlocking master lock and swinging side-hinged master door to provide accessibility to entire group of compartments. Provide access to each compartment for removing mail by swinging compartment door.

a. Front-Loading Master Door: Fabricated from extruded aluminum and braced and framed to hold compartment doors; with master-door lock and concealed, full-length, stainless-steel piano hinge on one side. Fabricate master door to remain open while mail is deposited.
1) Master-Door Lock: Manufacturer's standard five-pin tumbler, cylinder lock; with two **OR** three, **as directed**, keys.
OR

Master-Door Lock: Cylinder lock keyed to building keying system; with two **OR** three, **as directed**, keys. Provide cylinders specified in Division 08 Section "Door Hardware".

b. Compartments and Doors: Manufacturer's standard compartments with extruded aluminum doors. Equip each with lock, tenant identification, and concealed, full-length, flush hinge on one side. Provide one compartment prepared for master-door lock and with outgoing mail slot, **as directed**.

1) Compartments: Number and size as follows: **OR** As indicated on Drawings, of the following sizes: **OR** As indicated on Drawings, **as directed**.

a) Size 1: Provide compartments with inside dimensions not less than 3 inches high by 6 inches wide by 15 inches deep (76 mm high by 152 mm wide by 381 mm deep).

b) Size 2: Provide compartments with inside dimensions not less than 5 inches high by 3-1/2 inches wide by 15 inches deep (127 mm high by 89 mm wide by 381 mm deep).

c) Size 3: Provide compartments with inside dimensions not less than 5 inches high by 7-1/2 inches wide by 15 inches deep (127 mm high by 191 mm wide by 381 mm deep).

d) Size 4: Provide compartments with inside dimensions not less than 10-1/2 inches high by 3-1/2 inches wide by 15 inches deep (267 mm high by 89 mm wide by 381 mm deep).

e) Size 5: Provide compartments with inside dimensions not less than 10-1/2 inches high by 7-1/2 inches wide by 15 inches deep (267 mm high by 191 mm wide by 381 mm deep).

2) Tenant Identification: 2-inch-wide by 5/8-inch- (51-mm-wide by 16-mm-) high, clear-plastic cardholder set in recessed slot in face of compartment door. Provide cardboard strip and self-adhesive numbers.

OR

Tenant Identification: Laminated, black plastic tabs, engraved with identification and adhesively applied to face of compartment door.

OR

Tenant Identification: Identification engraved into face of compartment door.

c. Compartments and Doors: Manufacturer's standard compartments with ornamental doors fabricated from solid, die-cast brass **OR** zinc, **as directed**. Equip each with glass window, **as directed**, lock, nameplate, and two hinges.

1) Compartments: Number and size as follows: **OR** As indicated on Drawings, of the following sizes: **OR** As indicated on Drawings, **as directed**.

a) Size 1: Provide compartments 15 inches (381 mm) deep with doors 5 inches high by 3-1/2 inches wide (127 mm high by 89 mm wide).

b) Size 2: Provide compartments 15 inches (381 mm) deep with doors 6 inches high by 5-1/2 inches wide (152 mm high by 140 mm wide).

c) Size 3: Provide compartments 15 inches (381 mm) deep with doors 6 inches high by 11 inches wide (152 mm high by 279 mm wide).

2) Compartment-Door Locks: Five-pin tumbler, cylinder cam **OR** spring-latch-type, **as directed**, locks capable of at least 1000 key changes; with two **OR** three, **as directed**, keys for each compartment door. Key each compartment differently.

3) Compartment-Door Locks: Removable core locks, furnished by Owner and installed as Work of this Section.

4) Compartment-Door Locks: Spring-latch-type lock designed to accommodate cylinders keyed to building keying system; with two **OR** three, **as directed**, keys for each compartment door. Provide cylinders specified in Division 08 Section "Door Hardware".

5) Compartment-Door Locks: Three-digit, single-dial, combination locks with spring latch and automatic throw off. Set each compartment with different combination.

d. Frames: Fabricated from extruded aluminum or aluminum sheet **OR** brass sheet **OR** zinc sheet or plate, **as directed**; ganged and nested units, with cardholder and blank cards for tenant's identification behind each compartment.
e. Snap-on Trim: Fabricated from same material and finish as compartment doors.
f. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
g. Exposed Aluminum Finish: Finish surfaces exposed to view as follows:
1) Anodic Finish: Clear, **as directed**.
2) Baked-Enamel or Powder-Coated Finish: Black **OR** Dark bronze **OR** Gold **OR** Medium bronze **OR** Silver **OR** Color as indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.
h. Brass Finish: Buffed finish, lacquered **OR** Hand-rubbed finish, lacquered **OR** Brushed satin, lacquered, **as directed**.
i. Zinc Finish: Manufacturer's standard powder-coated finish, tan, **as directed**.

2. Rear-Loading, Private-Delivery Horizontal Mail Receptacles: Consisting of multiple compartments enclosed within recessed wall box. Provide access to compartments for distributing incoming mail from rear of unit with accessibility to entire group of compartments. Provide access to each compartment for removing mail by swinging compartment door.
a. Rear-Loading Cover: Not required **OR** Lift-off rear cover fabricated from extruded aluminum or aluminum sheet, finished to match front of unit, **as directed**.
OR
Rear-Loading Door: Side hinged, fabricated from extruded aluminum or aluminum sheet, finished to match front of unit; with full-length, stainless-steel piano hinge on one side and positive-latching **OR** locking, **as directed**, mechanism on the other. Fabricate rear-loading door to open not less than 90 degrees and to remain open while mail is deposited.
1) Rear-Door Lock: Manufacturer's standard five-pin tumbler, cylinder lock; with two **OR** three, **as directed**, keys.
OR
Rear-Door Lock: Cylinder lock keyed to building keying system; with two **OR** three, **as directed**, keys. Provide cylinders specified in Division 08 Section "Door Hardware".
b. Compartments and Doors: Manufacturer's standard compartments with doors fabricated from extruded aluminum. Equip each with lock, tenant identification, and concealed, full-length, flush hinge on one side. Provide one compartment prepared for master-door lock and with outgoing mail slot, **as directed**.
1) Compartments: Number and size as follows: **OR** As indicated on Drawings, of the following sizes: **OR** As indicated on Drawings, **as directed**.
a) Size 1: Provide with inside dimensions not less than 3 inches high by 6 inches wide by 15 inches deep (76 mm high by 152 mm wide by 381 mm deep).
b) Size 2: Provide compartments with inside dimensions not less than 5 inches high by 3-1/2 inches wide by 15 inches deep (127 mm high by 89 mm wide by 381 mm deep).
c) Size 3: Provide compartments with inside dimensions not less than 5 inches high by 7-1/2 inches wide by 15 inches deep (127 mm high by 191 mm wide by 381 mm deep).
d) Size 4: Provide compartments with inside dimensions not less than 10-1/2 inches high by 3-1/2 inches wide by 15 inches deep (267 mm high by 89 mm wide by 381 mm deep).
e) Size 5: Provide compartments with inside dimensions not less than 10-1/2 inches high by 7-1/2 inches wide by 15 inches deep (267 mm high by 191 mm wide by 381 mm deep).
2) Tenant Identification: 2-inch-wide by 5/8-inch- (51-mm-wide by 16-mm-) high, clear-plastic cardholder set in recessed slot in face of compartment door. Provide cardboard strip and self-adhesive numbers.
OR

Tenant Identification: Laminated, black plastic tabs, engraved with identification and adhesively applied to face of compartment door.
OR
Tenant Identification: Identification engraved into face of compartment door.

c. Compartments and Doors: Manufacturer's standard compartments with ornamental doors fabricated from solid, die-cast brass **OR** zinc, **as directed**. Equip each with glass window, **as directed**, lock, nameplate, and two hinges.
   1) Compartments: Number and size as follows: **OR** As indicated on Drawings, of the following sizes: **OR** As indicated on Drawings, **as directed**.
      a) Size 1: Provide compartments 15 inches (381 mm) deep with doors 5 inches high by 3-1/2 inches wide (127 mm high by 89 mm wide).
      b) Size 2: Provide compartments 15 inches (381 mm) deep with doors 6 inches high by 5-1/2 inches wide (152 mm high by 140 mm wide).
      c) Size 3: Provide compartments 15 inches (381 mm) deep with doors 6 inches high by 11 inches wide (152 mm high by 279 mm wide).
d. Compartment-Door Locks: Five-pin tumbler, cylinder cam **OR** spring-latch-type, **as directed**, locks capable of at least 1000 key changes; with two **OR** three, **as directed**, keys for each compartment door. Key each compartment differently.
e. Compartment-Door Locks: Removable core locks, furnished by Owner and installed as Work of this Section.
f. Compartment-Door Locks: Spring-latch-type lock designed to accommodate cylinders keyed to building keying system; with two **OR** three, **as directed**, keys for each compartment door. Provide cylinders specified in Division 08 Section "Door Hardware".
g. Compartment-Door Locks: Three-digit, single-dial, combination locks with spring latch and automatic throw off. Set each compartment with different combination.
h. Frames: Fabricated from extruded aluminum or aluminum sheet **OR** brass sheet **OR** zinc sheet or plate, **as directed**; ganged and nested units, with cardholder and blank cards for tenant's identification behind each compartment.
i. Snap-on Trim: Fabricated from same material and finish as compartment doors.
j. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
k. Exposed Aluminum Finish: Finish surfaces exposed to view as follows:
   1) Anodic Finish: Clear, **as directed**.
   2) Baked-Enamel or Powder-Coated Finish: Black **OR** Dark bronze **OR** Gold **OR** Medium bronze **OR** Silver **OR** Color as indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.
l. Brass Finish: Buffed finish, lacquered **OR** Hand-rubbed finish, lacquered **OR** Brushed satin, lacquered, **as directed**.
m. Zinc Finish: Manufacturer's standard powder-coated finish, tan, **as directed**.

D. Private Postal-Facility Horizontal Mail Receptacles
   1. Standard, Rear-Loading Horizontal Mail Receptacles: Consisting of multiple compartments with open backs, enclosed within recessed, modular wall box, with approximate overall module dimensions of 30 inches high by 23-1/2 inches wide by 15-1/2 inches deep (762 mm high by 596 mm wide by 394 mm deep); for installation between studs spaced 24 inches (610 mm) o.c. Provide access to compartments for distributing incoming mail from rear of unit with accessibility to entire group of compartments. Provide access to each compartment for removing mail by swinging compartment door.
      a. Compartments: Provide 10 **OR** 20 **OR** 30, **as directed**, equal-sized compartments within each module.
         OR
         Compartments: Provide number and size, and number of modules as indicated on Drawings.
      b. Compartment Doors: Fabricated from extruded or die-cast aluminum. Equip each with lock, tenant identification, and concealed, full-length, flush hinge on one side.

1) Tenant Identification: Identification engraved into face of compartment door **OR** self-adhesive placards, **as directed**.
2) Compartment-Door Locks: Five-pin tumbler, cylinder cam **OR** spring-latch-type, **as directed**, locks capable of at least 1000 key changes; with two **OR** three, **as directed**, keys for each compartment door. Key each compartment differently.

c. Frames: Fabricated from aluminum or cold-rolled steel sheet; ganged and nested units, with cardholder and blank cards for tenant's identification behind each compartment.

d. Trim: Fabricated from same material as compartment doors.

e. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.

f. Exposed Aluminum Finish: Finish surfaces exposed to view with silver powder coat on doors, black on trim **OR** gold powder coat on doors and trim **OR** silver powder coat on doors and trim, **as directed**.

2. Rack-Ladder, Rear-Loading Horizontal Mail Receptacles: Consisting of multiple compartments with open backs, enclosed within recessed, modular wall box, with approximate overall module dimensions of 12 inches high by 23-1/2 inches wide by 15-1/2 inches deep (305 mm high by 596 mm wide by 394 mm deep); for installation between rack ladders. Provide access to compartments for distributing incoming mail from rear of unit with accessibility to entire group of compartments. Provide access to each compartment for removing mail by swinging compartment door.

a. Compartments: Provide one within each module and number of modules as indicated on Drawings.
OR
Compartments: Provide two **OR** four **OR** eight **OR** 12, **as directed**, equal-sized compartments within each module and number of modules as indicated on Drawings.
OR
Compartments: Provide number and size, and number of modules as indicated on Drawings.

b. Compartment Doors: Fabricated from extruded aluminum. Equip each with lock, tenant identification, and concealed, full-length, flush hinge on one side.
1) Tenant Identification: Identification engraved into face of compartment door **OR** self-adhesive placards, **as directed**.
2) Compartment-Door Locks: Five-pin tumbler, cylinder cam **OR** spring-latch-type, **as directed**, locks capable of at least 1000 key changes; with two **OR** three, **as directed**, keys for each compartment door. Key each compartment differently.

c. Frames: Fabricated from aluminum or cold-rolled steel sheet; ganged and nested units, with cardholder and blank cards for tenant's identification behind each compartment.

d. Trim: Fabricated from same material as compartment doors.

e. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.

f. Rack Ladders: Aluminum or steel with manufacturer's standard finish.
1) Height of Rack Ladders: Two **OR** Three **OR** Four **OR** Five **OR** Six, **as directed**, modules high.
2) Provide two rack ladders for first column of modules and one ladder for each additional, adjacent column of modules.

g. Exposed Aluminum Finish: Finish surfaces exposed to view with silver powder coat on doors, black on trim.

E. Vertical Mail Receptacles

1. USPS-Approved Vertical Mail Receptacles: Consisting of three to seven compartments enclosed within wall box; with inside dimensions of each compartment not less than 15 inches high by 5 inches wide by 6 inches deep (381 mm high by 127 mm wide by 152 mm deep). Provide access to compartments for distributing incoming mail from front of unit by unlocking master lock and tilting inner compartments forward as a group. Provide access to each compartment for removing mail by swinging compartment door. Comply with USPS-STD-4B+.

a. Mounting: Recessed **OR** Semirecessed with mounting frame **OR** Surface mounted with mounting frame **OR** As indicated on Drawings, **as directed**.
b. Mail Delivery: USPS **OR** Private, **as directed**.
c. Compartments: Provide three - seven.
OR
Compartments: Provide number as indicated on Drawings.
d. Compartment Doors and Frames: Fabricated from striated, extruded aluminum. Equip each compartment door with lock, slot in face of door to receive tenant identification, and concealed, full-length, flush hinge on one side. Provide one double-wide compartment with outgoing mail slot, **as directed**.
1) Tenant Identification: Cardboard name and number tab **OR** Laminated, black plastic tabs, engraved with identification, **as directed**.
2) Compartment-Door Locks (for units served by USPS): Five-pin tumbler, cylinder cam **OR** spring-latch-type, **as directed**, locks capable of at least 1000 key changes; with two **OR** three, **as directed**, keys for each compartment door. Key each compartment differently.
OR
Compartment-Door Locks: Removable core locks, furnished by Owner and installed as Work of this Section.
OR
Compartment-Door Locks: Spring-latch-type lock designed to accommodate cylinders keyed to building keying system; with two **OR** three, **as directed**, keys for each compartment door. Provide cylinders specified in Division 08 Section "Door Hardware".
e. Frames: Fabricated from aluminum or cold-rolled steel sheet; ganged and nested units, with cardholder and blank cards for tenant's identification within each compartment.
f. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
g. Exposed Aluminum Finish: Finish surfaces exposed to view as follows:
1) Anodic Finish: Clear **OR** Gold **OR** As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
2) Baked-Enamel or Powder-Coated Finish: Aluminum **OR** Black **OR** Brass **OR** Dark bronze **OR** Gold **OR** Green **OR** Ivory **OR** Medium bronze **OR** Silver **OR** Color as indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.

F. USPS-Approved Cluster Box Units (CBUs)
1. General: Consisting of multiple compartments enclosed within freestanding, pedestal-mounted enclosure. Provide access to compartments for distributing incoming mail from front of unit by unlocking master lock and swinging pair of side-hinged master doors to provide accessibility to entire group of compartments. Provide access to each compartment for removing mail by swinging compartment door. Comply with USPS-B-1118F.
2. Compartment Enclosure: Fabricated from aluminum sheet with aluminum mounting pedestal and weather-protection hood, with the following number and size of compartments:
a. Type I: Provide eight compartments 12 inches wide by 3 inches high by 15 inches deep (305 mm wide by 76 mm high by 381 mm deep), one outgoing mail compartment 12 inches wide by 3 inches high by 15 inches deep (305 mm wide by 76 mm high by 381 mm deep), one parcel compartment 12 inches wide by 10 inches high by 15 inches deep (305 mm wide by 254 mm high by 381 mm deep), and another parcel compartment 12 inches wide by 13-1/2 inches high by 15 inches deep (305 mm wide by 343 mm high by 381 mm deep).
b. Type II: Provide 12 compartments 12 inches wide by 3 inches high by 15 inches deep (305 mm wide by 76 mm high by 381 mm deep), one outgoing mail compartment 12 inches wide by 3 inches high by 15 inches deep (305 mm wide by 76 mm high by 381 mm deep), and one parcel compartment 12 inches wide by 10 inches high by 15 inches deep (305 mm wide by 254 mm high by 381 mm deep).

c. Type III: Provide 16 compartments 12 inches wide by 3 inches high by 15 inches deep (305 mm wide by 76 mm high by 381 mm deep), one outgoing mail compartment 12 inches wide by 3 inches high by 15 inches deep (305 mm wide by 76 mm high by 381 mm deep), one parcel compartment 12 inches wide by 10 inches high by 15 inches deep (305 mm wide by 254 mm high by 381 mm deep), and another parcel compartment 12 inches wide by 13-1/2 inches high by 15 inches deep (305 mm wide by 343 mm high by 381 mm deep).

d. Type IV: Provide 13 compartments 12 inches wide by 4-3/4 inches high by 15 inches deep (305 mm wide by 121 mm high by 381 mm deep), one outgoing mail compartment 12 inches wide by 4-3/4 inches high by 15 inches deep (305 mm wide by 121 mm high by 381 mm deep), and one parcel compartment 12 inches wide by 10 inches high by 15 inches deep (305 mm wide by 254 mm high by 381 mm deep).

3. Compartment Doors and Frames: Fabricated from one-piece extruded aluminum or aluminum sheet. Equip each compartment door with lock, tenant identification, and concealed, full-length, flush hinge on one side. Provide outgoing mail slot with weather protection flap.

a. Tenant Identification: Number engraved into face **OR** applied into recess, **as directed**, of compartment door.

b. Compartment-Door Locks: Comply with USPS-L-1172C, PSIN O910, for locks and keys, or equivalent as approved by USPS; with three keys for each compartment door. Key each compartment differently.

c. Parcel-Locker-Door Locks: Two-key security system in which control key provides access to parcel-locker key, which opens compartment and is retained once opened.

4. Pedestal: Aluminum, with same finish as compartment enclosure and attached with theft-resistant fasteners.

5. Exposed Aluminum Finish: Finish surfaces exposed to view with powder-coated finish in postal gray (light gray) **OR** color as selected from manufacturer's full range of colors, **as directed**.

G. Neighborhood Delivery And Collection Box Units (NDCBUs)

1. General: Consisting of multiple compartments, with inside dimensions of each compartment not less than 5 inches high by 6 inches wide by 15 inches deep (127 mm high by 152 mm wide by 381 mm deep), enclosed within freestanding, pedestal-mounted enclosure. Provide access to compartments for distributing incoming mail from rear of unit by side-hinged rear door with accessibility to entire group of compartments. Provide access to each compartment for removing mail by swinging compartment door.

2. Compartment Enclosure: Fabricated from aluminum sheet with integral weather protection hood, with eight equal-sized compartments (Type I) **OR** 12 equal-sized compartments (Type II) **OR** 16 equal-sized compartments (Type III) **OR** compartments of number and size as indicated on Drawings, **as directed**.

3. Compartment Doors and Frames: Fabricated from one-piece extruded aluminum or aluminum sheet. Equip each compartment door with lock, tenant identification, and concealed, full-length, flush hinge on one side. Provide top left compartment with outgoing mail slot, **as directed**.

a. Tenant Identification: Number engraved into face of compartment door.

b. Compartment-Door Locks: Dustproof, five-pin tumbler, cylinder cam locks capable of at least 1000 key changes; with three, **as directed**, keys for each compartment door. Key each compartment differently.

4. Rear-Loading Door: Fabricated from aluminum sheet, with full-length, stainless-steel piano hinge on one side and three-point latching mechanism on the other. Fabricate rear-loading door to open not less than 90 degrees and to remain open while mail is deposited.

a. Rear-Door Lock: Door prepared to receive lock furnished by local postmaster.

OR

Rear-Door Lock: Cylinder lock with two **OR** three, **as directed**, keys. Provide cylinders specified in Division 08 Section "Door Hardware".

5. Pedestal: Same material and finish as compartment enclosure and attached with theft-resistant fasteners **OR** As indicated on Drawings, **as directed**.

6. Exposed Aluminum Finish: Finish surfaces exposed to view as follows:

a. Anodic Finish: Clear, **as directed**.

b. Baked-Enamel or Powder-Coated Finish: Black **OR** Dark bronze **OR** Gold **OR** Medium bronze **OR** Color as selected from manufacturer's full range, **as directed**.

H. USPS-Approved Parcel Lockers

1. Front-Loading, USPS-Approved Indoor Parcel Lockers: Consisting of single or multiple compartments enclosed within a larger enclosure of type indicated below. Provide access to compartments for distributing incoming parcels from front of unit. Provide access to each compartment for removing parcels by swinging compartment door. Comply with USPS-STD-4C **OR** USPS-STD-4B+ or USPS-B-1116A construction, adapted for larger-sized, interior, parcel compartments, **as directed**.
   a. Enclosure Type: Recessed **OR** Freestanding, **as directed**.
   b. Mail Delivery: USPS **OR** Private, **as directed**.
   c. Compartments: Number and size as follows: **OR** As indicated on Drawings, of the following sizes: **OR** As indicated on Drawings, **as directed**.
      1) Type X, Parcel Only (No Master Door): Single parcel receptacle 15 inches high by 12 inches wide by 15 inches deep (381 mm high by 305 mm wide by 381 mm deep) **OR** 18 inches high by 12 inches wide by 15 inches deep (457 mm high by 305 mm wide by 381 mm deep), **as directed**.
      2) Type X, Parcel Only (No Master Door): A group of parcel receptacles in single-column configuration without a master door; one **OR** two, **as directed**, compartment(s) 18 inches high by 12 inches wide by 15 inches deep (457 mm high by 305 mm wide by 381 mm deep) and one compartment 15 inches high by 12 inches wide by 15 inches deep (381 mm high by 305 mm wide by 381 mm deep).
      3) Type XI, Parcel Only: A group of parcel receptacles in single-column configuration with single master door prepared for master-door lock; one **OR** two, **as directed**, compartment(s) 15 inches high by 12 inches wide by 15 inches deep (381 mm high by 305 mm wide by 381 mm deep) and one **OR** two, **as directed**, compartment(s) 18 inches high by 12 inches wide by 15 inches deep (457 mm high by 305 mm wide by 381 mm deep).
   d. Compartments: Fabricated from aluminum sheet with number and size as follows: **OR** as indicated on Drawings, **as directed**.
      1) Type I: Provide one box with two compartments, one on top of the other, each compartment with inside dimensions of 12 inches wide by 14 inches high by 15 inches deep (305 mm wide by 356 mm high by 381 mm deep).
      2) Type II: Provide one box with four compartments, side by side, two on top and two on bottom, each compartment with inside dimensions of 12 inches wide by 14 inches high by 15 inches deep (305 mm wide by 356 mm high by 381 mm deep).
   e. Front-Loading Master Door: Fabricated to hold compartment doors; prepared to receive master-door lock provided by local postmaster.
   f. Compartment Doors and Frames: Fabricated from same material and finish as adjacent mail receptacles **OR** extruded aluminum **OR** aluminum sheet **OR** metallic-coated steel sheet **OR** aluminum or metallic-coated steel sheet, **as directed**. Equip each compartment door with lock, identification, and concealed, full-length, spring-loaded, flush hinge on right side.
      1) Compartment Identification: Black, sequential numbers engraved into **OR** stamped onto, **as directed**, recess in face of compartment door.
      2) Compartment-Door Locks (for USPS delivery): Dual lock security system in which master lock provides access to customer lock (USPS-L-1172C, PSIN O910) and parcel-locker key opens compartment and is retained once opened.
      3) Compartment-Door Locks (for private delivery): Two-key security system in which control key provides access to parcel-locker key, which opens compartment and is retained once opened.
   g. Exposed Aluminum Finish: Finish surfaces exposed to view as follows:
      1) Anodic Finish: Clear **OR** Brass **OR** Dark bronze **OR** As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.

2) Baked-Enamel or Powder-Coated Finish: Silver **OR** Black **OR** Medium bronze **OR** Dark bronze **OR** Gold **OR** Color as indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.

h. Metallic-Coated Steel Finish: Finish surfaces exposed to view with baked-enamel or powder-coated finish; color as indicated by manufacturer's designations **OR** color as selected from manufacturer's full range, **as directed**.

2. Rear-Loading, USPS-Approved Indoor Parcel Lockers: Consisting of single or multiple compartments enclosed within recessed wall box. Provide access to compartments for distributing incoming parcels from rear of unit with accessibility to entire group of compartments. Provide access to each compartment for removing parcels by swinging compartment door. Comply with USPS-STD-4C **OR** USPS-STD-4B+ or USPS-B-1116A construction, adapted for larger-sized, interior, parcel compartments, **as directed**.

a. Mail Delivery: USPS **OR** Private, **as directed**.

b. Compartments: Number and size as follows: **OR** As indicated on Drawings, of the following sizes: **OR** As indicated on Drawings, **as directed**.

1) Type XII, Parcel Only: A group of parcel receptacles in single-column configuration with a rear-access cover; one **OR** two, ,**as directed** compartment(s) 15 inches high by 12 inches wide by 15 inches deep (381 mm high by 305 mm wide by 381 mm deep) and one **OR** two, **as directed**, compartment(s) 18 inches high by 12 inches wide by 15 inches deep (457 mm high by 305 mm wide by 381 mm deep).

c. Compartments: Fabricated enclosure with number and size as follows: **OR** as indicated on Drawings, **as directed**.

1) Type I: Provide one box with two compartments, one on top of the other, each compartment with inside dimensions of 12 inches wide by 14 inches high by 15 inches deep (305 mm wide by 356 mm high by 381 mm deep).

2) Type II: Provide one box with four compartments, side by side, two on top and two on bottom, each compartment with inside dimensions of 12 inches wide by 14 inches high by 15 inches deep (305 mm wide by 356 mm high by 381 mm deep).

d. Rear-Loading Cover: Not required **OR** Lift-off rear cover fabricated from extruded aluminum or aluminum sheet, finished to match front of unit, **as directed**.

OR

Rear-Loading Door: Side hinged, fabricated from extruded aluminum or aluminum sheet, finished to match front of unit; with full-length, stainless-steel piano hinge on one side and positive-latching **OR** locking, **as directed**, mechanism on the other.

1) Rear-Door Lock: Door prepared to receive lock provided by local postmaster.

OR

Rear-Door Lock: Cylinder lock keyed to building keying system; with two **OR** three, **as directed**, keys. Provide cylinders specified in Division 08 Section "Door Hardware".

e. Compartment Doors and Frames: Fabricated from same material and finish as adjacent mail receptacles **OR** extruded aluminum **OR** aluminum sheet **OR** metallic-coated steel sheet **OR** aluminum or metallic-coated steel sheet, **as directed**. Equip each compartment door with lock, identification, and concealed, full-length, spring-loaded, flush hinge on one side.

1) Compartment Identification: Black, sequential numbers engraved into **OR** stamped onto, **as directed**, recess in face of compartment door.

2) Compartment-Door Locks (for USPS delivery): Dual-lock security system in which master lock provides access to customer lock (USPS-L-1172C, PSIN O910) and parcel-locker key opens compartment and is retained once opened.

3) Compartment-Door Locks (for private delivery): Two-key security system in which control key provides access to parcel-locker key, which opens compartment and is retained once opened.

f. Exposed Aluminum Finish: Finish surfaces exposed to view as follows:

1) Anodic Finish: Clear **OR** Brass **OR** Dark bronze **OR** As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.

2) Baked-Enamel or Powder-Coated Finish: Silver **OR** Black **OR** Medium bronze **OR** Dark bronze **OR** Gold **OR** Color as indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.

g. Metallic-Coated Steel Finish: Finish surfaces exposed to view with baked-enamel or powder-coated finish; color as indicated by manufacturer's designations **OR** color as selected from manufacturer's full range, **as directed**.

3. USPS-Approved Outdoor Parcel Lockers (OPLs), Pedestal Mounted: Consisting of multiple compartments enclosed within freestanding, pedestal-mounted enclosure. Provide access to compartments for distributing incoming mail from front of unit by unlocking master lock and swinging pair of side-hinged master doors to provide accessibility to entire group of compartments. Provide access to each compartment for removing mail by swinging compartment door. Comply with USPS-B-1116A.

a. Compartment Enclosure: Fabricated from aluminum sheet with aluminum mounting pedestal and weather-protection hood, with the following number and size of compartments:

1) Type I: Provide one box with two compartments, one on top of the other, each compartment with inside dimensions of 12 inches wide by 14 inches high by 15 inches deep (305 mm wide by 356 mm high by 381 mm deep).

2) Type II: Provide one box with four compartments, side by side, two on top and two on bottom, each compartment with inside dimensions of 12 inches wide by 14 inches high by 15 inches deep (305 mm wide by 356 mm high by 381 mm deep).

b. Compartment Doors and Frames: Fabricated from one-piece extruded aluminum or aluminum sheet. Equip each compartment door with lock, tenant identification, and concealed, full-length, flush hinge on one side. Provide outgoing mail slot with weather protection flap.

1) Locker Identification: Number engraved into face **OR** applied into recess, **as directed**, of compartment door.

2) Door Locks: Two-key security system in which control key provides access to parcel-locker key, which opens compartment and is retained once opened.

c. Pedestal: Aluminum, with same finish as compartment enclosure and attached with theft-resistant fasteners.

d. Exposed Aluminum Finish: Finish surfaces exposed to view with powder-coated finish in postal gray (light gray) **OR** color as selected from manufacturer's full range of colors, **as directed**.

I. USPS-Approved Collection Boxes

1. USPS-Approved, Front-Loading Collection **OR** Receiving, **as directed**, Boxes: Consisting of single compartment with fire-resistant cushion bottom, enclosed within wall box, with mail slot **OR** hopper door, **as directed**, to receive mail. Provide access to compartment for collecting mail from front of unit. Comply with USPS Publication 16.

a. Mail Collection: USPS **OR** Private, **as directed**.

b. Mounting: Recessed **OR** Semirecessed **OR** Surface mounted, **as directed**.

c. Type: Collection box **OR** Receiving box for mail chutes, **as directed**.

d. Height: Sized to match height of four **OR** five **OR** six **OR** seven, **as directed**, horizontal mail receptacles.

OR

Height: As indicated on Drawings, **as directed**.

e. Compartment Door and Frame: Fabricated from 1/4-inch- (6-mm-) **OR** minimum 1/8-inch- (3-mm-), **as directed**, thick aluminum, with opening not less than 12 by 20 inches (305 by 508 mm) and not more than 18 by 30 inches (457 by 762 mm). Equip door with lock and concealed, full-length, flush hinge on one side.

1) Door Lock (for units served by USPS): Door prepared to receive lock provided by local postmaster.

OR

Door Lock: Cylinder lock keyed to building keying system; with two **OR** three, **as directed**, keys. Provide cylinders specified in Division 08 Section "Door Hardware".

2) Identification: Engrave face of compartment door with 1-inch- (25-mm-) high letters as follows: "U.S. MAIL LETTER BOX" on two lines at top or bottom of unit.

3) Door Style: Set door within face frame **OR** Extend door full width and height of unit, with no exposed frame, **as directed**.

f. Mail Slot: Fabricated from 1/4-inch- (6-mm-) thick aluminum, with 11-inch-wide by 1-1/4-inch- (279-mm-wide by 32-mm-) high opening, protected by inside hood and hinge flap, and with inside baffle to prevent removal of mail from box.

OR

Hopper Door: Fabricated from 1/4-inch- (6-mm-) thick aluminum, with opening that allows a bundle measuring 6-1/2 inches wide by 11-1/2 inches long by 4 inches high (165 mm wide by 292 mm long by 102 mm high) to be deposited, and with inside baffle to prevent removal of mail from box. Equip door with door pull and concealed, full-length bottom hinge.

1) Identification: Engrave face of hopper door with 1-inch- (25-mm-) high letters as follows: "LETTERS AND LETTER MAIL TIED IN BUNDLES."

2) Door Style: Set door within face frame **OR** Extend door full width and height of unit, with no exposed frame, **as directed**.

g. Exposed Materials: Fabricated from stainless-steel-clad **OR** brass-clad, **as directed**, extruded or sheet aluminum.

h. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.

i. Schedule-Card Holder: Provide recessed or surface-mounted holder for pick-up schedule card in center of bottom front portion of unit. Fabricate of same material and finish as front of unit.

j. Mailbag Hooks: Provide two aluminum or stainless-steel hooks at exterior front edge of bottom of surface-mounted units, spaced 15 to 17-1/2 inches (381 to 445 mm) apart, for supporting mailbags.

k. Mailbag Rack: Provide internal rack system for supporting mailbags within unit.

2. USPS-Approved, Rear-Loading Collection Boxes: Consisting of single compartment with fire-resistant cushion bottom, enclosed within recessed wall box, with mail slot **OR** hopper door, **as directed**, to receive mail. Provide access to compartment for collecting mail from rear of unit. Comply with USPS Publication 16.

a. Mail Collection: USPS **OR** Private, **as directed**.

b. Height: Sized to match height of four **OR** five **OR** six **OR** seven, **as directed**, horizontal mail receptacles.

OR

Height: As indicated on Drawings, **as directed**.

c. Compartment Frame and Front Panel: Fabricated from 1/4-inch- (6-mm-) **OR** minimum 1/8-inch- (3-mm-), **as directed**, thick aluminum.

1) Identification: Engrave face of front panel with 1-inch- (25-mm-) high letters as follows: "U.S. MAIL LETTER BOX" on two lines at top or bottom of unit.

d. Mail Slot: Fabricated from 1/4-inch- (6-mm-) thick metal plate, with 11-inch-wide by 1-1/4-inch- (279-mm-wide by 32-mm-) high opening, protected by inside hood and hinge flap, and with inside baffle to prevent removal of mail from box.

OR

Hopper Door: Fabricated from 1/4-inch- (6-mm-) thick metal plate, with opening that allows a bundle measuring 6-1/2 inches wide by 11-1/2 inches long by 4 inches high (165 mm wide by 292 mm long by 102 mm high) to be deposited, and with inside baffle to prevent removal of mail from box. Equip door with door pull and concealed, full-length bottom hinge.

1) Identification: Engrave face of hopper door with 1-inch- (25-mm-) high letters as follows: "LETTERS AND LETTER MAIL TIED IN BUNDLES."

2) Door Style: Set door within face frame **OR** Extend door full width and height of unit, with no exposed frame, **as directed**.

e. Rear-Loading Enclosure: Lift-off rear cover fabricated from same material and finish as front of unit.
OR
Rear-Loading Door: Side hinged, with opening not less than 12 by 20 inches (305 by 508 mm) and not more than 18 by 30 inches (457 by 762 mm), fabricated from same material and finish as front of unit; with full-length, stainless-steel piano hinge on one side and positive-latching mechanism on the other. Fabricate rear-loading door to remain open while mail is collected.
1) Rear-Door Lock (for units served by USPS): Door prepared to receive lock provided by local postmaster.
OR
Rear-Door Lock: Cylinder lock keyed to building keying system; with two **OR** three, **as directed**, keys. Provide cylinders specified in Division 08 Section "Door Hardware".

f. Exposed Materials: Fabricated from extruded or sheet aluminum.

g. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.

h. Schedule-Card Holder: Provide recessed or surface-mounted holder for pick-up schedule card in center of bottom front portion of unit. Fabricate of same material and finish as front of unit.

i. Mailbag Hooks: Provide two aluminum or stainless-steel hooks at exterior front edge of bottom of surface-mounted units, spaced 15 to 17-1/2 inches (381 to 445 mm) apart, for supporting mailbags.

j. Mailbag Rack: Provide internal rack system for supporting mailbags within unit.

3. Finish surfaces exposed to view as follows:
a. Aluminum Finish: Finish surfaces exposed to view as follows:
1) Anodic Finish: Clear **OR** Black **OR** Gold **OR** Dark bronze **OR** Light bronze **OR** Medium bronze **OR** As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
2) Baked-Enamel or Powder-Coated Finish: Black **OR** Gold **OR** Dark bronze **OR** Medium bronze **OR** Silver **OR** Color as indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.
b. Brass Finish: Buffed finish, lacquered **OR** Hand-rubbed finish, lacquered **OR** Brushed satin, lacquered, **as directed**.
c. Stainless-Steel Finish: No. 4.

J. Private Collection Boxes
1. Private, Horizontal, Front-Loading Collection Boxes: Consisting of single compartment of same depth as horizontal mail receptacles, enclosed within wall box, with slot in top of front to receive mail. Provide access to compartment for collecting mail from front of unit.
a. Height: Sized to match height of four **OR** five **OR** six **OR** seven, **as directed**, horizontal mail receptacles.
b. Mounting: Recessed **OR** Semirecessed **OR** Surface mounted, **as directed**.
c. Compartment Door and Frame: Fabricated from extruded aluminum or aluminum sheet that is full height of unit including **OR** in portion of unit below, **as directed**, mail slot, and equipped with lock and concealed, continuous side hinge.
1) Door Lock (for units served by USPS): Door prepared to receive lock provided by local postmaster.
OR
Door Lock: Cylinder lock keyed to building keying system; with two **OR** three, **as directed**, keys. Provide cylinders specified in Division 08 Section "Door Hardware".
2) Identification: Engrave face of compartment door with 1-inch- (25-mm-) high letters as follows: "LETTERS" **OR** "OUTGOING MAIL" **OR** OFFICE," **as directed**.
d. Aluminum Finish: Finish surfaces exposed to view as follows:
1) Anodic Finish: Clear, **as directed**.

2) Baked-Enamel or Powder-Coated Finish: Black **OR** Dark bronze **OR** Gold **OR** Medium bronze **OR** Color as indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.

2. Private, Horizontal, Rear-Loading Collection Boxes: Consisting of single compartment of same depth as horizontal mail receptacles, enclosed within recessed wall box, with slot in top of front to receive mail. Provide access to compartment for collecting mail from rear of unit.
   a. Height: Sized to match height of four **OR** five **OR** six **OR** seven, **as directed**, horizontal mail receptacles.
   b. Rear-Loading Cover: Not required **OR** Lift-off rear cover fabricated from extruded aluminum or aluminum sheet, finished to match front of unit, **as directed**.
      OR
      Rear-Loading Door: Side hinged, fabricated from extruded aluminum or aluminum sheet, finished to match front of unit; with continuous hinge on one side and positive-latching **OR** locking, **as directed**, mechanism on the other.
      1) Rear-Door Lock (for units served by USPS if lock is required): Door prepared to receive lock provided by local postmaster.
         OR
         Rear-Door Lock: Cylinder lock keyed to building keying system; with two **OR** three, **as directed**, keys. Provide cylinders specified in Division 08 Section "Door Hardware".
   c. Exposed Materials: Fabricated from extruded or sheet aluminum.
   d. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
   e. Identification: Engrave front of unit below mail slot with 1-inch- (25-mm-) high letters as follows: "LETTERS' **OR** "OUTGOING MAIL" **OR** "OFFICE," **as directed**.
   f. Aluminum Finish: Finish surfaces exposed to view as follows:
      1) Anodic Finish: Clear, **as directed**.
      2) Baked-Enamel or Powder-Coated Finish: Black **OR** Dark bronze **OR** Gold **OR** Medium bronze **OR** Color as indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.
3. Vertical Collection Boxes: Consisting of single compartment enclosed within wall box, with slot in top of front to receive mail. Provide access to compartment for collecting incoming mail from front of unit.
   a. Mounting: Recessed **OR** Semirecessed **OR** Surface mounted, **as directed**.
   b. Size: Same height as adjacent vertical mail receptacles **OR** 8-3/4 inches wide by 19 inches high by 6-1/2 inches deep (222 mm wide by 483 mm high by 165 mm deep) **OR** 15 inches wide by 19 inches high by 6-1/2 inches deep (381 mm wide by 483 mm high by 165 mm deep), **as directed**.
   c. Compartment Door and Frame: Fabricated from aluminum, with opening for mail. Equip door with lock and concealed, full-length, flush hinge on one side. Set door within face frame.
      1) Door Lock (for units served by USPS): Door prepared to receive lock provided by local postmaster.
         OR
         Door Lock: Cylinder lock keyed to building keying system; with two **OR** three, **as directed**, keys. Provide cylinders specified in Division 08 Section "Door Hardware".
      2) Identification: Engrave face of compartment door with 1-inch- (25-mm-) high letters as follows: "LETTERS" **OR** "OUTGOING MAIL" **OR** "OFFICE," **as directed**.
   d. Exposed Materials: Fabricated from extruded or sheet aluminum.
   e. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
   f. Aluminum Finish: Finish surfaces exposed to view as follows:
      1) Anodic Finish: Clear, **as directed**.
      2) Baked-Enamel or Powder-Coated Finish: Aluminum **OR** Black **OR** Brass **OR** Dark bronze **OR** Gold **OR** Green **OR** Ivory **OR** Medium bronze **OR** Silver **OR** Color as

indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.

4. Private, Pedestal-Mounted Collection Boxes: Consisting of single compartment enclosed within freestanding, pedestal-mounted enclosure, with slot in top of front of unit to receive mail. Provide access to compartment for collecting mail from front or rear of unit through door equipped with concealed, continuous side hinge and lock.
   a. Compartment Enclosure: Fabricated from extruded aluminum or aluminum sheet with integral weather-protection hood.
   b. Pedestal: Same material and finish as parcel locker and attached with theft-resistant fasteners **OR** As indicated on Drawings, **as directed**.
   c. Aluminum Finish: Finish surfaces exposed to view as follows:
      1) Anodic Finish: Clear, **as directed**.
      2) Baked-Enamel or Powder-Coated Finish: Blue **OR** Gray **OR** White **OR** Color as indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.
5. Private, Curbside Collection Boxes: Consisting of single compartment enclosed within curved-top, freestanding enclosure with four legs and casters, **as directed**. Fabricate enclosure from welded and riveted steel. Provide hopper door with door pull in top of unit to receive packages, with opening size not less than 4-1/2 inches high by 15-1/2 inches wide (114 mm high by 394 mm wide). Provide access to compartment for collecting packages from bottom of front of unit through door equipped with concealed, continuous bottom hinge and lock.
   a. Door Lock: Five-pin tumbler cylinder **OR** Hasp for padlock, **as directed**.
   b. Snorkel: Provide rear-mounted, drive-by attachment with opening not less than 12 inches wide by 3 inches high (305 mm wide by 76 mm high).
   c. Steel Finish: Baked-enamel or powder-coated finish; gray **OR** white **OR** color as indicated by manufacturer's designations **OR** color as selected from manufacturer's full range, **as directed**.

K. Data Distribution Boxes
1. Data Distribution Boxes: Consisting of multiple compartments enclosed within enclosure.
   a. Enclosure Configuration: Freestanding **OR** Recessed in wall **OR** Recessed in wall and installed between rack ladders, **as directed**.
   b. Compartment Access: Provide access to compartments as follows:
      1) For Distributing Incoming Mail from Front of Unit: Mail slot in each compartment door.
      2) For Distributing Incoming Mail from Rear of Unit: Open backs with aluminum cover finished to match front of unit, **as directed**.
      3) For Removing Mail: Unlocking and swinging compartment door.
   c. Compartments: Number and size as follows: **OR** As indicated on Drawings, of the following sizes: **OR** As indicated on Drawings, **as directed**.
      1) Size 1: Provide compartments with inside dimensions not less than 5 inches high by 12-1/2 inches wide by 15 inches deep (127 mm high by 318 mm wide by 381 mm deep).
   d. Compartment Doors: Equip each with lock and concealed, continuous hinge.
      1) Door Locks: Five-pin tumbler, cylinder cam **OR** spring-latch-type, **as directed**, locks capable of at least 1000 key changes; with two **OR** three, **as directed**, keys for each compartment door. Key each compartment differently.
         OR
         Door Locks: Three-digit, single-dial, combination locks with spring latch and automatic throw off. Set each compartment with different combination.
   e. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
   f. Exposed Materials: Fabricated from steel sheet or aluminum with powder-coat finish.
   g. Rack Ladders: Aluminum or steel with manufacturer's standard finish.

h. Powder-Coated Finish: Silver **OR** Silver with black trim **OR** Silver with slate trim **OR** Sandalwood with sand trim **OR** Color as indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.

L. Mail Chutes

1. General: Factory assembled and fabricated with tight joints, overlaps in direction of mail flow, and free of ledges. Provide transition sections so all sections of chutes are connected and overlap at least 2 inches (51 mm). Fabricate mail chutes so joint sections comply with same dimensions with no reduction in chute size. Provide removable panels for access to concealed portions of chutes that exceed 5 feet (1.5 m) in length. Comply with USPS Publication 16, **as directed**.
   a. Mail Collection: USPS **OR** Private, **as directed**.
   b. Inside Dimensions: 8 inches wide by 2 inches deep (203 mm wide by 51 mm deep) (for chutes served by USPS) **OR** 14 inches wide by 3 inches deep (356 mm wide by 76 mm deep) **OR** 14 inches wide by 7 inches deep (356 mm wide by 178 mm deep), **as directed**.
   c. Mounting: Recessed **OR** Semirecessed **OR** Surface mounted **OR** As detailed, **as directed**.
2. Exposed Front Panels: Continuous, one-piece frames and covers fabricated from 0.125-inch- (3.2-mm-) thick, stainless-steel-clad **OR** brass-clad, **as directed**, extruded aluminum, and retaining removable transparent material as follows, for not less than 3/4 of length of front of chute on each floor:
   a. Transparent Material: Manufacturer's standard glazing, complying with USPS Publication 16.
3. Concealed Front Panels: Consisting of continuous, one-piece frames retaining 0.0269-inch- (0.7-mm-) thick, metallic-coated steel sheet panels. Extend concealed front panels from top of ceiling fasciae to bottom of floor collar above.
4. Sides and Backs: Continuous, one-piece, 0.125-inch- (3.2-mm-) thick aluminum sheet extending from floor to ceiling on each floor and extending 54 inches (1372 mm) above finish flooring at top story.
5. Floor and Ceiling Fasciae and Lock Band: Manufacturer's standard, matching material and finish of front frames and covers. Provide lock band with locking device and keyed lock that prevents key removal if locking device is not secured.
6. Mail Slots: Same material and finish as chute; not less than 4-3/4 inches wide by 1/2 inch high (121 mm wide by 13 mm high) with device designed to guide mail into inside opening of same size located 2-1/2 inches (64 mm) below mail slot. Provide mail slots on each floor.
   a. For chutes served by USPS, inscribe the words "U.S. MAIL" on face of mail slots.
7. Finish surfaces exposed to view as follows:
   a. Aluminum Finish: Finish surfaces exposed to view as follows:
      1) Anodic Finish: Clear **OR** Black **OR** Dark bronze **OR** Medium bronze **OR** As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
      2) Baked-Enamel or Powder-Coated Finish: Color as indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.
   b. Brass Finish: Buffed finish, lacquered **OR** Hand-rubbed finish, lacquered **OR** Brushed satin, lacquered, **as directed**.
   c. Stainless-Steel Finish: No. 4.

M. Accessories

1. Directory for Mail Receptacles: Surface-mounted, front-opening unit, with clear glass or plastic window.
   a. Framed, Top-Mount Unit for Horizontal Mail Receptacles: Fabricate directory as framed, horizontal unit with modular sections having a 24-name capacity (3 modules) **OR** 32-name capacity (4 modules) **OR** 40-name capacity (5 modules), **as directed**; of same material, size, **as directed**, and finish as adjacent mail receptacles; mounted above mail receptacles as indicated on Drawings, **as directed**.

b. Framed, Side-Mount Unit for Horizontal Mail Receptacles: Fabricate directory as framed, horizontal unit with 50-name capacity, 28 inches (711 mm) **OR** 60-name capacity, 33-3/8 inches (848 mm) **OR** 70-name capacity, 38-3/4 inches (984 mm), **as directed** high; of same material and finish as adjacent mail receptacles; mounted along side of mail receptacles as indicated on Drawings, **as directed**.

c. Framed, Side-Mount Unit for Vertical Mail Receptacles: Fabricate directory as framed, vertical unit with modular sections having a 40-name capacity (1 module) **OR** 80-name capacity (2 modules) **OR** 120-name capacity (3 modules) **OR** 160-name capacity (4 modules) **OR** 200-name capacity (5 modules), **as directed**; of same size, material, and finish as adjacent vertical mail compartment doors unless otherwise indicated.

d. Insert Units for Vertical Mail Receptacles: Fabricate directory as modular inserts having a 40-name capacity (1 module) **OR** 80-name capacity (2 modules) **OR** 120-name capacity (3 modules) **OR** 160-name capacity (4 modules) **OR** 200-name capacity (5 modules), **as directed**; of same size, material, and finish as adjacent vertical mail compartment doors unless otherwise indicated.

e. Provide name strips made of 1/4-inch- (6-mm-) high label tape.

2. Key Keeper: Consisting of single compartment with door; interior compartment size not less than 4-3/4 inches wide by 2-1/4 inches high by 1-1/2 inches deep (121 mm wide by 57 mm high by 38 mm deep), **as directed**. USPS approved, **as directed**.

a. Mounting: Recessed **OR** Surface mounted, **as directed**.

b. Style: Compartment door set within face frame **OR** extending full width and height of unit, with no exposed frame, **as directed**.

c. Type of Operation: Loose key in box **OR** Retractor reel with minimum 20-inch- (508-mm-) long chain **OR** Push button, 24-V switch in box, **as directed**.

d. Mail Delivery: USPS **OR** Private, **as directed**.

e. Door Lock (for units served by USPS): Door prepared to receive lock furnished by local postmaster.

OR

Door Lock: Five-pin tumbler, cylinder cam lock capable of at least 1000 key changes; with two **OR** three, **as directed**, keys.

OR

Door Lock: Cylinder lock keyed to building keying system; with two **OR** three, **as directed**, keys. Provide cylinders specified in Division 08 Section "Door Hardware".

f. Exposed Material and Finish: Exposed surfaces fabricated from same material and finish as adjacent mail receptacles.

g. Exposed Material and Finish: Steel, aluminum **OR** brass, **as directed**, powder-coated finish.

h. Exposed Material and Finish: Stainless steel, brushed finish.

i. Exposed Material and Finish: Aluminum, as follows:

1) Anodic Finish: Clear **OR** Brass **OR** Dark bronze **OR** As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.

2) Baked-Enamel or Powder-Coated Finish: Black **OR** Dark bronze **OR** Medium bronze **OR** Gold **OR** Color as indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.

3. Key Cabinet: Wall-mounted, metallic-coated, **as directed**, steel cabinet with pivoting, key-holding panels and side-hinged door equipped with five-pin tumbler, cylinder door lock and concealed, full-length flush hinge. Finish cabinet, panels, and door with baked-enamel or powder-coated finish. Provide key control system consisting of key-holding hooks, labels, two sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers.

a. Capacity: Keys for 150 percent of the number of, **as directed**, mail-receptacle locks.

b. Cross-Index System: Consisting of index cards for recording key information. Include three receipt forms for each key-holding hook.

c. Baked-Enamel or Powder-Coated Finish: Color as indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.

4. Mail-Sorting Collection Unit: Consisting of 1/4-inch- (6-mm-) thick, metal face plate and through-the-wall hopper door(s) allowing receipt and separation of mail.
   a. Hopper Doors: One **OR** Two **OR** Three, **as directed**, door(s), with door pull for each and with opening size not less than dimensions approved by the Owner.
      1) Engrave doors with 1-inch- (25-mm-) high letters as follows: "STAMPED MAIL" **OR** "METERED MAIL," **as directed**.
      2) Identification: Engrave unit at top with 2-inch- (51-mm-) high letters as follows: "U.S. MAIL" **OR** "UNITED STATES MAIL," **as directed**.
   b. Exposed Material and Finish: Exposed surfaces fabricated from same material and finish as adjacent mail receptacles.
   c. Aluminum Finish: Finish surfaces exposed to view as follows:
      1) Anodic Finish: Clear **OR** Black **OR** Dark bronze **OR** Light bronze **OR** Medium bronze **OR** As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
      2) Baked-Enamel or Powder-Coated Finish: Black **OR** Dark bronze **OR** Gold **OR** Medium bronze **OR** Color as indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.
   d. Brass Finish: Buffed finish, lacquered **OR** Hand-rubbed finish, lacquered **OR** Brushed satin, lacquered, **as directed**.
   e. Stainless-Steel Finish: No. 4.
5. Letter Drops (Through Wall): Consisting of 11-inch-wide by 3-1/2-inch- (279-mm-wide by 89-mm-) high, top-hinged, spring-loaded flap that pivots inward, held in place by 1-inch- (25-mm-) wide face frame. Fabricated from 1/4-inch- (6-mm-) thick aluminum or steel, with exposed surfaces finished to match adjacent mail receptacles.
   a. Sleeve: Provide metallic-coated, **as directed**, steel wall sleeve for full depth of wall.
   b. Finished Frame: Provide finished face frame on back side of wall opening.
   c. Identification: Engrave face of swinging flap with 1-inch- (25-mm-) high letters as follows: "U.S. MAIL" **OR** "LETTERS" **OR** "OUTGOING MAIL," .**as directed**
   d. Exposed Material and Finish: Exposed surfaces fabricated from same material and finish as adjacent mail receptacles, **as directed**.
6. Package Depository (Through Wall): Consisting of 1/4-inch- (6-mm-) thick, aluminum or steel face plate and through-the-wall hopper door with hinged baffle, **as directed**, allowing receipt of packages; fabricated from 1/4-inch- (6-mm-) thick aluminum or steel.
   a. Hopper Door: Equipped with door pull and concealed, full-length bottom hinge; with opening size not less than 15 inches wide by 6-1/2 inches high (381 mm wide by 165 mm high) **OR** as indicated on Drawings, **as directed**.
   b. Sleeve: Provide metallic-coated, **as directed**, steel wall sleeve for full depth of wall.
   c. Slowdown: Provide steel slowdown ramp on back side of wall opening.
   d. Identification: Engrave face of hopper door with 1-inch- (25-mm-) high letters as follows: "BOOK DEPOSITORY," .**as directed**
   e. Finish: Exposed surfaces finished same as mail receptacles.
   f. Aluminum Finish: Finish surfaces exposed to view as follows:
      1) Anodic Finish: Clear **OR** As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
      2) Baked-Enamel or Powder-Coated Finish: Dark bronze **OR** Gold **OR** Color as indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.
   g. Steel Finish: Finish surfaces exposed to view with baked-enamel or powder-coated finish; color as indicated by manufacturer's designations **OR** color as selected from manufacturer's full range, **as directed**.

N. Fabrication
   1. Form postal specialties to required shapes and sizes, with true lines and angles, square, rigid, and without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges and corners free of sharp edges and burrs and safe to touch. Fabricate doors of postal specialties to preclude binding, warping, or misalignment.

2. Preassemble postal specialties in shop to greatest extent possible to minimize field assembly.
3. Mill joints to a tight, hairline fit. Cope or miter corner joints. Form joints exposed to weather to exclude water penetration.
4. Drill or punch holes required for fasteners and remove burrs. Use security fasteners where fasteners are exposed. If used, seal external rivets before finishing.
5. Weld in concealed locations to greatest extent possible without distorting or discoloring exposed surfaces. Remove weld spatter and welding oxides from exposed surfaces.
6. Fabricate tubular and channel frame assemblies with manufacturer's standard welded or mechanical joints. Provide subframes and reinforcement as required for a complete system to support loads.
7. Fabricate rack ladders to support indicated number of units to form a column of units.
8. Where dissimilar metals will contact each other, protect against galvanic action by painting contact surfaces with bituminous coating or by applying other permanent separation as recommended by manufacturers of dissimilar metals.

O. General Finish Requirements
1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
2. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
3. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

P. Copper-Alloy Finishes
1. Buffed Finish, Lacquered: M21-O6x (Mechanical Finish: buffed, smooth specular; Coating: clear organic coating as specified below).
2. Hand-Rubbed Finish, Lacquered: M31-M34-O6x (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed; Coating: clear organic coating as specified below).
3. Brushed Satin Finish, Lacquered: M32-O6x (Mechanical Finish: directionally textured, medium satin; Coating: clear organic coating as specified below).
4. Clear Organic Coating: Clear, waterborne, air-drying, acrylic lacquer specially developed for coating copper-alloy products, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm). It consists of a solution of methyl methacrylate copolymer with benzotriazole to prevent breakdown of the film in UV light, and is called "Incralac."

1.3 EXECUTION

A. Installation
1. General: Install postal specialties level and plumb, according to manufacturer's written instructions and roughing-in drawings.
   a. Where dissimilar metals will be in permanent contact with each other, protect against galvanic action by painting contact surfaces with bituminous coating or by applying other permanent separation as recommended by manufacturer for this purpose.
   b. Where aluminum will contact grout, concrete, masonry, or wood, protect against corrosion by painting contact surfaces with bituminous coating.
   c. Final acceptance of postal specialties served by USPS depends on compliance with USPS requirements.
2. Horizontal Mail Receptacles: Install horizontal mail receptacles with center of tenant-door lock cylinders and bottom of compartments at the maximum and minimum heights above finished floor established by USPS and manufacturer's written instructions.

a. Install removable-core and keyed-in door lock cylinders as required for each type of cylinder lock.
b. Install and align two rack ladders for the first column of mail receptacles and one rack ladder for each additional adjacent column of mail receptacles.

3. Vertical Mail Receptacles: Install vertical mail receptacles with center of master lock cylinder not more than 48 inches (1219 mm) and not less than 30 inches (762 mm) above finished floor.
4. Pedestal-Mounted Postal Specialties: Anchor units with 1/2-inch- (13-mm-) diameter, galvanized **OR** stainless, **as directed**,-steel anchor bolts with hooked ends, for CBUs, NDCBUs, and some models of parcel lockers and collection boxes.
5. Collection Boxes: Install collection boxes with centerline of mail slots **OR** handle of hopper doors, **as directed**, not more than 48 inches (1219 mm) above finished floor.
6. Receiving Boxes: Install receiving boxes with bottom of unloading door not less than 30 inches (762 mm) above finished floor.
   a. Install receiving boxes with exterior of box bottom not more than 20 inches (508 mm) above finished floor.
7. Freestanding Data Distribution Boxes: Locate freestanding data distribution boxes at locations indicated or, if not indicated, as directed.
8. Rack-Ladder Data Distribution Boxes: Install and align two rack ladders for the first column of data distribution boxes and one rack ladder for each additional adjacent column of data distribution boxes.
9. Mail Chutes: Mount chutes with bottom ends extending 1 inch (25 mm) into receiving boxes. Attach chutes with straps, collars, and sleeves. Do not penetrate chute with fasteners.
   a. Comply with USPS Publication 16 for installation.
   b. Install chutes with centerline of mail slots not more than 48 inches (1219 mm) above finished floor.
10. Key Keeper: Install horizontally **OR** vertically **OR** as indicated on Drawings, **as directed**.

B. Field Quality Control
1. Arrange for USPS personnel to examine and test postal specialties served by USPS after they have been installed according to USPS regulations.
2. Obtain written final approval of postal specialties to be served by USPS. Obtain this approval from USPS postmaster that authorizes mail collection for the served installation.

C. Adjusting, Cleaning, And Protection
1. Remove temporary protective coverings and strippable films, if any, as postal specialties are installed unless otherwise indicated in manufacturer's written installation instructions.
2. Adjust doors, hardware, and moving parts to function smoothly, and lubricate as recommended by manufacturer. Verify that integral locking devices operate properly.
3. Touch up marred finishes or replace postal specialties that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by postal specialty manufacturer.
4. Replace postal specialties that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
5. On completion of postal specialty installation, clean interior and exterior surfaces as recommended by manufacturer.

END OF SECTION 10552

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Task	Specification	Specification Description
10672	01906	Miscellaneous Carpentry

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SECTION 10810 - TOILET AND BATH ACCESSORIES

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for toilet and bath accessories. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. This Section includes the following:
a. Public-use washroom accessories.
b. Public-use shower room accessories.
c. Private-use bathroom accessories.
d. Healthcare accessories.
e. Warm-air dryers.
f. Childcare accessories.
g. Underlavatory guards.
h. Custodial accessories.

C. Submittals
1. Product Data: For each type of product indicated.
2. Product Schedule:
a. Identify locations using room designations indicated on Drawings.
b. Identify products using designations indicated on Drawings.

D. Warranty
1. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within 15 years from date of Substantial Completion.

1.2 PRODUCTS

A. Materials
1. Stainless Steel: ASTM A 666, Type 304, 0.0312-inch (0.8-mm) minimum nominal thickness, unless otherwise indicated.
2. Brass: ASTM B 19 flat products; ASTM B 16 (ASTM B 16M), rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
3. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.0359-inch (0.9-mm) minimum nominal thickness.
4. Galvanized Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.
5. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
6. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
7. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
8. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
9. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

B. Public-Use Washroom Accessories
1. Toilet Tissue (Roll) Dispenser:

a. Description: Roll-in-reserve dispenser with hinged front secured with tumbler lockset **OR** Single-roll dispenser **OR** Double-roll dispenser **OR** Double-roll dispenser with shelf, **as directed**.
b. Mounting: Recessed **OR** Partition mounted serving two adjacent toilet compartments **OR** Surface mounted, **as directed**.
c. Operation: Noncontrol delivery with standard spindle **OR** Noncontrol delivery with theft-resistant spindle **OR** Spindleless with tension-spring controlled delivery **OR** Spindleless with tension-spring controlled delivery and self-locking device extending through core that prevents core removal until roll is empty **OR** Eccentric-shaped, molded-plastic spindle revolves one-half revolution per dispensing operation for controlled delivery; core cannot be removed until roll is empty, **as directed**.
d. Capacity: Designed for 4-1/2- or 5-inch- (114- or 127-mm-) **OR** 5-inch- (127-mm-), **as directed,** diameter tissue rolls.
e. Material and Finish: Stainless steel, No. 4 finish (satin) **OR** Chrome-plated zinc alloy (zamac) or steel **OR** Satin-finish aluminum bracket with plastic spindle **OR** ABS plastic, gray, **as directed**.

2. Combination Toilet Tissue Dispenser:
   a. Description: Combination unit with double-roll toilet tissue dispenser and the following:
      1) Removable sanitary-napkin waste receptacle with self-closing disposal-opening cover.
      2) Seat-cover dispenser with minimum capacity of 500 **OR** 1000, **as directed,** single or half-fold seat covers.
   b. Mounting: Recessed **OR** Surface mounted **OR** Partition mounted, dual access with two tissue rolls per compartment **OR** Partition mounted, dual access with two tissue rolls per compartment and with one side that mounts flush with partition of accessible compartment, **as directed**.
   c. Toilet Tissue Dispenser Capacity: 4-1/2- or 5-inch- (114- or 127-mm-) diameter tissue rolls.
   d. Toilet Tissue Dispenser Operation: Noncontrol delivery with theft-resistant spindles.
   e. Material and Finish: Stainless steel, No. 4 finish (satin).
   f. Lockset: Tumbler type.
3. Toilet Tissue (Folded) Dispenser:
   a. Description: Folded-tissue dispenser with cover hinged at bottom.
   b. Mounting: Surface mounted.
   c. Minimum Capacity: 1250 single-fold tissues.
   d. Material and Finish: Stainless steel, No. 4 finish (satin).
   e. Lockset: Tumbler type.
   f. Refill Indicators: Pierced slots at front.
4. Toilet Tissue (Jumbo-Roll) Dispenser:
   a. Description: One-roll unit **OR** Two-roll unit with sliding panel to expose other roll, **as directed**.
   b. Mounting: Surface mounted.
   c. Capacity: 9- or 10-inch- (228- or 254-mm-) diameter rolls.
   d. Material and Finish: Stainless steel, No. 4 finish (satin) **OR** ABS plastic, gray, **as directed**.
   e. Lockset: Tumbler type.
   f. Refill Indicator: Pierced slots at front.
5. Paper Towel (Folded) Dispenser:
   a. Mounting: Recessed **OR** Semirecessed **OR** Deck mounted, recessed **OR** Surface mounted, **as directed**.
   b. Minimum Capacity: 400 C-fold or 525 multifold towels **OR** 600 C-fold or 800 multifold towels **OR** 400 single-fold towels, **as directed**.
   c. Material and Finish: Stainless steel, No. 4 finish (satin) **OR** ABS plastic, gray, **as directed**.
   d. Lockset: Tumbler type.
   e. Refill Indicators: Pierced slots at sides or front.
6. Paper Towel (Roll) Dispenser:

a. Description: Lever-actuated mechanism permits controlled delivery of paper rolls in preset lengths per stroke.
b. Mounting: Recessed **OR** Semirecessed **OR** Surface mounted, **as directed**.
c. Minimum Capacity: 8-inch (203-mm) wide, 800-foot (244-m) long roll.
d. Material and Finish: Stainless steel, No. 4 finish (satin) **OR** ABS plastic, gray, **as directed**.
e. Lockset: Tumbler type.

7. Waste Receptacle:
   a. Mounting: Open top, recessed **OR** Self-closing disposal-opening cover, recessed **OR** Semirecessed **OR** Surface mounted **OR** Wall mounted for corner installation **OR** Freestanding **OR** Undercounter, **as directed**.
   b. Minimum Capacity: Capacity in gal. (L) **as directed**.
   c. Material and Finish: Stainless steel, No. 4 finish (satin).
   d. Liner: Reusable vinyl liner.
   e. Lockset: Tumbler type for waste-receptacle.
8. Combination Towel (Folded) Dispenser/Waste Receptacle:
   a. Description: Combination unit for dispensing C-fold or multifold towels, with removable waste receptacle.
   b. Mounting: Surface mounted **OR** Surface mounted with stainless-steel collar **OR** Recessed **OR** Recessed with projecting receptacle **OR** Semirecessed, **as directed**.
      1) Designed for nominal 4-inch (100-mm) **OR** 6-inch (150-mm), **as directed,** wall depth.
   c. Minimum Towel-Dispenser Capacity: 600 C-fold or 800 multifold paper towels.
   d. Minimum Waste-Receptacle Capacity: 4 gal. (15 L) **OR** 12 gal. (45.4 L), **as directed.**
   e. Material and Finish: Stainless steel, No. 4 finish (satin).
   f. Liner: Reusable, vinyl waste-receptacle liner.
   g. Lockset: Tumbler type for towel-dispenser compartment and waste receptacle.
9. Combination Towel (Roll) Dispenser/Waste Receptacle:
   a. Description: Combination unit for dispensing preset length of roll paper towels, with removable waste receptacle.
   b. Mounting: Recessed **OR** Semirecessed **OR** Surface mounted, **as directed**.
   c. Minimum Towel-Dispenser Capacity: 8-inch (203-mm) wide, 800-foot (244-m) long roll.
   d. Minimum Waste Receptacle Capacity: 8 gal. (30 L) **OR** 12 gal. (45.4 L) **OR** 15 gal. (56.8 L), **as directed**.
   e. Material and Finish: Stainless steel, No. 4 finish (satin).
   f. Liner: Reusable, vinyl waste-receptacle liner.
   g. Lockset: Tumbler type for towel dispenser compartment and waste receptacle.
10. Multipurpose Soap/Towel Dispenser Unit:
    a. Description: Combination unit for dispensing soap in liquid or lotion **OR** lather, **as directed,** form and folded towels.
    b. Mounting: Recessed, designed for nominal 4-inch (100-mm) wall depth **OR** Surface mounted with stainless-steel collar, **as directed**.
    c. Minimum Soap-Dispenser Capacity: 80 oz. (2.36 L).
    d. Minimum Towel-Dispenser Capacity: 600 C-fold or 800 multifold **OR** 1000 single-fold, **as directed,** towels.
    e. Material and Finish: Stainless steel, No. 4 finish (satin) for unit body and soap valve.
    f. Lockset: Tumbler type.
11. Liquid-Soap Dispenser:
    a. Description: Designed for dispensing soap in liquid or lotion **OR** lather, **as directed,** form.
    b. Mounting: Deck mounted on vanity **OR** Deck mounted on lavatory **OR** Horizontally oriented, recessed **OR** Horizontally oriented, surface mounted **OR** Vertically oriented, surface mounted, **as directed**.
    c. Capacity: Capacity in **oz. (mL), as directed.**
    d. Materials: Valve and reservoir materials and finishes, **as directed**.
    e. Lockset: Tumbler type.
    f. Refill Indicator: Window type.
12. Grab Bar:

a. Mounting: Flanges with concealed **OR** exposed, **as directed,** fasteners.
b. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
   1) Finish: Smooth, No. 4, satin finish **OR** Smooth, No. 4, satin finish on ends and slip-resistant texture in grip area, **as directed**.
c. Outside Diameter: 1-1/4 inches (32 mm) **OR** [1-1/2 inches (38 mm), **as directed**.
d. Configuration and Length: As indicated on Drawings **OR** Straight, 36 inches (914 mm) long, **as directed**.

13. Vendor:
    a. Type: Sanitary napkin **OR** Sanitary napkin and tampon **OR** Condom, **as directed**.
    b. Mounting: Fully recessed, designed for 4-inch (100-mm) wall depth, **OR** Semirecessed, **OR** Surface mounted, **as directed**.
    c. Capacity: **As directed**.
    d. Operation: No coin (free) **OR** Single coin (25 cents) **OR** Two coin (50 cents), **as directed**.
    e. Exposed Material and Finish: Stainless steel, No. 4 finish (satin).
    f. Lockset: Tumbler type with separate lock and key for coin box.
14. Sanitary-Napkin Disposal Unit:
    a. Mounting: Recessed **OR** Partition mounted, dual access **OR** Surface mounted, **as directed**.
    b. Door or Cover: Self-closing disposal-opening cover and hinged face panel with tumbler lockset.
    c. Receptacle: Removable.
    d. Material and Finish: Stainless steel, No. 4 finish (satin) **OR** ABS plastic, gray, **as directed**.
15. Seat-Cover Dispenser:
    a. Mounting: Surface mounted **OR** Recessed **OR** Partition mounted, dual access, **as directed**.
    b. Minimum Capacity: 250 **OR** 500, **as directed,** seat covers.
    c. Exposed Material and Finish: Stainless steel, No. 4 finish (satin) **OR** ABS plastic, gray, **as directed**.
    d. Lockset: Tumbler type.
16. Fold-Down Purse Shelf:
    a. Description: Hinged unit with spring-loaded shelf that automatically returns to vertical position.
    b. Nominal Size: 15 inches (381 mm) long by 5-1/2 inches (140 mm) wide.
    c. Material and Finish: Chrome-plated cast-zinc alloy (zamac) with stippled finish on tray or stainless steel, No. 4 finish (satin) **OR** Chrome-plated cast-zinc alloy (zamac) with stippled finish on tray and bright chrome finish on edges **OR** Stainless steel, No. 4 finish (satin), **as directed**.
17. Mirror Unit:
    a. Frame: Stainless-steel angle, 0.05 inch (1.3 mm) thick **OR** Stainless-steel channel **OR** Stainless steel, fixed tilt **OR** Stainless steel, adjustable tilt, **as directed**.
       1) Corners: Manufacturer's standard **OR** Mitered and mechanically interlocked **OR** Welded and ground smooth, **as directed**.
    b. Integral Shelf: 5 inches (127 mm) deep.
    c. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
       1) One-piece, galvanized steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
       2) Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
    d. Size: As indicated on Drawings **OR as directed**.
18. Facial Tissue Dispenser:
    a. Mounting: Wall mounted, recessed **OR** Surface mounted, **as directed**.
    b. Nominal Depth: 2-1/4 inches (57 mm) **OR** 4 inches (102 mm), **as directed**.
    c. Capacity: 150 double-ply tissues.
    d. Material and Finish:

1) Dispenser Face: Stainless steel, No. 4 finish (satin) **OR** Stainless steel, No. 7 finish (polished), **as directed**.
2) Cabinet: Steel with corrosion-resistant finish.

C. Public-Use Shower Room Accessories
1. Shower Curtain Rod:
a. Description: 1-inch (25.4-mm) OD; fabricated from nominal 0.0375-inch- (0.95-mm-) thick stainless steel **OR** 1-1/4-inch (32-mm) OD; fabricated from nominal **0.05-inch- (1.3-mm-) thick stainless steel, as directed.**
b. Mounting Flanges: Stainless-steel flanges designed for exposed fasteners.
c. Finish: No. 4 (satin).
2. Shower Curtain:
a. Size: Minimum 6 inches (152 mm) **OR** 12 inches (305 mm), **as directed,** wider than opening by 72 inches (1828 mm) high.
b. Material: Vinyl, minimum 0.006-inch- (0.15-mm-) thick, opaque, matte, **OR** Duck, minimum 8 oz. (227 g), white, 100 percent cotton, **OR** Nylon-reinforced vinyl, minimum 10-oz. (284-g) or 0.008-inch- (0.2-mm-) thick vinyl, with integral antibacterial agent, **as directed**.
c. Color: White **OR** Green **OR** As selected from manufacturer's full range, **as directed**.
d. Grommets: Corrosion resistant at minimum 6 inches (152 mm) o.c. through top hem.
e. Shower Curtain Hooks: Chrome-plated or stainless-steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.
3. Folding Shower Seat:
a. Configuration: L-shaped seat, designed for wheelchair access **OR** Rectangular seat **OR** Triangular, corner-type seat **OR** Stainless-steel seat designed to fold into recessed-mounted, stainless-steel wall box, **as directed**.
b. Seat: Phenolic or polymeric composite of slat-type or one-piece construction in color as selected **OR** White vinyl padded seat **OR** Stainless steel, No. 4 finish (satin); 0.05-inch (1.3-mm) minimum nominal thickness; with single-piece, pan-type construction and edge seams welded and ground smooth, **as directed**.
c. Mounting Mechanism: Stainless steel, No. 4 finish (satin).
d. Dimensions: **As directed.**
4. Soap Dish:
a. Description: With **OR** Without, **as directed,** washcloth bar.
b. Mounting: Recessed **OR** Surface mounted, **as directed**.
c. Material and Finish: Stainless steel, No. 4 finish (satin).

D. Private-Use Bathroom Accessories
1. Toilet Tissue Dispenser:
a. Description: Single-roll dispenser **OR** Double-roll dispenser **OR** Single-roll dispenser with hood **OR** Double-roll dispenser with hood, **as directed**.
b. Mounting: Recessed **OR** Surface mounted, **as directed**.
c. Capacity: Designed for 4-1/2- or 5-inch- (114- or 127-mm-) diameter tissue rolls.
d. Material and Finish: Solid brass, polished **OR** Polished brass-plated zinc alloy (zamac) **OR** Polished chrome-plated brass **OR** Polished chrome-plated zinc alloy (zamac) **OR** Stainless steel, No. 4 finish (satin) **OR** Stainless steel, No. 7 finish (polished), **as directed**.
2. Shower Curtain Rod:
a. Outside Diameter: 1 inch (25.4 mm) **OR** 1-1/4 inch (32 mm), **as directed**.
b. Mounting: Flanges with exposed **OR** concealed, **as directed,** fasteners.
c. Rod Material and Finish: Solid brass, polished **OR** Polished chrome-plated brass **OR** Stainless steel, No. 4 finish (satin) **OR** Stainless steel, No. 7 finish (polished), **as directed**.
d. Flange Material and Finish: Polished brass-plated zinc alloy (zamac) **OR** Polished chrome-plated brass **OR** Polished chrome-plated zinc alloy (zamac) **OR** Stainless steel, No. 4 finish (satin) **OR** Stainless steel, No. 7 finish (polished), **as directed**.
e. Accessories: Integral chrome-plated brass glide hooks.
3. Soap Dish:

a. Description: **As directed**.
b. Mounting: Recessed **OR** Surface mounted, **as directed**.
c. Material and Finish: Solid brass, polished **OR** Polished brass-plated zinc alloy (zamac) **OR** Polished chrome-plated brass **OR** Polished chrome-plated zinc alloy (zamac) **OR** Stainless steel, No. 4 finish (satin) **OR** Stainless steel, No. 7 finish (polished), **as directed**.

4. Medicine Cabinet:
   a. Mounting: Recessed, for nominal 4-inch (100-mm) wall depth **OR** Surface mounted, **as directed**.
   b. Size: 18 by 24 inches (460 by 610 mm).
   c. Door: Framed mirror door concealing storage cabinet equipped with continuous hinge and spring-buffered, rod-type stop and magnetic door catch.
   d. Shelves: Three, adjustable.
   e. Material and Finish:
      1) Cabinet: Stainless steel, No. 4 finish (satin) **OR** Steel with corrosion resistant finish, **as directed**.
      2) Mirror Frame: **As directed.**
      3) Door: **As directed.**
      4) Hinge: **As directed.**
      5) Shelves: **As directed.**
5. Facial Tissue Dispenser:
   a. Mounting: Wall mounted, recessed **OR** Surface mounted, **as directed**.
   b. Depth: 2-5/8 inches (67 mm) **OR** 4 inches (102 mm), **as directed**.
   c. Material and Finish:
      1) Dispenser Face: Polished chrome-plated brass **OR** Polished brass-plated zinc alloy (zamac) **OR** Polished chrome-plated steel **OR** Stainless steel, No. 4 finish (satin) **OR** Stainless steel, No. 7 finish (polished), **as directed**.
      2) Cabinet: Steel with corrosion-resistant finish.
6. Robe Hook:
   a. Description: Double-prong **OR** Single-prong, **as directed,** unit.
   b. Material and Finish: Solid brass, polished **OR** Polished brass-plated zinc alloy (zamac) **OR** Polished chrome-plated brass **OR** Polished chrome-plated zinc alloy (zamac) **OR** Stainless steel, No. 4 finish (satin) **OR** Stainless steel, No. 7 finish (polished), **as directed**.
7. Toothbrush and Tumbler Holder:
   a. Description: **As directed**.
   b. Material and Finish: Solid brass, polished **OR** Polished brass-plated zinc alloy (zamac) **OR** Polished chrome-plated brass **OR** Polished chrome-plated zinc alloy (zamac) **OR** Stainless steel, No. 4 finish (satin) **OR** Stainless steel, No. 7 finish (polished), **as directed**.
8. Towel Bar:
   a. Description: 3/4-inch- (19-mm-) square tube with rectangular end brackets **OR** 3/4-inch- (19-mm-) round tube with circular end brackets, **as directed**.
   b. Mounting: Flanges with concealed **OR** exposed, **as directed,** fasteners.
   c. Length: 18 inches (457 mm), **OR** 24 inches (610 mm), **OR** 30 inches (762 mm), **as directed**.
   d. Material and Finish: Stainless steel, No. 4 finish (satin) **OR** Stainless steel, No. 7 finish (polished) **OR** Polished aluminum, **as directed**.
9. Towel Pin:
   a. Description: Projecting minimum of 3 inches (75 mm) **OR** 5 inches (127 mm), **as directed,** from wall surface.
   b. Material and Finish: Polished brass-plated zinc alloy (zamac) **OR** Polished chrome-plated brass **OR** Stainless steel, No. 4 finish (satin) **OR** Stainless steel, No. 7 finish (polished), **as directed**.
10. Towel Ring:
    a. Description: Pin projecting approximately 2-1/2 inches (63 mm) from wall with square **OR** circular **OR** oval **OR** trapezoidal, **as directed,** ring.

b. Pin Material and Finish: Solid brass, polished **OR** Polished brass-plated zinc alloy (zamac) **OR** Polished chrome-plated brass **OR** Polished chrome-plated zinc alloy (zamac) **OR** Stainless steel, No. 4 finish (satin) **OR** Stainless steel, No. 7 finish (polished), **as directed**.
c. Ring Material and Finish: Matching pin **OR** Clear plastic, **as directed**.

11. Towel Shelf:
    a. Description: Surface-mounted, guest-towel shelf with four 3/8-inch- (9-mm-) diameter **OR** 5/16-inch- (8-mm-) square, **as directed,** stainless steel tubes mounted in support arms.
        1) Towel Bar: 1/4-inch (6-mm-) diameter **OR** 5/16-inch- (8-mm-) square, **as directed,** stainless-steel towel bar below shelf.
    b. Length: 18 inches (457 mm) **OR** 24 inches (610 mm), **as directed.**
    c. Material and Finish: Polished brass-plated stainless steel tubes mounted in zinc alloy (zamac) support arms **OR** Polished chrome-plated stainless steel tubes mounted in zinc alloy (zamac) support arms **OR** Stainless steel, No. 7 finish (polished), **as directed**.
12. Towel Rack:
    a. Description: Surface-mounted, guest-towel unit with approximately 1/4-inch- (6-mm-) diameter wire rings welded to upright wire bracket.
    b. Capacity: 2 **OR** 3 **OR** 4, **as directed,** sets of bath towels, hand towels, and washcloths.
    c. Nominal Height: 11 inches (279 mm) **OR** 17 inches (432 mm) **OR** 21 inches (533 mm), **as directed**.
    d. Material and Finish: Polished brass-plated zinc alloy (zamac) **OR** Polished chrome-plated zinc alloy (zamac), **as directed**.
13. Retractable Clothesline:
    a. Description: Surface-mounted rectangular **OR** circular, **as directed,** housing with minimum 72-inch- (1829-mm-) long, retractable, spring-actuated, synthetic clothesline and remote retention bracket.
    b. Material and Finish Chrome-plated brass **OR** Stainless steel, No. 7 finish (polished), **as directed**.
14. Bottle Opener:
    a. Description: Surface-mounted unit with standard **OR** vandal-resistant, **as directed,** fasteners.
    b. Material and Finish: Stainless steel, No. 4 finish (satin) **OR** Stainless steel, No. 7 finish (polished) **OR** Chrome-plated steel, **as directed**.

E. Healthcare Accessories
1. Specimen Pass-Through Cabinet:
    a. Description: With self-closing doors on both sides, lock that prevents doors from both being opened at the same time, and removable stainless-steel tray.
    b. Nominal Wall Opening: 12 by 11-1/4 inches (305 by 285 mm), width times height.
    c. Material and Finish: Stainless steel, No. 4 finish (satin).
2. Specimen Pass-Through Box:
    a. Description: With minimum 12-inch (305-mm) diameter turntable removable cylinder that revolves on stainless-steel self-lubricating ball bearing plates, and with mechanism to prevent over rotation of cylinder.
    b. Nominal Wall Opening: 13-1/4 by 14 inches (335 by 355 mm), width times height.
    c. Material and Finish: Stainless steel, No. 4 finish (satin).
    d. Lockset: Tumbler type.
3. Bedpan and Urinal Cabinet:
    a. Description: For storing one conventional size bedpan and one urinal bottle; with door that produces 1/2-inch (13-mm) opening at top and bottom of cabinet to allow air circulation.
    b. Mounting: Recessed.
    c. Nominal Wall Opening: 13-1/2 by 26-1/2 by 5 inches (340 by 670 by 130 mm), width times height times depth.
    d. Material and Finish: Stainless steel, No. 4 finish (satin).
4. Bedpan and Urinal Rack:
    a. Description: For storing one conventional size bedpan and one urinal bottle.
    b. Mounting: Surface mounted.

c. Size: 12 by 27 inches (300 by 685 mm), width times height.
d. Material and Finish: Stainless steel, No. 4 finish (satin).

F. Warm-Air Dryers
1. Warm-Air Dryer:
a. Mounting: Recessed **OR** Semirecessed **OR** Surface mounted, **as directed**.
b. Operation: Touch-button **OR** Electronic-sensor, **as directed,** activated with timed power cut-off switch.
1) Operation Time: 30 to 40, **OR** 80, **as directed,** seconds.
c. Cover Material and Finish: Steel, with white enamel finish **OR** Cast iron, with enamel finish in color selected **OR** Chrome-plated steel **OR** Stainless steel, No. 4 finish (satin) **OR** Molded plastic, gray **OR** Molded plastic, white, **as directed**.
d. Electrical Requirements: 115 V, 13 A, 1500 W **OR** 115 V, 15 A, 1725 W **OR** 115 V, 20 A, 2300 W **OR** 208-240 V, 9-10 A, 1900-2300 W, **as directed**.

G. Childcare Accessories
1. Diaper-Changing Station:
a. Description: Horizontal **OR** Vertical, **as directed,** unit that opens by folding down from stored position and with child-protection strap.
1) Engineered to support a minimum of 250-lb (113-kg) static load when opened.
b. Mounting: Surface mounted, with unit projecting not more than 4 inches (100 mm) from wall when closed **OR** Semirecessed, with unit projecting not more than 1 inch (25 mm) from wall when closed, **as directed**.
c. Operation: By pneumatic shock-absorbing mechanism.
d. Material and Finish: High-density polyethylene in manufacturer's standard color **OR** High-density polyethylene with plastic laminate insert in color selected **OR** Stainless steel, No. 4 finish (satin), with replaceable insulated polystyrene tray liner and rounded plastic corners **OR** Stainless steel, No. 4 finish (satin), exterior shell with rounded plastic corners; high-density polyethylene interior in manufacturer's standard color, **as directed**.
e. Liner Dispenser: Built in.
2. Diaper-Pack Vendor:
a. Mounting: Surface mounted **OR** Recessed, **as directed**.
b. Minimum Capacity: 100 diaper packs.
c. Coin Operation: Coin slot preset for 1 U.S. dollar, adjustable up in 25-cent increments.
d. Material and Finish: Stainless steel, No. 4 finish (satin).
3. Child-Protection Seat:
a. Description: Unit that opens by folding down from stored position and with child-protection strap.
1) Engineered to support a minimum of 80-lb (36-kg), **OR** 150-lb (68-kg), **as directed,** static load when opened.
b. Mounting: Surface mounted, with unit projecting not more than 4-1/2 inches (114 mm), **OR** 6 inches (152 mm), **as directed,** from wall when closed.
c. Material and Finish: High-density polyethylene in manufacturer's standard color.

H. Underlavatory Guards
1. Material and Finish: Antimicrobial, molded-plastic, white.

I. Custodial Accessories
1. Utility Shelf:
a. Description: With exposed edges turned down not less than 1/2 inch (12.7 mm) and supported by two triangular brackets welded to shelf underside.
b. Size: 16 inches (406 mm) long by 6 inches (152 mm) deep.
c. Material and Finish: Not less than nominal 0.05-inch- (1.3-mm-) thick stainless steel, No. 4 finish (satin).
2. Mop and Broom Holder:

a. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
b. Length: 36 inches (914 mm).
c. Hooks: Three.
d. Mop/Broom Holders: Four, spring-loaded, rubber hat, cam type.
e. Material and Finish: Stainless steel, No. 4 finish (satin).
1) Shelf: Not less than nominal 0.05-inch- (1.3-mm-) thick stainless steel.
2) Rod: Approximately 1/4-inch- (6-mm-) diameter stainless steel.

3. Paper Towel (Folded) Dispenser:
a. Mounting: Recessed **OR** Semirecessed **OR** Surface mounted, **as directed**.
b. Minimum Capacity: 400 C-fold or 525 multifold towels **OR** 600 C-fold or 800 multifold towels **OR** 400 single-fold towels, **as directed**.
c. Material and Finish: Stainless steel, No. 4 finish (satin) **OR** ABS plastic, gray, **as directed**.
d. Lockset: Tumbler type.
e. Refill Indicators: Pierced slots at sides or front.

4. Paper Towel (Roll) Dispenser:
a. Description: Lever-actuated mechanism permits controlled delivery of paper rolls in preset lengths per stroke.
b. Mounting: Recessed **OR** Semirecessed **OR** Surface mounted, **as directed**.
c. Minimum Capacity: 8-inch (203-mm) wide, 800-foot (244-m) long roll.
d. Material and Finish: Stainless steel, No. 4 finish (satin), **OR** ABS plastic, gray, **as directed**.
e. Lockset: Tumbler type.

5. Liquid-Soap Dispenser:
a. Description: Designed for dispensing soap in liquid or lotion **OR** lather, **as directed,** form.
b. Mounting: Deck mounted on vanity **OR** Deck mounted on lavatory **OR** Horizontally oriented, recessed **OR** Horizontally oriented, surface mounted **OR** Vertically oriented, surface mounted, **as directed**.
c. Capacity: Capacity in oz. (mL), **as directed.**
d. Materials: Valve and reservoir materials and finishes, **as directed**.
e. Lockset: Tumbler type.
f. Refill Indicator: Window type.

J. Fabrication
1. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

1.3 EXECUTION

A. Installation
a. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
b. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to method in ASTM F 446.

END OF SECTION 10810

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SECTION 10810a - DETENTION TOILET ACCESSORIES

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for detention toilet accessories. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section Includes:
a. Safety hooks.
b. Shelves.
c. Combination shelves with safety hooks.
d. Miscellaneous toilet accessories.
e. Stainless-steel mirrors.
f. Grab bars.
g. Shower seats.

C. Submittals
1. Product Data: For each type of product indicated.
2. LEED Submittals:
a. Product Data for Credit EQ 4.1: For security sealants, including printed statement of VOC content.
3. Samples: For each type of detention toilet accessory indicated.
4. Product Schedule: Indicate types, quantities, sizes, and installation locations by room.
5. Coordination Drawings: Drawings showing location of each built-in anchor supporting detention toilet accessories, including anchors to be installed as work of other Sections, drawn to scale and coordinating anchorage with detention toilet accessories.
6. Welding certificates.
7. Maintenance data.
8. Warranties: Sample of special warranties.
9. Other Informational Submittals:
a. Examination reports documenting inspection of substrates, areas, and conditions.
b. Anchor inspection reports documenting inspections of built-in and cast-in anchors.
c. Field quality-control certification signed by Contractor and Detention Specialist.

D. Quality Assurance
1. Welding Qualifications: Qualify procedures and personnel according to the following:
a. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
b. AWS D1.3, "Structural Welding Code - Sheet Steel."
c. AWS D1.6, "Structural Welding Code - Stainless Steel."
2. Preinstallation Conference: Conduct conference at Project site.
3. Coordination Meetings: Conduct coordination meetings at Project site to comply with requirements in Division 01 Section "Special Project Procedures For Detention Facilities".

E. Warranty
1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace detention toilet accessories that fail in materials or workmanship within two years from date of Substantial Completion.

1.2 PRODUCTS

A. Materials
1. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, CS (Commercial Steel), Type B.
2. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, CS (Commercial Steel), Type B; with G60 (Z180) zinc (galvanized) coating designation.
3. Stainless-Steel Sheet: ASTM A 666 or ASTM A 240/A 240M, austenitic stainless steel, Type 304; Type 430 for mirrors.
4. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
5. Concealed Bolts: ASTM A 307, Grade A unless otherwise indicated.
6. Cast-in-Place Anchors in Concrete: Anchors of type indicated below, fabricated from corrosion-resistant materials capable of sustaining, without failure, a load equal to 4 times the load imposed, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
   a. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.
7. Embedded Plate Anchors: Fabricated from steel shapes and plates, minimum 3/16 inch (4.8 mm) thick; with minimum 1/2-inch- (12.7-mm-) diameter headed studs welded to back of plate.
8. Proprietary Built-in Masonry Anchors: Fabricated from 0.134-inch (3.41-mm) nominal-thickness steel sheet **OR** 1/4-inch (6.3-mm) nominal-thickness steel plate **OR** 1/2-inch (12.7-mm) nominal-thickness steel plate, **as directed**, into 6-inch- (152-mm-) **OR** 8-inch- (203-mm-), **as directed**, deep blocks matching size of concrete masonry units; with weld nuts attached on inside to receive field-bolted attachments, **as directed**.
   a. Finish: Factory primed for field painting for anchors with field-welded attachments **OR** Polyester powder coat for anchors with bolted attachments **OR** Epoxy paint for anchors with bolted attachments, **as directed**.
9. Welding Rods and Bare Electrodes: Select according to AWS specifications.

B. Security Sealants
1. Manufacturer's standard, high-modulus, nonsag, two-part, pick-proof, epoxy sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), recommended for sealing nonmoving interior joints in security applications.

C. Security Fasteners
1. Fasteners that are operable only by tools produced by fastener manufacturer or other licensed fabricator for use on specific type of fastener.
2. Provide drive-system type, head style, material, and protective coating as required for assembly, installation, and strength, and as follows:
   a. Drive-System Types: Pinned Torx-Plus **OR** Pinned Torx, **as directed**.
   b. Fastener Strength: 120,000 psi (827 MPa).
   c. Socket Button Head Fasteners:
      1) Heat-treated alloy steel, ASTM F 835 (ASTM F 835M).
      2) Stainless steel, ASTM F 879 (ASTM F 879M), Group 1 CW.
   d. Socket Flat Countersunk Head Fasteners:
      1) Heat-treated alloy steel, ASTM F 835 (ASTM F 835M).
      2) Stainless steel, ASTM F 879 (ASTM F 879M), Group 1 CW.
   e. Socket Head Cap Fasteners:
      1) Heat-treated alloy steel, ASTM A 574 (ASTM A 574M).
      2) Stainless steel, ASTM F 837 (ASTM F 837M), Group 1 CW.
   f. Protective Coatings for Heat-Treated Alloy Steel:
      1) Zinc and clear trivalent chromium, where indicated.
      2) Zinc phosphate with oil, ASTM F 1137, Grade I, or black oxide unless otherwise indicated.

D. Detention Safety Hooks

1. Individual, Curved, Detention Safety Hook: 0.188-inch (4.77-m) nominal-thickness, stainless-steel curved hook held by 0.141-inch- (3.58-mm-) **OR** 0.109-inch- (2.77-mm-), **as directed**, thick, stainless-steel bracket punched with not less than 2 holes for fastening with security fastener. Provide friction washer assembly, adjustable with a nonremovable security screw that maintains pressure on hook and allows hook to pivot when load exceeds preset limit. Provide No. 4 finish.
2. Individual, Straight, Detention Safety Hook: 3/8-inch- (9.5-mm-) **OR** 1/4-inch- (6.3-mm-), **as directed**, diameter, stainless-steel straight hook held by 0.109-inch- (2.77-mm-) **OR** 0.078-inch- (1.98-mm-), **as directed**, thick, stainless-steel mounting plate approximately 4 inches (102 mm) square. Provide pivoting assembly that maintains pressure on hook and snaps down when load exceeds 8 lbf (35.6 N). Provide No. 4 finish.
   a. Mounting: Front mounting with security fasteners **OR** Chase mounting with welded anchor nuts on backplate, **as directed**.
3. Multiple, Curved, Safety Hook Strip: Minimum 5-1/2-inch- (140-mm-) high backplate by length indicated, formed from 0.125-inch- (3.18-mm-) **OR** 0.109-inch- (2.77-mm-) **OR** 0.078-inch- (1.98-mm-), **as directed**, thick, stainless-steel sheet. Provide 0.188-inch- (4.77-mm-) thick, stainless-steel hooks attached to backplate; with each hook having a friction washer assembly, adjustable with a nonremovable security screw that maintains pressure on hook and allows hook to pivot when load exceeds preset limit. Provide No. 4 finish.
   a. Configuration: 16 inches (406 mm) long with 2 hooks **OR** 18 inches (457 mm) long with 4 hooks **OR** 21 inches (533 mm) long with 4 hooks **OR** 24 inches (610 mm) long with 3 hooks **OR** 32 inches (813 mm) long with 4 hooks, **as directed**.
   b. Mounting: Front mounting with security fasteners **OR** Chase mounting with welded anchor nuts on backplate, **as directed**.
4. Multiple, Straight, Safety Hook Strip: Minimum 5-1/2-inch- (140-mm-) high backplate by length indicated, formed from 0.141-inch- (3.58-mm-) **OR** 0.109-inch- (2.77-mm-) **OR** 0.078-inch- (1.98-mm-), **as directed**, thick, stainless-steel sheet. Provide 3/8-inch- (9.5-mm-) **OR** 1/4-inch- (6.3-mm-), **as directed**, diameter, stainless-steel straight hooks attached to backplate. Provide pivoting assembly that maintains pressure on hook and snaps down when load exceeds 8 lbf (35.6 N). Provide No. 4 finish.
   a. Configuration: 16 inches (406 mm) long with 2 hooks **OR** 18 inches (457 mm) long with 4 hooks **OR** 24 inches (610 mm) long with 3 hooks **OR** 32 inches (813 mm) long with 4 hooks, **as directed**.
   b. Mounting: Front mounting with security fasteners **OR** Chase mounting with welded anchor nuts on backplate, **as directed**.

E. Detention Shelves

1. Surface-Mounted, Steel Detention Shelf: Minimum 6 inches high by 8 inches (152 mm high by 203 mm) deep by 16 inches (406 mm) **OR** 24 inches (610 mm) **OR** 32 inches (813 mm), **as directed**, long; formed from 0.138-inch (3.50-mm) **OR** 0.108-inch (2.74-mm), **as directed**, nominal-thickness, metallic-coated steel sheet; with welded side gussets and minimum 1-inch (25.4-mm) flanged front edge; with back punched for fastening to wall with security fasteners. Provide factory priming for field-painted **OR** baked-enamel, **as directed**, finish.
2. Surface-Mounted, Stainless-Steel Detention Shelf: Minimum 5-1/2 inches high by 8 inches (140 mm high by 203 mm) deep by 18 inches (457 mm) **OR** 24 inches (610 mm), **as directed**, long; formed from 0.078-inch- (1.98-mm-) thick, stainless-steel sheet; with welded side gussets and hemmed front edge. Provide No. 4 finish.
   a. Mounting: Front mounting with security fasteners **OR** Chase mounting with welded anchor nuts on backplate, **as directed**.
3. Recessed Detention Shelf: Minimum inside dimensions of 16 inches (406 mm) wide by 5 inches high by 4 inches (127 mm high by 102 mm) deep; formed from 0.062-inch- (1.57-mm-) thick, stainless-steel sheet; with 1-inch- (25.4-mm-) wide flanged front edge. Secure to wall with rear-mounting steel strap and adjustment bolts. Provide No. 4 finish.

F. Combination Detention Shelves With Safety Hooks

1. Steel Detention Shelf with Multiple, Curved Safety Hooks: Minimum 6 inches high by 8 inches (152 mm high by 203 mm) deep by length indicated, formed from 0.138-inch (3.50-mm) **OR** 0.108-inch (2.74-mm), **as directed**, nominal-thickness, metallic-coated steel sheet, with welded side gussets and hemmed or flanged front edge. Provide 0.138-inch (3.50-mm) nominal-thickness, zinc-plated-steel curved hooks held by 0.1265-inch- (3.21-mm-) thick steel brackets welded to backplate, with each hook having a friction washer assembly, adjustable with a nonremovable security screw that maintains pressure on hook and allows hook to pivot when load exceeds preset limit. Provide factory priming for field-painted **OR** baked-enamel, **as directed**, finish.
   a. Configuration: 16 inches (406 mm) long with 2 hooks **OR** 24 inches (610 mm) long with 3 hooks **OR** 32 inches (813 mm) long with 4 hooks, **as directed**.
   b. Mounting: Front mounting with security fasteners **OR** Chase mounting with welded anchor nuts on backplate, **as directed**.
2. Stainless-Steel Detention Shelf with Multiple, Curved Safety Hooks: Minimum 5-1/2 inches high by 8 inches (140 mm high by 203 mm) deep by length indicated; formed from 0.078-inch- (1.98-mm-) thick, stainless-steel sheet; with welded side gussets and hemmed or flanged front edge. Provide 0.141-inch (3.58-mm) stainless-steel curved hooks held by 0.141-inch- (3.58-mm-) thick stainless-steel brackets welded to backplate, with each hook having a friction washer assembly, adjustable with a nonremovable security screw that maintains pressure on hook and allows hook to pivot when load exceeds preset limit. Provide No. 4 finish.
   a. Configuration: 16 inches (406 mm) long with 2 hooks **OR** 18 inches (457 mm) long with 4 hooks **OR** 24 inches (610 mm) long with 3 hooks **OR** 32 inches (813 mm) long with 4 hooks, **as directed**.
   b. Mounting: Front mounting with security fasteners **OR** Chase mounting with welded anchor nuts on backplate, **as directed**.
3. Stainless-Steel Detention Shelf with Multiple, Straight Safety Hooks: Minimum 5-1/2 inches high by 8 inches (140 mm high by 203 mm) deep by length indicated; formed from 0.078-inch- (1.98-mm-) thick, stainless-steel sheet; with welded side gussets and hemmed or flanged front edge. Provide 3/8-inch- (9.5-mm-) **OR** 1/4-inch- (6.3-mm-), **as directed**, diameter, stainless-steel straight hooks held by 0.109-inch- (2.77-mm-) **OR** 0.078-inch- (1.98-mm-), **as directed**, thick, stainless-steel mounting plate. Provide pivoting assembly that maintains pressure on hook and snaps down when load exceeds 8 lbf (35.6 N). Provide No. 4 finish.
   a. Configuration: 16 inches (406 mm) long with 2 hooks **OR** 18 inches (457 mm) long with 4 hooks **OR** 24 inches (610 mm) long with 3 hooks **OR** 32 inches (813 mm) long with 4 hooks, **as directed**.
   b. Mounting: Front mounting with security fasteners **OR** Chase mounting with welded anchor nuts on backplate, **as directed**.

G. Miscellaneous Detention Toilet Accessories
1. Recessed, Detention Toilet Tissue Dispenser: Minimum 5-inch diameter by 4-1/2 inches (127-mm diameter by 114 mm) deep; formed from 0.062-inch- (1.57-mm-) thick, stainless-steel sheet. Secure to wall with rear-mounting steel strap and adjustment bolts. Provide No. 4 finish.
   a. Face: 1-inch (25.4-mm) lip around entire face **OR** 7-inch- (178-mm-) square face flange, **as directed**.
2. Recessed, Detention Soap Dish: Minimum inside dimensions of 5-3/4 inches wide by 4-1/2 inches high by 2-1/2 inches (146 mm wide by 114 mm high by 64 mm) deep with 3/4-inch (19-mm) lip around entire face; formed from 0.062-inch- (1.57-mm-) **OR** 0.050-inch- (1.27-mm-), **as directed**, thick, stainless-steel sheet. Secure to wall with rear-mounting steel strap and adjustment bolts. Provide No. 4 finish.

H. Detention Mirrors
1. Small, Framed Detention Mirror: Approximately 9-1/2 inches wide by 11 inches (241 mm wide by 279 mm) high; formed from 0.038-inch- (0.95-mm-) thick, stainless-steel sheet with fiberboard backing; enclosed in a frame formed from 0.064-inch (1.63-mm) nominal-thickness, zinc-plated

steel sheet; with round corners. Fabricate frame with welded and ground corners or from one piece of metal. Provide No. 8 **OR** 4, **as directed**, finish for mirror, chrome plating for frame.

a. Mounting: Front mounting with security fasteners to 0.168-inch (4.27-mm) nominal-thickness, metallic-coated steel mounting plate **OR** Chase mounting with welded anchor nuts on backplate, **as directed**.

2. Small, Integrally Framed Detention Mirror: Approximately 9-1/2 inches wide by 11 inches (241 mm wide by 279 mm) high; with mirror and integral frame formed from a single sheet of 0.038-inch- (0.95-mm-) **OR** 0.062-inch- (1.57-mm-), **as directed**, thick stainless steel; with round corners. Provide No. 8 **OR** 4, **as directed**, finish for mirror, chrome plating for frame.

a. Mounting: Front mounting with security fasteners to 0.168-inch (4.27-mm) nominal-thickness, metallic-coated steel mounting plate **OR** Chase mounting with welded anchor nuts on backplate, **as directed**.

3. Large, Framed Detention Mirror with Square Corners: Minimum 11 inches wide by 16 inches (279 mm wide by 406 mm) high; formed from 0.038-inch- (0.95-mm-) **OR** 0.078-inch- (1.98-mm-), **as directed**, thick, stainless-steel sheet with fiberboard backing and No. 8 **OR** No. 4, **as directed**, finish; enclosed in a metal frame.

a. Frame: Formed from 0.064-inch (1.63-mm) nominal-thickness, chrome-plated steel **OR** 0.062-inch- (1.57-mm-) thick, stainless-steel **OR** 0.078-inch- (1.98-mm-) thick, stainless-steel, **as directed**, sheet. Fabricate frame with welded and ground corners or from one piece of metal.

b. Mounting: Front mounting with security fasteners to 0.168-inch (4.27-mm) nominal-thickness, metallic-coated steel mounting plate **OR** Chase mounting with welded anchor nuts on backplate, **as directed**.

4. Large, Framed Detention Mirror with Round Corners: Minimum 11 inches wide by 16 inches (279 mm wide by 406 mm) high, formed from a single sheet of 0.038-inch- (0.95-mm-) **OR** 0.078-inch- (1.98-mm-), **as directed**, thick stainless steel with No. 8 **OR** No. 4, **as directed**, finish; enclosed in a metal frame.

a. Frame: Formed from 0.064-inch (1.63-mm) nominal-thickness, chrome-plated steel **OR** 0.078-inch- (1.98-mm-) thick, stainless-steel, **as directed**, sheet. Fabricate frame with welded and ground corners or from one piece of metal.

b. Mounting: Front mounting with security fasteners to 0.168-inch (4.27-mm) nominal-thickness, metallic-coated steel mounting plate **OR** Chase mounting with welded anchor nuts on backplate, **as directed**.

5. Large, Integrally Framed Detention Mirror with Round Corners: Minimum 11 inches wide by 16 inches (279 mm wide by 406 mm) high; with mirror and integral frame formed from 0.038-inch- (0.95-mm-) **OR** 0.062-inch- (1.57-mm-) **OR** 0.078-inch- (1.98-mm-), **as directed**, thick, stainless-steel sheet; with round corners. Provide No. 8 **OR** 4, **as directed**, finish for mirror, chrome plating for frame.

a. Mounting: Front mounting with security fasteners to 0.168-inch (4.27-mm) nominal-thickness, metallic-coated steel mounting plate **OR** Chase mounting with welded anchor nuts on backplate, **as directed**.

I. Detention Grab Bars

1. Grab Bars: 1-1/2 inches (38.1 mm) in diameter; formed from 0.038-inch- (0.95-mm-) thick, stainless-steel tubing, with 3-inch- (76.2-mm-) diameter flanges formed from 0.125-inch- (3.18-mm-) thick, stainless steel. Closure plates formed from 0.125-inch- (3.18-mm-) thick, stainless steel. All-welded construction. Provide No. 4 finish.

a. Length: As indicated on Drawings **OR** 36 inches (914 mm) long, **as directed**.

b. Mounting: Front mounting with security fasteners **OR** Chase mounting with welded anchor nuts on backplate, **as directed**.

J. Detention Shower Seats

1. Shower Seats: Double-pan retractable, recessed shower seat with recessed handle. Approximately 16-inch by 16-inch (406-mm by 406-mm) overall size formed from 0.062-inch- (1.57-mm-) **OR** 0.078-inch- (1.98-mm-), **as directed**, thick, stainless-steel sheet. Seat pivots on

solid 0.375-inch- (9.5-mm-) diameter stainless-steel rod and self-latches when closed. Minimum 750 lb. (340 kg) loading capacity. Provide No. 4 finish.

K. Fabrication
1. Coordinate dimensions and attachment methods of detention toilet accessories with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.
2. Shear and punch metals cleanly and accurately. Remove burrs.
3. Form edges and corners to be free of sharp edges and rough areas. Fold back exposed edges of unsupported sheet metal to form a 1/2-inch- (12.7-mm-) wide hem on the concealed side, or ease edges to a radius of approximately 1/32 inch (0.8 mm) and support with concealed stiffeners.
4. Form metal in maximum lengths to minimize joints. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
5. Weld corners and seams continuously to comply with referenced AWS standard and the following:
   a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   b. Obtain fusion without undercut or overlap.
   c. Remove welding flux immediately.
   d. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
   e. Weld before finishing components to greatest extent possible. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
6. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure detention toilet accessories rigidly in place and to support expected loads. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce formed-metal units as needed to attach and support other construction.
7. Cut, reinforce, drill, and tap detention toilet accessories to receive hardware, security fasteners, and similar items.
8. Form exposed work true to line and level with accurate angles and surfaces. Grind off and ease edges unless otherwise indicated.
9. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed security fasteners of type indicated or, if not indicated, flat-head (countersunk) security fasteners. Locate joints where least conspicuous.

L. Finishes
1. Finish detention toilet accessories after assembly.
2. Steel Finishes:
   a. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
   b. Factory Priming for Field-Painted Finish: Apply manufacturer's standard prime coat immediately after surface preparation and pretreatment.
   c. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 1.2 mils (0.03 mm).
      1) Color and Gloss: As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.
   d. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service), nickel plus chromium electrodeposited on base metal.
3. Stainless-Steel Finishes: Remove tool and die marks and stretch lines or blend into finish.

a. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

1.3 EXECUTION

A. Installation
1. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing detention toilet accessories to in-place construction. Include threaded fasteners for concrete and masonry inserts, security fasteners, and other connectors.
2. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry or similar construction.
3. Apply security sealant around perimeter in a continuous ribbon on back of detention toilet accessories before installation.
4. Security Fasteners: Install detention toilet accessories using security fasteners with head style appropriate for installation requirements, strength, and finish of adjacent materials. Provide stainless-steel security fasteners in stainless-steel materials, **as directed**.

B. Field Quality Control
1. Inspect installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.
2. Remove and replace detention work where inspections indicate that work does not comply with specified requirements.
3. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.
4. Prepare field quality-control certification that states installed products and their installation comply with requirements in the Contract Documents.

C. Adjusting And Cleaning
1. Remove temporary labels and protective coatings.
2. Adjust safety hooks to release with application of 8-lbf (35.6-N) load.
3. Painting: Immediately after erection, clean bolted connections and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
4. Touchup Painting: Cleaning and touchup painting of bolted connections and abraded areas of shop paint are specified in Division 07..

END OF SECTION 10810a

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Task	Specification	Specification Description
10810	01352	No Specification Required

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SECTION 10811 - BATH ACCESSORIES

DESCRIPTION OF WORK

This specification covers the furnishing and installation of materials for bath accessories. Products shall be as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

GENERAL

Definitions

1. Supply and Delivery Only: Include supply and delivery to site(s) FOB destination freight prepaid. Unless otherwise specified or scheduled, unloading and handling at site is by Owner.

Submittals

2. Product Data.
3. Shop Drawings.
4. Quality Assurance/Control Submittals:
   a. Certificates: Submit manufacturer's written self certification that bath accessories meet or exceed specified requirements.

Quality Assurance

5. Regulatory Requirements: Comply with following:
   a. Accessibility:
      1) Architectural Barriers Act of 1968 as amended (42 USC 4152-4157) and HUD implementing regulations (24 CFR Part 40).
         a) Uniform Federal Accessibility Standards (UFAS).
      2) Section 504 of the Rehabilitation Act of 1973 as amended (29 USC 794) and HUD implementing regulations 24 CFR Part 8.
      3) Fair Housing Accessibility Guidelines (24 CFR Chapter 1).
      4) Americans with Disabilities Act of 1990 (ADA) (28 CFR Part 35).
6. Mock-ups: Install one complete mock-up of bath accessories in each typical bathroom installation. Comply with Detailed Scope of Work for bathroom renovation mock-up requirements.
   a. Locations: As directed.
   b. Approved Mock-ups: Standard for rest of work.
   c. Approved Mock-ups: May remain part of completed project.

Scheduling

7. Scheduling and Completion: Comply with requirements of Detailed Scope of Work.

PRODUCTS

Bath Accessories

8. Ceramic Soap Dishes at Ceramic Tile Bathtub Surround: See Division 9 Section “Ceramic Tile.”
9. Metal Soap Dishes at Porcelain Steel Bathtub Surround:
   a. Recessed: FS WW-P-541/8B, Type VI, Class 2, heavy duty satin stainless steel.
   b. Fastenings: Plated expansion toggle or molly bolts, lead anchors or as required by existing wall conditions.

10. Safety Grab Bars: Type 304 stainless steel, minimum 32 mm (1-1/4 inch) OD, maximum 38 mm (1-1/2 inch) OD, 1.2 mm (18 gage) wall thickness in accordance with Uniform Federal Accessibility Standards (UFAS).
    a. Grab Bar Posts: Stainless steel.
    b. Post Flanges: Diameter of not less than 68 mm (2-11/16 inches) with center line of screw holes located minimum 13 mm (1/2 inch) from edges of flange.
11. Shower Curtains and Rods: By Bobrick Washroom Equipment, McKinney/Parker, or Leigh Products, or approved equal:
    a. Rods: Type 304 stainless steel, satin finish, adjustable length type to fit bathtub length, minimum 25 mm (1 inch) OD, minimum 1.0 mm (20 gage) wall thickness, similar to Bobrick No. B-6107 or McKinney/Parker No. 267.
    b. Flanges: Chrome plated cast brass or stainless steel.
    c. Shower Curtains: FS L-C-780a, Style I, opaque, matte white vinyl 0.2 mm (0.008 inch) thick, 1 829 mm (72 inches) by 1 829 mm (72 inches) high.
        1) Curtains: Germ proof, bacteria proof, and mildew resistant.
        2) Curtains: Similar to Bobrick No. 204-2 or McKinney/Parker No. 268SC.
    d. Curtain Hooks: Stainless steel, Type 304 or nickel plated brass wire, similar to Bobrick No. 204-1 or McKinney/Parker No. 269SH. Provide 12 hooks per curtain.
12. Other Bathroom Accessories: FS WW-P-541/8B, Type 304 stainless steel, satin finish, by Bobrick Washroom Equipment, McKinney/Parker, or Leigh Products, or approved equal:
    a. Surface Mounted:
        1) Medicine Cabinets: Type III, Class 2, Style S, swinging door, minimum 381 mm (15 inches) wide by 610 mm (24 inches) high. Provide complete with magnetic catch, three adjustable shelves, and full length mirror.
        2) Towel Bars: Type IV, Class 1, square bar, 610 mm (24 inches) long.
        3) Toilet Paper Holders: Type I, Class 1, Mounting S, Style A.
        4) Tumbler and Toothbrush Holders: Type VI, Class 4.
        5) Lavatory Soap Dishes: Type VI, Class 1.
        6) Robe hooks.
    b. Recessed:
        1) Medicine Cabinets: Type III, Class 2, Style R, enamel painted steel, swinging door, minimum 381 mm (15 inches) wide by 610 mm (24 inches) high. Provide complete with magnetic catch, three adjustable shelves, and full length mirror.
        2) Toilet Paper Holders: Type I, Class 1, Style K.
        3) Lavatory Soap Dishes: Type VI, Class 2.
13. Window Curtains and Rods: Provide over bathroom window openings.
    a. Rods: Solid steel with brass finish, minimum 10 mm (3/8 inch) diameter.
    b. Rod Brackets: Two brass-finished brackets with open tops and brass finish.
    c. Window Curtains: FS L-C-780a, Style II, opaque, matte white vinyl 0.2 mm (0.008 inch) thick.
        1) Curtains : Germ proof, bacteria proof, and mildew resistant.
        2) Size: To fit bathroom windows.
14. Joint Sealant: Mildew resistant one-component silicone; FS TT-S-001543A, Class A; ASTM C 920, Type S, Grade NS, Class 25, Uses NT, G, and A.
    a. Color: As selected from manufacturer's standard line.

EXECUTION

Examination

15. Site Verification of Conditions:
    1) Field Measurements: Verify field measurements.
    2) Existing Conditions: Ensure proper openings and blocking have been installed.

Installation

16. General: Install accessories rigidly and securely to blocking in walls using methods and materials recommended by manufacturer.
    a. Locations and Mounting Heights: As indicated or directed.
    b. Comply with Regulatory Requirements.
17. Bath Accessories: Securely install flanges for bath accessories and window curtain rods in accordance with manufacturer s recommendations and approved Shop Drawing.
    a. Safety Grab Bars: Install 100 mm (4 inch) by 100 mm (4 inch) perforated 1.2 mm (18 gage) galvanized steel plates at each post, flush to wall, by using toggle bolts, molly bolts, or anchors as required by conditions.
        1) After installation of wall finish, secure each grab bar flange to perforated plates through wall finish with three - 6 mm (1/4 inch) chrome plated machine screws, screwed into threaded sleeves or tee nuts welded to plates.
    b. Shower Curtains and Rods: Mount flanges to existing wall with approved expansion type inserts and chrome plated or stainless steel wood screws.
18. Bath Accessories at Bathroom with Porcelain Steel Surround:
    a. Metal Soap Dishes: Mount to new porcelain enamel panels and anchored securely to existing walls using approved mechanical fastenings.
        1) Waterproof with joint sealant between surround panel and dishes.
    b. China Soap Dishes: Anchor securely, using approved mechanical fastening.
    c. Safety Grab Bars: After installation of wall panels, secure each grab bar flange to perforated plates through panels with three - 6 mm (1/4 inch) chrome plated machine screws, screwed into threaded sleeves or tee nuts welded to plates.

Cleaning

19. Cleaning: Comply with requirements of Detailed Scope of Work.

END OF SECTION 10811

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Task	Specification	Specification Description
10811	10810	Toilet And Bath Accessories
10811	10810a	Detention Toilet Accessories
10812	10810	Toilet And Bath Accessories

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Task	Specification	Specification Description
11021	08710a	Detention Door Hardware
11071	16140	Wiring Devices
11131	01352	No Specification Required

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SECTION 11132 - PROJECTION SCREENS

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for projection screens. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section Includes:
a. Manually operated projection screens.
b. Electrically operated projection screens and controls.
c. Rigid rear-projection screens.

C. Definitions
1. Gain of Front-Projection Screens: Ratio of light reflected from screen material to that reflected perpendicularly from a magnesium carbonate surface as determined per SMPTE RP 94.
2. Gain of Rear-Projection Screens: Ratio of light refracted by screen material to that reflected perpendicularly from a magnesium carbonate surface as determined per SMPTE RP 94, except that for measuring luminance of test screen, projection lamp shall be placed behind screen same distance as it was placed in front of magnesium carbonate surface for measuring luminance of reference standard.
3. Half-Gain Angle: The angle, measured from the axis of the screen surface to the most central position on a perpendicular plane through the horizontal centerline of the screen where the gain is half of the peak gain.

D. Submittals
1. Product Data: For each type of product indicated.
2. Shop Drawings: For projection screens. Show layouts and types of projection screens. Include the following:
a. For manually operated projection screens:
1) Drop lengths.
2) Anchorage details.
3) Accessories.
b. For electrically operated projection screens and controls:
1) Location of screen centerline relative to ends of screen case.
2) Location of wiring connections for electrically operated units.
3) Location of seams in viewing surfaces.
4) Drop lengths.
5) Anchorage details, including connection to supporting structure for suspended units.
6) Details of juncture of exposed surfaces with adjacent finishes.
7) Accessories.
8) Wiring diagrams.
c. For rigid rear-projection screens:
1) Frame details.
2) Anchorage details.
3) Details of juncture of exposed surfaces with adjacent finishes.
4) Accessories.
3. Maintenance Data: For projection screens to include in maintenance manuals.

E. Quality Assurance

1. 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.

F. Delivery, Storage, And Handling
1. Environmental Limitations: Do not deliver or install projection screens until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Store rear-projection screens in manufacturer's protective packaging and according to manufacturer's written instructions.

1.2 PRODUCTS

A. Manually Operated Projection Screens
1. General: Manufacturer's standard spring-roller-operated units, consisting of case, screen, mounting accessories, and other components necessary for a complete installation.
   a. Screen Mounting: Top edge securely anchored to a 3-inch- (75-mm-) diameter, rigid steel roller; bottom edge formed into a pocket holding a tubular metal slat, with ends of slat protected by plastic caps, and with a saddle and pull attached to slat by screws.
   b. Tab Tensioning: Provide units that have a durable low-stretch cord, such as braided polyester, on each side of screen connected to edge of screen by tabs to pull screen flat horizontally. In lieu of tab tensioning, screens may be constructed from vinyl-coated screen cloth that contains horizontal stiffening monofilaments to resist edge curling, **as directed**.
2. Bracket-Mounted or Ceiling-Suspended, Metal-Encased, Manually Operated Screens: Units designed and fabricated for suspending from wall brackets or ceiling, fabricated from formed-steel sheet not less than 0.027 inch (0.7 mm) thick or from aluminum extrusions; with vinyl covering or baked-enamel finish and matching end caps. Provide mounting brackets unless otherwise indicated.
3. Surface-Mounted, Metal-Encased, Manually Operated Screens: Units designed and fabricated for surface mounting on wall or ceiling, fabricated from formed-steel sheet not less than 0.027 inch (0.7 mm) thick or from aluminum extrusions; with flat back design and vinyl covering or baked-enamel finish. Provide units with matching end caps and concealed mounting.
4. Surface-Mounted, Wood-Finished, Manually Operated Screens: Units designed and fabricated for surface mounting on wall or ceiling; with flat back design, hardwood finish, and concealed mounting brackets.
   a. Hardwood: Oak **OR** Walnut **OR** Mahogany **OR** Cherry **OR** As selected from manufacturer's full range of species, **as directed**.
   b. Finish: As selected from manufacturer's full range.

B. Electrically Operated Projection Screens
1. General: Manufacturer's standard units consisting of case, screen, motor, controls, mounting accessories, and other components necessary for a complete installation. Provide units that are listed and labeled as an assembly by UL or another testing and inspecting agency acceptable to authorities having jurisdiction, **as directed**.
   a. Controls: Remote, key-operated, **as directed**, three-position control switch installed in recessed device box with flush cover plate matching other electrical device cover plates in room where switch is installed.
      1) Provide two **OR** three, **as directed**, control switches for each screen.
      2) Provide number of control switches indicated for each screen.
      3) Provide power supply for low-voltage systems if required.
      4) Provide locking cover plates for switches.
      5) Provide key-operated, power-supply switch.

6) Provide infrared **OR** radio-frequency, **as directed**, remote control consisting of battery-powered transmitter and receiver.
7) Provide video interface control for connecting to projector. Projector provides signal to raise or lower screen.

b. Motor in Roller: Instant-reversing motor of size and capacity recommended by screen manufacturer; with permanently lubricated ball bearings, automatic thermal-overload protection, preset limit switches to automatically stop screen in up and down positions, and positive-stop action to prevent coasting. Mount motor inside roller with vibration isolators to reduce noise transmission.

c. End-Mounted Motor: Instant-reversing, gear-drive motor of size and capacity recommended by screen manufacturer; with permanently lubricated ball bearings, automatic thermal-overload protection, preset limit switches to automatically stop screen in up and down positions, and positive-stop action to prevent coasting. Locate motor in its own compartment on right end of screen unless otherwise indicated **OR** on left end of screen unless otherwise indicated **OR** on end of screen indicated, **as directed**.

d. Screen Mounting: Top edge securely anchored to rigid metal roller and bottom edge formed into a pocket holding a 3/8-inch- (9.5-mm-) diameter metal rod with ends of rod protected by plastic caps.
1) Roller for end-mounted motor supported by self-aligning bearings in brackets.
2) Roller for motor in roller supported by vibration- and noise-absorbing supports.

e. Tab Tensioning: Provide units that have a durable low-stretch cord, such as braided polyester, on each side of screen connected to edge of screen by tabs to pull screen flat horizontally. In lieu of tab tensioning, screens may be constructed from vinyl-coated screen cloth that contains horizontal stiffening monofilaments to resist edge curling.

2. Surface-Mounted, Metal-Encased, Electrically Operated Screens: Motor-in-roller **OR** End-mounted motor, **as directed**, units designed and fabricated for surface mounting on wall or ceiling, fabricated from formed-steel sheet not less than 0.027 inch (0.7 mm) thick or from aluminum extrusions; with flat back design and vinyl covering or baked-enamel finish. Provide with matching end caps and concealed mounting.

3. Surface-Mounted, Wood-Finished, Electrically Operated Screens: Motor in roller units designed and fabricated for surface mounting on wall or ceiling; with flat back design, hardwood finish, and concealed mounting brackets.
a. Hardwood: Oak **OR** Walnut **OR** Mahogany **OR** Cherry **OR** As selected from manufacturer's full range of species, **as directed**.
b. Finish: As selected from manufacturer's full range.

4. Suspended, Electrically Operated Screens without Ceiling Closure: Motor-in-roller **OR** End-mounted motor, **as directed**, units designed and fabricated for suspended mounting, with bottom of case entirely or partially open under screen compartment.
a. Provide metal or metal-lined motor enclosure on units with end-mounted motor.
b. Provide metal or metal-lined wiring compartment on units with motor in roller.
c. Screen Case: Made from metal **OR** metal and fire-retardant materials **OR** metal, wood, wood products, and fire-retardant materials, **as directed**.
d. Provide screen case with trim flange to receive ceiling finish **OR** constructed to be installed with underside flush with ceiling **OR** constructed to be installed with ceiling finish applied to underside, **as directed**.
e. Finish on Exposed Surfaces: Prime painted **OR** Vinyl covering or baked enamel, **as directed**.

5. Suspended, Electrically Operated Screens with Automatic Ceiling Closure: Motor-in-roller **OR** End-mounted motor, **as directed**, units designed and fabricated for suspended mounting; with bottom of case composed of two panels, fully enclosing screen, motor, and wiring; one panel hinged and designed to open and close automatically when screen is lowered and fully raised, the other removable or openable for access to interior of case.
a. Provide metal or metal-lined motor enclosure on units with end-mounted motor.
b. Provide metal or metal-lined wiring compartment on units with motor in roller.
c. Screen Case: Made from metal **OR** metal and fire-retardant materials **OR** metal, wood, wood products, and fire-retardant materials, **as directed**.

d. Provide screen case with trim flange to receive ceiling finish **OR** constructed to be installed with underside flush with ceiling **OR** constructed to be installed with ceiling finish applied to underside, **as directed**.

e. Finish on Exposed Surfaces: Prime painted **OR** Vinyl covering or baked enamel, **as directed**.

C. Front-Projection Screen Material

1. Matte-White Viewing Surface: Peak gain not less than 0.9, and gain not less than 0.8 at an angle of 50 degrees from the axis of the screen surface.
2. Matte-Gray Viewing Surface: Peak gain not less than 0.8, and half-gain angle of not less than 50 degrees from the axis of the screen surface.
3. Glass-Beaded Viewing Surface: Peak gain not less than 2.0, and half-gain angle of at least 15 degrees from the axis of the screen surface.
4. Matte Reflective Viewing Surface: Peak gain not less than 1.3, and half-gain angle of at least 40 degrees from the axis of the screen surface.
5. Wide-Angle Reflective Viewing Surface: Peak gain not less than 1.5, and half-gain angle of at least 35 degrees from the axis of the screen surface.
6. Multipurpose Reflective Viewing Surface: Peak gain not less than 1.8, and half-gain angle of at least 25 degrees from the axis of the screen surface.
7. High-Gain Reflective Viewing Surface: Peak gain not less than 2.5, and half-gain angle of at least 20 degrees from the axis of the screen surface.
8. Material: Vinyl-coated, glass-fiber fabric or vinyl sheet.
9. Mildew-Resistance Rating: 0 or 1 when tested according to ASTM G 21.
10. Flame Resistance: Passes NFPA 701.
11. Flame-Spread Index: Not greater than 75 when tested according to ASTM E 84.
12. Seams: Where length of screen indicated exceeds maximum length produced without seams in material specified, provide screen with horizontal seam placed as follows:
    a. At top **OR** bottom, **as directed**, of screen at juncture between extra drop length and viewing surface.
    b. In location indicated.
13. Seamless Construction: Provide screens, in sizes indicated, without seams.
14. Edge Treatment: Black **OR** Without black, **as directed**, masking borders.
15. Size of Viewing Surface: 50 by 50 inches (1270 by 1270 mm) **OR** 60 by 60 inches (1524 by 1524 mm) **OR** 70 by 70 inches (1778 by 1778 mm) **OR** 84 by 84 inches (2133 by 2133 mm) **OR** 48 by 65 inches (1219 by 1651 mm) **OR** 54 by 72 inches (1371 by 1828 mm) **OR** 58 by 79 inches (1473 by 2006 mm) **OR** 72 by 96 inches (1828 by 2438 mm), **as directed**.
16. Provide extra drop length of dimensions and at locations indicated.
    a. Color: Same as viewing surface **OR** Black, **as directed**.

D. Flexible Rear-Projection Screen Material

1. Wide-Angle Screens: Peak gain not less than 1.0, and half-gain angle of at least 35 degrees from the axis of the screen surface.
2. Moderate-Gain Screens: Peak gain not less than 1.3, and half-gain angle of at least 30 degrees from the axis of the screen surface.
3. High-Gain Screens: Peak gain not less than 1.8, and half-gain angle of at least 15 degrees from the axis of the screen surface.
4. Material: Coated vinyl sheet.
5. Mildew-Resistance Rating: 0 or 1 when tested according to ASTM G 21.
6. Flame Resistance: Passes NFPA 701.
7. Flame-Spread Index: Not greater than 75 when tested according to ASTM E 84.
8. Seamless Construction: Provide screens, in sizes indicated, without seams.
9. Size of Viewing Surface: 50 by 50 inches (1270 by 1270 mm) **OR** 60 by 60 inches (1524 by 1524 mm) **OR** 70 by 70 inches (1778 by 1778 mm) **OR** 84 by 84 inches (2133 by 2133 mm) **OR** 48 by 65 inches (1219 by 1651 mm) **OR** 54 by 72 inches (1371 by 1828 mm) **OR** 58 by 79 inches (1473 by 2006 mm) **OR** 72 by 96 inches (1828 by 2438 mm), **as directed**.

10. Provide extra drop length of dimensions and at locations indicated.
    a. Color: Same as viewing surface **OR** Black, **as directed**.

E. Optically Coated Rigid Rear-Projection Screens
1. Screen Substrate: Optically clear substrate complying with the following requirements:
    a. Clear float glass complying with ASTM C 1036 for Type I (transparent glass, flat), Class 1 (clear), and Quality q3 (glazing select), 6.0 mm thick **OR** 10.0 mm thick **OR** 12.0 mm thick **OR** thickness as indicated, **as directed**.
    b. Colorless, transparent, cast-acrylic sheet with a luminous transmittance of 92 percent per ASTM D 1003 and complying with ASTM D 4802, Category A-1 (cell cast), Finish 1 (smooth or polished), 1/4 inch (6.4 mm) thick **OR** 3/8 inch (9.5 mm) thick **OR** 1/2 inch (12.7 mm) thick **OR** thickness as indicated, **as directed**.
    c. Fresnel lens cast from colorless, transparent, acrylic with a luminous transmittance of 92 percent per ASTM D 1003 and complying with ASTM D 4802, Category A-1 (cell cast), Finish 1 (smooth or polished) on one side and Finish 2 (patterned) on other side, 1/4 inch (6.4 mm) thick **OR** 3/8 inch (9.5 mm) thick **OR** 1/2 inch (12.7 mm) thick **OR** thickness as indicated, **as directed**.
2. Optical Coating: Durable, washable coating bonded to one side of substrate.
3. Wide-Angle Screens: Peak gain not less than 1.0, and half-gain angle of at least 35 degrees from the axis of the screen surface.
4. Moderate-Gain Screens: Peak gain not less than 1.3, and half-gain angle of at least 30 degrees from the axis of the screen surface.
5. General-Purpose Screens: Peak gain of not less than 1.8, and half-gain angle of at least 28 degrees from the axis of the screen surface.
6. High-Gain Screens: Peak gain not less than 2.0, and half-gain angle of at least 20 degrees from the axis of the screen surface.
7. Optical Tint: High-contrast dark gray **OR** Medium neutral gray **OR** Neutral white **OR** Manufacturer's standard, **as directed**.
8. Protective Coating: Provide formulation designed by screen manufacturer as a permanent topcoat over optical coatings to protect against normal abrasion before, during, and after installation.
9. Writing-Surface Coating: Provide screen manufacturer's protective coating, designed as a writing surface for dry-erase markers, on front of screen.
10. Size of Viewing Surface: 40 by 54 inches (1016 by 1371 mm) **OR** 43 by 57 inches (1092 by 1447 mm) **OR** 50 by 67 inches (1270 by 1701 mm) **OR** 54 by 72 inches (1371 by 1828 mm) **OR** 60 by 80 inches (1524 by 2032 mm) **OR** 72 by 96 inches (1828 by 2438 mm), **as directed**.

F. High-Performance Rigid Rear-Projection Screens
1. High-Performance Screens, General: Acrylic screen with Fresnel lens on rear surface and linear lenses on front surface.
    a. Screen Substrate: Optically clear acrylic with a luminous transmittance of 92 percent per ASTM D 1003 and complying with ASTM D 4802, Category A-1 (cell cast), Finish 2 (patterned), 1/4 inch (6.4 mm) thick **OR** 3/8 inch (9.5 mm) thick **OR** 1/2 inch (12.7 mm) thick **OR** thickness as indicated, **as directed**.
2. Performance:
    a. Peak gain not less than 3.0 **OR** 4.0, **as directed**, and horizontal half-gain angle of at least 50 degrees from the axis of the screen surface.
    b. Peak gain of 3.5 **OR** 4.0, **as directed**, and horizontal half-gain angle of at least 30 degrees from the axis of the screen surface.
    c. Performance: Peak gain of 5.0, and horizontal half-gain angle of at least 25 degrees from the axis of the screen surface.
    d. Performance: Peak gain not less than 1.5 **OR** 3.0, **as directed**, and horizontal half-gain angle of at least 20 degrees from the axis of the screen surface.
3. Size of Viewing Surface: 40 by 54 inches (1016 by 1371 mm) **OR** 43 by 57 inches (1092 by 1447 mm) **OR** 50 by 67 inches (1270 by 1701 mm) **OR** 54 by 72 inches (1371 by 1828 mm) **OR** 60 by 80 inches (1524 by 2032 mm) **OR** 72 by 96 inches (1828 by 2438 mm), **as directed**.

G. Rigid Rear-Projection Screen Accessories
1. Factory Frames: Screen manufacturer's standard frames of profile indicated, fabricated to sizes required to fit screens from aluminum extrusions complying with ASTM B 221 (ASTM B 221M) for 6063-T5 alloy and temper.
   a. Class II, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.
   b. Class II, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, integrally colored or electrolytically deposited color coating 0.010 mm or thicker) complying with AAMA 611.
      1) Color: Black **OR** Dark bronze **OR** Either black or dark bronze, as standard with manufacturer, **as directed**.
2. Glazing Accessories for Factory Frames: Provide gaskets and setting blocks with proven record of compatibility with screen and frame surfaces, of sizes and shapes to accommodate thickness of screen indicated and to fit glazing channel provided.
3. Glazing Accessories for Field-Framed Screens: Provide materials compatible with screen and frame surfaces while complying with applicable requirements in Division 08 Section "Glazing".

1.3 EXECUTION

A. Front-Projection Screen Installation
1. Install front-projection screens at locations indicated to comply with screen manufacturer's written instructions.
2. Install front-projection screens with screen cases in position and in relation to adjoining construction indicated. Securely anchor to supporting substrate in a manner that produces a smoothly operating screen with vertical edges plumb and viewing surface flat when screen is lowered.
   a. Install low-voltage controls according to NFPA 70 and complying with manufacturer's written instructions.
      1) Wiring Method: Install wiring in raceway except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use UL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.
   b. Test electrically operated units to verify that screen controls, limit switches, closures, and other operating components are in optimum functioning condition.
   c. Test manually operated units to verify that screen-operating components are in optimum functioning condition.

B. Rigid Rear-Projection Screen Installation
1. Install rear-projection screens at locations indicated to comply with screen manufacturer's written instructions. Handle screens carefully during installation using procedures and tools recommended by screen manufacturer; do not abrade screen surfaces.
2. Install optically coated rear-projection screens with optical coating toward projector **OR** audience, **as directed**.
3. Install high-performance, rear-projection screens with orientation as indicated in manufacturer's written instructions.
4. Install factory-framed, rear-projection screens in prepared wall openings. Securely anchor frames to surrounding construction so frames are plumb and level and screen surfaces are flat.
5. Install rear-projection screens with glass substrates, in frames specified in other Sections, to comply with applicable requirements in Division 08 Section "Glazing" and with screen manufacturer's written instructions. Set projection screen with surfaces flat and edges plumb and level.

6. Install rear-projection screens with plastic substrates, in frames specified in other Sections, to comply with screen manufacturer's written instructions. Clamp units only at top edge and allow for expansion and contraction of plastic glazing material by providing frame with adequate bite and edge clearances.

C. Protecting And Cleaning Rigid Rear-Projection Screens
1. Provide temporary covering of rear-projection screens until time of Substantial Completion. Use type of covering approved by screen manufacturer that will effectively protect screen from abrasion, breakage, or other damage.
2. Clean rear-projection screens on both faces immediately before date scheduled for inspection intended to establish date of Substantial Completion. Use methods and cleaning materials recommended by screen manufacturer, taking care not to scratch or damage optical coatings or screen substrates.

D. Projection Screen Schedule
1. Manually Operated, Front-Projection Screen Type: Surface mounted, metal encased **OR** Surface mounted, wood finished, **as directed**.
   a. Screen Surface: Matte white **OR** Matte gray **OR** Glass beaded **OR** Matte reflective **OR** Wide-angle reflective **OR** Multipurpose reflective **OR** High-gain reflective, **as directed**.
   b. Viewing Surface Size: 50 by 50 inches (1270 by 1270 mm) **OR** 60 by 60 inches (1524 by 1524 mm) **OR** 70 by 70 inches (1778 by 1778 mm) **OR** 84 by 84 inches (2133 by 2133 mm) **OR** 48 by 65 inches (1219 by 1651 mm) **OR** 54 by 72 inches (1371 by 1828 mm) **OR** 58 by 79 inches (1473 by 2006 mm) **OR** 72 by 96 inches (1828 by 2438 mm), **as directed**.
   c. Extra Drop Length: As needed at top of screen for bottom of screen to be 36 inches (900 mm) above floor and 36 inches (900 mm) at bottom of screen, **as directed**.
2. Electrically Operated, Front-Projection Screen Type: Surface mounted, metal encased **OR** Surface mounted, wood finished **OR** Suspended, without ceiling closure **OR** Suspended, with automatic ceiling closure, **as directed**.
   a. Motor Configuration: Motor in roller **OR** End-mounted motor on right end of screen **OR** End-mounted motor on left end of screen **OR** End-mounted motor on end of screen indicated, **as directed**.
   b. Screen Surface: Matte white **OR** Matte gray **OR** Glass beaded **OR** Matte reflective **OR** Wide-angle reflective **OR** Multipurpose reflective **OR** High-gain reflective, **as directed**.
   c. Viewing Surface Size: 50 by 50 inches (1270 by 1270 mm) **OR** 60 by 60 inches (1524 by 1524 mm) **OR** 70 by 70 inches (1778 by 1778 mm) **OR** 84 by 84 inches (2133 by 2133 mm) **OR** 48 by 65 inches (1219 by 1651 mm) **OR** 54 by 72 inches (1371 by 1828 mm) **OR** 58 by 79 inches (1473 by 2006 mm) **OR** 72 by 96 inches (1828 by 2438 mm), **as directed**.
   d. Extra Drop Length: As needed at top of screen for bottom of screen to be 36 inches (900 mm) above floor and 36 inches (900 mm) at bottom of screen, **as directed**.
3. Manually Operated, Rear-Projection Screen Type: Surface mounted, metal encased **OR** Surface mounted, wood finished, **as directed**.
   a. Screen Type: Wide angle **OR** Moderate gain **OR** High gain, **as directed**.
   b. Viewing Surface Size: 50 by 50 inches (1270 by 1270 mm) **OR** 60 by 60 inches (1524 by 1524 mm) **OR** 70 by 70 inches (1778 by 1778 mm) **OR** 84 by 84 inches (2133 by 2133 mm) **OR** 48 by 65 inches (1219 by 1651 mm) **OR** 54 by 72 inches (1371 by 1828 mm) **OR** 58 by 79 inches (1473 by 2006 mm) **OR** 72 by 96 inches (1828 by 2438 mm), **as directed**.
   c. Extra Drop Length: As needed at top of screen for bottom of screen to be 36 inches (900 mm) above floor and 36 inches (900 mm) at bottom of screen, **as directed**.
4. Electrically Operated, Rear-Projection Screen Type: Surface mounted, metal encased **OR** Surface mounted, wood finished **OR** Suspended, without ceiling closure **OR** Suspended, with automatic ceiling closure, **as directed**.
   a. Motor Configuration: Motor in roller **OR** End-mounted motor on right end of screen **OR** End-mounted motor on left end of screen **OR** End-mounted motor on end of screen indicated, **as directed**.
   b. Screen Type: Wide angle **OR** Moderate gain **OR** High gain, **as directed**.

c. Viewing Surface Size: 50 by 50 inches (1270 by 1270 mm) **OR** 60 by 60 inches (1524 by 1524 mm) **OR** 70 by 70 inches (1778 by 1778 mm) **OR** 84 by 84 inches (2133 by 2133 mm) **OR** 48 by 65 inches (1219 by 1651 mm) **OR** 54 by 72 inches (1371 by 1828 mm) **OR** 58 by 79 inches (1473 by 2006 mm) **OR** 72 by 96 inches (1828 by 2438 mm), **as directed**.

d. Extra Drop Length: As needed at top of screen for bottom of screen to be 36 inches (900 mm) above floor and 36 inches (900 mm) at bottom of screen, **as directed**.

5. Rigid Rear-Projection Screen Type: Optically coated screen.
   a. Screen Substrate: Glass **OR** Acrylic, **as directed**.
   b. Screen Type: Wide angle **OR** Moderate gain **OR** General purpose **OR** High gain, **as directed**.
   c. Optical Tint: High-contrast dark gray **OR** Medium neutral gray **OR** Neutral white, **as directed**.
   d. Size of Viewing Surface: 40 by 54 inches (1016 by 1371 mm) **OR** 43 by 57 inches (1092 by 1447 mm) **OR** 50 by 67 inches (1270 by 1701 mm) **OR** 54 by 72 inches (1371 by 1828 mm) **OR** 60 by 80 inches (1524 by 2032 mm) **OR** 72 by 96 inches (1828 by 2438 mm), **as directed**.
   e. Additional Features: Protective coating **OR** Writing surface coating **OR** Factory frame, **as directed**.
6. Rigid Rear-Projection Screen Type: High-performance screen.
   a. Gain: Not less than 1.5 **OR** 3 **OR** 3.5 **OR** 4 **OR** 5, **as directed**.
   b. Horizontal Half-Gain Angle: At least 20 **OR** 25 **OR** 30 **OR** 50, **as directed**, degrees from screen axis.
   c. Size of Viewing Surface: 40 by 54 inches (1016 by 1371 mm) **OR** 43 by 57 inches (1092 by 1447 mm) **OR** 50 by 67 inches (1270 by 1701 mm) **OR** 54 by 72 inches (1371 by 1828 mm) **OR** 60 by 80 inches (1524 by 2032 mm) **OR** 72 by 96 inches (1828 by 2438 mm), **as directed**.
   d. Additional Features: Factory frame.

END OF SECTION 11132

Task	Specification	Specification Description
11132	01352	No Specification Required
11139	11132	Projection Screens
11151	01352	No Specification Required
11151	02725	Parking Control Equipment
11151	02725a	Prefabricated Control Booths
11151	13720a	Intrusion Detection

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SECTION 11161 - LOADING DOCK EQUIPMENT

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for loading dock equipment. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section Includes:
a. Dock levelers.
b. Truck levelers.
c. Truck restraints.
d. Light-communication systems.
e. Dock bumpers.
f. Dock lifts (scissors lifts).
g. Dock seals.
h. Dock shelters.
i. Transparent-strip door curtains.

C. Definitions
1. Operating Range: Maximum amount of travel above and below the loading dock level.
2. Working Range: Recommended amount of travel above and below the loading dock level for which loading and unloading operations can take place.

D. Submittals
1. Product Data: For each type of product indicated.
2. Shop Drawings: For loading dock equipment. Include plans, elevations, sections, details, and attachments to other work.
a. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
b. Wiring Diagrams: For power, signal, and control wiring.
3. Samples: For each type of dock-seal and -shelter fabric indicated.
4. Qualification Data: For qualified Installer.
5. Welding certificates.
6. Product Test Reports.
7. Operation and Maintenance Data.
8. Warranty: Sample of special warranty.

E. Quality Assurance
1. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
2. Welding Qualifications: Qualify procedures and personnel according to the following:
a. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
b. AWS D1.3, "Structural Welding Code - Sheet Steel."
3. 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.
4. Preinstallation Conference: Conduct conference at Project site.

F. Delivery, Storage, And Handling
1. Store and handle dock seals and shelters in a manner to avoid significant or permanent damage to fabric or frame.

a. Comply with manufacturer's written instructions for minimum and maximum temperature requirements for storage.

G. Project Conditions
1. Field Measurements: Verify actual dimensions of construction contiguous with loading dock equipment, including recessed pit dimensions. slopes of driveways, and heights of loading docks, by field measurements before fabrication.

H. Warranty
1. Special Warranty for Dock Levelers: Manufacturer's standard form in which manufacturer agrees to repair or replace dock-leveler components that fail in materials or workmanship within specified warranty period.
a. Failures include, but are not limited to, the following:
1) Structural failures including cracked or broken structural support members, load-bearing welds, and front and rear hinges.
2) Faulty operation of operators, control system, or hardware.
3) Deck plate failures including cracked plate or permanent deformation in excess of 1/4 inch (6 mm) between deck supports.
4) Hydraulic system failures including failure of hydraulic seals and cylinders.
b. Warranty Period for Structural Assembly: 10 years from date of Substantial Completion.
c. Warranty Period for Hydraulic System: Five years from date of Substantial Completion.
d. Warranty shall be for unlimited usage of leveler for the specified rated capacity over the term of the warranty.

1.2 PRODUCTS

A. Materials
1. Steel Plates, Shapes, and Bars: ASTM 36/A 36M.
2. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from steel plate complying with ASTM A 572/A 572M, Grade 55 (380).
3. Steel Tubing: ASTM A 500, cold formed.
4. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
5. Wood: DOC PS 20 dimension lumber, select structural grade, kiln dried.
6. Pressure-Treated Wood: DOC PS 20 dimension lumber, select structural grade, kiln dried, and pressure treated with waterborne preservatives to comply with AWPA C2.

B. Recessed Dock Levelers
1. General: Recessed, hinged-lip-type dock levelers designed for permanent installation in concrete pits preformed in the edge of loading platform; of type, function, operation, capacity, size, and construction indicated; and complete with controls, safety devices, and accessories required.
2. Standard: Comply with MH 30.1, except for structural testing to establish rated capacity, **as directed**.
3. Rated Capacity: Capable of supporting total gross load without permanent deflection or distortion.
4. Platform: Not less than 3/16-inch- (5-mm-) **OR** 1/4-inch- (6-mm-) **OR** 3/8-inch- (9.5-mm-), **as directed**, thick, nonskid steel plate.
a. Platform Size: As indicated on Drawings, **as directed**.
b. Frame: Manufacturer's standard **OR** Clean-pit type, designed to support leveler at sides of pit, with no side-to-side supports at front of pit floor, **as directed**.
c. Toe Guards: Equip open sides of dock leveler over range indicated with metal toe guards.
1) Toe-Guard Range: Entire upper operating **OR** working, **as directed**, range.
5. Hinged Lip: Not less than 1/2-inch- (13-mm-) **OR** 5/8-inch- (16-mm-) **OR** 3/4-inch- (19-mm-) **OR** 1-inch- (25-mm-), **as directed**, thick, nonskid steel plate.

a. Hinge: Full width, piano-type hinge with heavy-wall hinge tube and greased fittings, **as directed**, with gussets on lip and ramp for support.

b. Safety Barrier Lip: Designed to protect material-handling equipment from an accidental fall from loading platform edge of the dock leveler when the leveler is not in use.

6. Function: Dock levelers shall compensate for differences in height between truck bed and loading platform.

a. Vertical Travel: Operating range above platform level of sufficient height to enable lip to extend and clear truck bed before contact with the following minimum working range:

1) Above Adjoining Platform: 12 inches (305 mm) **OR** 18 inches (457 mm) **OR** As indicated on Drawings, **as directed**.

2) Below Adjoining Platform: 12 inches (305 mm) **OR** 14 inches (356 mm) **OR** As indicated on Drawings, **as directed**.

b. Automatic Vertical Compensation: Floating travel of ramp with lip extended and resting on truck bed shall compensate automatically for upward or downward movement of truck bed during loading and unloading.

c. Automatic Lateral Compensation: Tilting of ramp with lip extended and resting on truck bed shall compensate automatically for canted truck beds of up to 4 inches (102 mm) over width of ramp.

d. Lip Operation: Manufacturer's standard mechanism that automatically extends and supports hinged lip on ramp edge with lip resting on truck bed over dock leveler's working range, allows lip to yield under impact of incoming truck, and automatically retracts lip when truck departs.

1) Length of Lip Extension: 16 inches (406 mm) **OR** 18 inches (457 mm) **OR** 20 inches (508 mm) **OR** As indicated on Drawings, **as directed**.

e. Automatic Ramp Return: Automatic return of unloaded ramp, from raised or lowered positions to stored position, level with platform, as truck departs.

f. Interlock: Leveler will not operate while overhead door is in closed position **OR** leveler night lock is engaged **OR** truck restraint is not engaged **OR** inflatable dock seal is not inflated **OR** inflatable dock shelter is not inflated, **as directed**.

7. Mechanical Operating System: Manual control; counterbalance and spring operation. Spring-operated raising and walk-down lowering of unloaded ramp. Equip leveler with an upward-biased-spring counterbalancing mechanism controlled by a hold-down device. Ramp raises to top limit of operating range by operating recessed control handle in ramp to disengage hold-down device. Ramp lowers below platform level with lip retracted by operating auxiliary, recessed control handle to release support legs.

a. Free-Fall Protection: Manufacturer's standard protection system to limit free fall of loaded ramps with front edge supported by truck bed.

8. Hydraulic Operating System: Electric control from a remote-control station; fully hydraulic operation. Electric-powered hydraulic raising and hydraulic lowering of ramp. Equip leveler with a packaged unit including a unitized, totally enclosed, nonventilated electric motor, pump, manifold reservoir, and valve assembly of proper size, type, and operation for capacity of leveler indicated. Include means for lowering ramp below platform level with lip retracted behind dock bumpers. Provide a hydraulic velocity fuse connected to main hydraulic cylinder to limit loaded ramp's free fall to not more than 3 inches (76 mm).

a. Remote-Control Station: Weatherproof single **OR** Single, **as directed**,-button station of the constant-pressure type, enclosed in NEMA ICS 6, Type 4 **OR** Type 12, **as directed**, box. Ramp raises by depressing and holding button; ramp lowers at a controlled rate by releasing button.

b. Remote-Control Station with Emergency Stop: Weatherproof multibutton **OR** Multibutton, **as directed**, control station with an UP button of the constant-pressure type and an emergency STOP button of the momentary-contact type, enclosed in NEMA ICS 6, Type 4 **OR** Type 12, **as directed**, box. Ramp raises by depressing and holding UP button; ramp lowers at a controlled rate by releasing UP button. All ramp movement stops, regardless of position of ramp or lip, by depressing STOP button. Normal operation resumes by engaging a manual reset button or by pulling out STOP button.

1) Dual-Panel Control Station: Remote-control station for operating side-by-side dock levelers.
2) Master Panel: Control panel with integral fused disconnecting means for operating dock leveler, dock door, and truck restraints.

c. Independent Lip Operation: Electric-powered hydraulic raising and hydraulic lowering of lip, controlled independent of raising and lowering of ramp.

9. Electric Operating System: Electric control from a remote-control station; motorized operation. Electric activation for raising of ramp and automatic extending of lip. Equip leveler with a packaged unit including a unitized electric motor and shaft assembly of proper size, type, and operation for capacity of leveler indicated. Include means for lowering ramp below platform level with lip retracted behind dock bumpers.
   a. Remote-Control Station: Weatherproof single **OR** Single, **as directed**,-button station of the constant-pressure type, enclosed in NEMA ICS 6, Type 4 **OR** Type 12, **as directed**, box. Ramp raises by depressing and holding button; ramp lowers at a controlled rate by releasing button.
   b. Remote-Control Station with Emergency Stop: Weatherproof multibutton **OR** Multibutton, **as directed**, control station with an UP button of the constant-pressure type and an emergency STOP button of the momentary-contact type, enclosed in NEMA ICS 6, Type 4 **OR** Type 12, **as directed**, box. Ramp raises by depressing and holding UP button; ramp lowers at a controlled rate by releasing UP button. All ramp movement stops, regardless of position of ramp or lip, by depressing STOP button. Normal operation resumes by engaging a manual reset button or by pulling out STOP button.
10. Air-Bag Operating System: Electric control from a remote-control station; pneumatic operation. High-volume, low-pressure lifting of ramp. Equip leveler with a packaged unit including a PVC-coated, reinforced polyester lifting bag and two-stage, single-speed electric fan of proper size, type, and operation for capacity of leveler indicated. Include dock-leveler supports controlled by release chain for lowering ramp below platform level without extending lip.
   a. Remote-Control Station: Weatherproof single **OR** Single, **as directed**,-button station of the constant-pressure type, enclosed in NEMA ICS 6, Type 4, **as directed**, box. Ramp raises by depressing and holding button; ramp lowers at a controlled rate by releasing button.
11. Construction: Fabricate dock-leveler frame, platform supports, and lip supports from structural- or formed-steel shapes. Weld platform and hinged lip to supports. Fabricate entire assembly to withstand deformation during both operating and stored phases of service. Chamfer lip edge to minimize obstructing wheels of material-handling vehicles.
   a. Cross-Traffic Support: Manufacturer's standard method of supporting ramp at platform level in stored position with lip retracted. Provide a means to release supports to allow ramp to descend below platform level.
   b. Maintenance Strut: Integral strut to positively support ramp in up position during maintenance of dock leveler.
12. Integral Molded-Rubber Dock Bumpers: Fabricated from 4-inch- (102-mm-) **OR** 6-inch- (152-mm-), **as directed**, thick, heavy molded-rubber compound reinforced with nylon, rayon, or polyester cord; with Type A Shore durometer hardness of 80, plus or minus 5, when tested according to ASTM D 2240. Provide two dock bumpers for each recessed dock leveler, attached to face of loading dock with expansion bolts.
13. Integral Laminated-Tread Dock Bumper: Fabricated from 4-1/2-inch- (114-mm-) **OR** 6-inch- (152-mm-), **as directed**, thick, multiple, uniformly thick plies cut from fabric-reinforced rubber tires. Laminate plies under pressure on not less than two 3/4-inch- (19-mm-) diameter, steel supporting rods that are welded at one end to 1/4-inch- (6-mm-) thick, structural-steel end angle and secured with a nut and angle at the other end. Fabricate angles with predrilled anchor holes and sized to provide not less than 1 inch (25 mm) of tread plies extending beyond the face of closure angles.
14. Accessories:
   a. Curb Angles: 3-by-3-by-1/4-inch (76-by-76-by-6-mm) galvanized-steel curb angles for edge of recessed leveler pit, with 1/2-inch- (13-mm-) diameter by 6-inch- (152-mm-) long concrete anchors welded to angle at 6 inches (152 mm) o.c.

b. Self-Forming Pan: Manufacturer's standard prefabricated, self-forming steel form system for poured-in-place construction of concrete pit.
c. Night Locks: Manufacturer's standard means to prevent extending lip and lowering ramp when overhead doors are locked.
d. Side and rear weatherseals.
e. Foam insulation under dock-leveler platform.
f. Abrasive skid-resistant **OR** Smooth, **as directed**, surface.

15. Finish: Paint **OR** Hot-dip galvanize, **as directed**, dock levelers after assembly and testing, **as directed**.
    a. Toe Guards: Paint yellow **OR** orange, **as directed**, to comply with ANSI Z535.1.

C. Edge-Of-Dock Levelers

1. General: Surface-mounted, hinged-lip-type, edge-of-dock levelers designed for permanent installation on face of loading dock platform; of type, function, operation, capacity, size, and construction indicated; and complete with controls, safety devices, and accessories required.
2. Standard: Comply with MH 30.1, except for structural testing to establish rated capacity, **as directed**.
3. Rated Capacity: Capable of supporting total gross load without permanent deflection or distortion.
4. Platform Ramp Width: 66 inches (1676 mm) **OR** 72 inches (1829 mm) **OR** 78 inches (1981 mm) **OR** 84 inches (2134 mm) **OR** As indicated on Drawings, **as directed**.
5. Hinged Lip: Not less than 3/8-inch- (9.5-mm-) **OR** 7/16-inch- (11-mm-) **OR** 1/2-inch- (13-mm-), **as directed**, thick, nonskid steel tread plate.
    a. Hinge: Full width, piano-type hinge with heavy-wall hinge tube and greased fittings, **as directed**, with gussets on lip and ramp for support.
6. Function: Dock levelers shall compensate for differences in height between truck bed and loading platform.
    a. Vertical Travel: Operating range above platform level of sufficient height to enable lip to extend and clear truck bed before contact with the following minimum working range:
        1) Above Adjoining Platform: 5 inches (127 mm) **OR** 6 inches (152 mm) **OR** As indicated on Drawings, **as directed**.
        2) Below Adjoining Platform: 5 inches (127 mm) **OR** As indicated on Drawings, **as directed**.
    b. Automatic Vertical Compensation: Floating travel of ramp with lip extended and resting on truck bed shall compensate automatically for upward or downward movement of truck bed during loading and unloading.
    c. Automatic Lateral Compensation: Tilting of ramp with lip extended and resting on truck bed shall compensate automatically for canted truck beds of up to 3 inches (76 mm) over width of ramp.
    d. Lip Operation: Manufacturer's standard mechanism that automatically extends and supports hinged lip on ramp edge with lip resting on truck bed over dock leveler's working range, allows lip to yield under impact of incoming truck, and automatically retracts lip when truck departs.
        1) Length of Lip Extension: 15 inches (381 mm) **OR** 17 inches (432 mm) **OR** As indicated on Drawings, **as directed**.
    e. Automatic Ramp Return: Automatic return of unloaded ramp, from raised or lowered positions to stored position, level with platform, as truck departs. Leveler shall be capable of retracting to stored position while truck is at loading dock.
7. Mechanical Operating System: Manual control; counterbalance and spring operation. Spring-operated raising and walk-down lowering of unloaded ramp. Equip leveler with a torsion-spring counterbalancing mechanism controlled by a hold-down device.
    a. Lever Handle: Self-storing lever handle for raising unloaded ramp with minimal lifting force by pulling lever back to extend lip and pushing lever forward to lower ramp and lip.
    b. Removable Lifting Handle: For raising unloaded ramp by lifting action.
8. Hydraulic Operating System: Electric control from a remote-control station; fully hydraulic operation. Electric-powered hydraulic raising and hydraulic lowering of ramp. Equip leveler with

a packaged unit including a unitized, totally enclosed, nonventilated electric motor, pump, manifold reservoir, and valve assembly of proper size, type, and operation for capacity of leveler indicated. Provide a hydraulic velocity fuse connected to main hydraulic cylinder to limit loaded ramp's free fall to not more than 3 inches (76 mm).

a. Remote-Control Station: Weatherproof single **OR** Single, **as directed**,-button station of the constant-pressure type, enclosed in NEMA ICS 6, Type 12, **as directed**, box. Ramp and lip raise to vertical position and extend to truck bed by depressing and holding button.

9. Construction: Fabricate dock-leveler frame, platform supports, and lip supports from structural- and formed-steel shapes. Weld platform and hinged lip to supports. Fabricate entire assembly to withstand deformation during both operating and stored phases of service. Chamfer lip edge to minimize obstructing wheels of material-handling vehicles.
   a. Cross-Traffic Support: Manufacturer's standard method of supporting ramp at platform level in stored position with lip retracted. Provide a means to release supports to allow ramp to descend below platform level.
   b. Maintenance Strut: Integral strut to positively support ramp in up position during maintenance of dock leveler.
10. Integral Molded-Rubber Dock Bumpers: Fabricated from 4-inch- (102-mm-) **OR** 6-inch- (152-mm-), **as directed**, thick, heavy molded-rubber compound reinforced with nylon, rayon, or polyester cord; with Type A Shore durometer hardness of 80, plus or minus 5, when tested according to ASTM D 2240. Provide two dock bumpers for each recessed dock leveler, attached to face of loading dock with expansion bolts.
11. Integral Laminated-Tread Dock Bumper: Fabricated from 4-1/2-inch- (114-mm-) **OR** 6-inch- (152-mm-), **as directed**, thick, multiple, uniformly thick plies cut from fabric-reinforced rubber tires. Laminate plies under pressure on not less than two 3/4-inch- (19-mm-) diameter, steel supporting rods that are welded at one end to 1/4-inch- (6-mm-) thick, structural-steel end angle and secured with a nut and angle at the other end. Fabricate angles with predrilled anchor holes and sized to provide not less than 1 inch (25 mm) of tread plies extending beyond the face of closure angles.
12. Accessories:
   a. Self-forming pan.
   b. Cast-in-place design.
   c. Run-off guards.
   d. Ramp approach plate.
13. Dock-Leveler Finish: Painted in manufacturer's standard color.

D. Top-Of-Dock Levelers

E. General: Surface-mounted, hinged-lip-type, top-of-dock levelers designed for permanent installation on top edge of loading dock platform without concrete pit; of type, function, operation, capacity, size, and construction indicated; and complete with controls, safety devices, and accessories required.
1. Standard: Comply with MH 30.1, except for structural testing to establish rated capacity, **as directed**.
2. Rated Capacity: Capable of supporting total gross load without permanent deflection or distortion.
3. Platform Width: 72 inches (1829 mm) **OR** As indicated on Drawings, **as directed**.
4. Hinged Lip: Not less than 3/8-inch- (9.5-mm-) **OR** 7/16-inch- (11-mm-), **as directed**, thick, nonskid steel plate.
   a. Hinge: Full width, piano-type hinge with heavy-wall hinge tube and greased fittings, **as directed**, with gussets on lip and ramp for support.
5. Function: Dock levelers shall compensate for differences in height between truck bed and loading platform.
   a. Vertical Travel: Operating range above platform level of sufficient height to enable lip to extend and clear truck bed before contact with a minimum working range of 10 inches (250 mm), **as directed**, above and 4 inches (102 mm), **as directed**, below adjoining platform level.

b. Automatic Vertical Compensation: Floating travel of ramp with lip extended and resting on truck bed shall compensate automatically for upward or downward movement of truck bed during loading and unloading.

c. Lip Operation: Manufacturer's standard mechanism that automatically extends and supports hinged lip on ramp edge with lip resting on truck bed over dock leveler's working range, allows lip to yield under impact of incoming truck, and automatically retracts lip when truck departs.

1) Length of Lip Extension: 15 inches (381 mm) **OR** As indicated on Drawings, **as directed**.

d. Automatic Ramp Return: Automatic return of unloaded ramp, from raised or lowered positions to stored position, level with platform, as truck departs. Leveler shall be capable of retracting to stored position while truck is at loading dock.

6. Mechanical Operating System: Manual control; counterbalance and spring operation. Spring-operated raising and walk-down lowering of unloaded ramp. Equip leveler with a torsion-spring counterbalancing mechanism controlled by a hold-down device.

a. Removable Lifting Hook: For raising unloaded ramp by lifting action and pushing forward to lower ramp and lip.

7. Hydraulic Operating System: Electric control from a remote-control station, fully hydraulic operation. Electric-powered hydraulic raising and hydraulic lowering of ramp. Equip leveler with a packaged unit including a unitized, totally enclosed, nonventilated electric motor, pump, manifold reservoir, and valve assembly of proper size, type, and operation for capacity of leveler indicated.

a. Remote-Control Station: Weatherproof single **OR** Single, **as directed**,-button station of the constant-pressure type, enclosed in NEMA ICS 6, Type 12, **as directed**, box. Ramp and lip raise to vertical position and extend to truck bed by depressing and holding button.

8. Construction: Fabricate dock-leveler frame, platform supports, and lip supports from structural- or formed-steel shapes. Weld platform and hinged lip to supports. Fabricate entire assembly to withstand deformation during both operating and stored phases of service. Chamfer lip edge to minimize obstructing wheels of material-handling vehicles.

9. Integral Molded-Rubber Dock Bumpers: Fabricated from 4-inch- (102-mm-) **OR** 6-inch- (152-mm-), **as directed**, thick, heavy molded-rubber compound reinforced with nylon, rayon, or polyester cord; with Type A Shore durometer hardness of 80, plus or minus 5, when tested according to ASTM D 2240. Provide two dock bumpers for each recessed dock leveler, attached to face of loading dock with expansion bolts.

10. Integral Laminated-Tread Dock Bumper: Fabricated from 4-1/2-inch- (114-mm-) **OR** 6-inch- (152-mm-), **as directed**, thick, multiple, uniformly thick plies cut from fabric-reinforced rubber tires. Laminate plies under pressure on not less than two 3/4-inch- (19-mm-) diameter, steel supporting rods that are welded at one end to 1/4-inch- (6-mm-) thick, structural-steel end angle and secured with a nut and angle at the other end. Fabricate angles with predrilled anchor holes and sized to provide not less than 1 inch (25 mm) of tread plies extending beyond the face of closure angles.

11. Dock-Leveler Finish: Painted in manufacturer's standard color.

F. Vertical-Storing Dock Levelers

1. General: Recessed, hinged-lip-type, vertical-storing dock levelers designed for permanent installation in shallow concrete pits preformed in the edge of loading platform; of type, function, operation, capacity, size, and construction indicated; and complete with controls, safety devices, and accessories required.

2. Standard: Comply with MH 30.1, except for structural testing to establish rated capacity, **as directed**.

3. Rated Capacity: Capable of supporting total gross load without permanent deflection or distortion.

4. Platform: Not less than 3/16-inch- (5-mm-) **OR** 1/4-inch- (6-mm-), **as directed**, thick, nonskid steel plate.

a. Platform Size: As indicated on Drawings, **as directed**.

5. Hinged Lip: Not less than 1/2-inch- (13-mm-) **OR** 5/8-inch- (16-mm-), **as directed**, thick, nonskid steel plate.

a. Hinge: Full width, piano-type hinge with heavy-wall hinge tube and greased fittings, **as directed**, with gussets on lip and ramp for support.

6. Function: Dock levelers shall compensate for differences in height between truck bed and loading platform.
   a. Vertical Travel: Operating range above platform level of sufficient height to enable lip to extend and clear truck bed before contact with the following minimum working range:
      1) Above Adjoining Platform: 6 inches (152 mm) **OR** 10 inches (250 mm) **OR** 12 inches (305 mm) **OR** As indicated on Drawings, **as directed**.
      2) Below Adjoining Platform: 6 inches (152 mm) **OR** As indicated on Drawings, **as directed**.
   b. Automatic Vertical Compensation: Floating travel of ramp with lip extended and resting on truck bed shall compensate automatically for upward or downward movement of truck bed during loading and unloading.
   c. Automatic Lateral Compensation: Tilting of ramp with lip extended and resting on truck bed shall compensate automatically for canted truck beds of up to 4 inches (102 mm) over width of ramp.
   d. Lip Operation: Manufacturer's standard mechanism that automatically extends and supports hinged lip on ramp edge with lip resting on truck bed over dock leveler's working range, allows lip to yield under impact of incoming truck, and automatically retracts lip when truck departs.
      1) Length of Lip Extension: 16 inches (406 mm) **OR** 18 inches (457 mm) **OR** 20 inches (508 mm) **OR** As indicated on Drawings, **as directed**.
7. Hydraulic Operating System: Electric control from a remote-control station; fully hydraulic operation. Electric-powered hydraulic raising and hydraulic lowering of ramp. Equip leveler with a packaged unit including a unitized, totally enclosed, nonventilated electric motor, pump, manifold reservoir, and valve assembly of proper size, type, and operation for capacity of leveler indicated. Provide a hydraulic velocity fuse connected to main hydraulic cylinder to limit loaded ramp's free fall to not more than 3 inches (76 mm). Provide mechanical lock that prevents leveler from lowering without hydraulic pressure.
   a. Remote-Control Station: Weatherproof single **OR** Single, **as directed**,-button station of the constant-pressure type, enclosed in NEMA ICS 6, Type 12, **as directed**, box. Ramp lowers at a controlled rate.
   b. Remote-Control Station with Emergency Stop: Weatherproof multibutton **OR** Multibutton, **as directed**, control station with an UP button of the constant-pressure type and an emergency STOP button of the momentary-contact type, enclosed in NEMA ICS 6, Type 12, **as directed**, box. Ramp raises by depressing and holding UP button; ramp lowers at a controlled rate by releasing UP button. All ramp movement stops, regardless of position of ramp or lip, by depressing STOP button. Normal operation resumes by engaging a manual reset button or by pulling out STOP button.
      1) Master Panel: Control panel with integral fused disconnecting means for operating dock leveler, dock door, and truck restraints.
   c. Independent Lip Operation: Electric-powered hydraulic raising and lowering of lip, controlled independent of raising and lowering of ramp.
8. Construction: Fabricate dock-leveler frame, platform supports, run-off guards, **as directed,** and lip supports from structural- or formed-steel shapes. Weld platform and hinged lip to supports. Fabricate entire assembly to withstand deformation during both operating and stored phases of service. Chamfer lip edge to minimize obstructing wheels of material-handling vehicles.
9. Integral Molded-Rubber Dock Bumpers: Fabricated from 4-inch- (102-mm-) **OR** 6-inch- (152-mm-), **as directed**, thick, heavy molded-rubber compound reinforced with nylon, rayon, or polyester cord; with Type A Shore durometer hardness of 80, plus or minus 5, when tested according to ASTM D 2240. Provide two dock bumpers for each recessed dock leveler, attached to face of loading dock with expansion bolts.
10. Integral Laminated-Tread Dock Bumper: Fabricated from 4-1/2-inch- (114-mm-) **OR** 6-inch- (152-mm-), **as directed**, thick, multiple, uniformly thick plies cut from fabric-reinforced rubber tires. Laminate plies under pressure on not less than two 3/4-inch- (19-mm-) diameter, steel supporting

rods that are welded at one end to 1/4-inch- (6-mm-) thick, structural-steel end angle and secured with a nut and angle at the other end. Fabricate angles with predrilled anchor holes and sized to provide not less than 1 inch (25 mm) of tread plies extending beyond the face of closure angles.

11. Accessories:
    a. Interlock: Leveler will not operate while overhead door is in closed position **OR** truck restraint is not engaged, **as directed**.
    b. Curb Angles: 3-by-3-by-1/4-inch (76-by-76-by-6-mm) galvanized-steel curb angles for edge of recessed leveler pit, with 1/2-inch- (13-mm-) diameter by 6-inch- (152-mm-) long concrete anchors welded to angle at 6 inches (152 mm) o.c.
12. Finish: Paint **OR** Hot-dip galvanize, **as directed**, dock levelers after assembly and testing, **as directed**.

G. Truck Levelers
1. General: Two-cylinder, hydraulic ramp designed to raise and lower end of truck at loading dock. Equip leveler with a packaged unit including a unitized electric motor, pump, manifold reservoir, and valve assembly of proper size, type, and operation for capacity indicated. Provide manufacturer's standard means for limiting loaded ramp's free fall.
2. Rated Capacity: Capable of supporting total gross load without permanent deflection or distortion.
3. Travel Speed: Leveler raises and lowers at 3 fpm (0.015 m/s), measured at traveling end.
4. Surface-Mounted Units: Designed for mounting on surface of concrete driveway.
5. Shallow-Pit-Mounted Units: Designed for mounting in sloping shallow pit; capable of 18 inches (457 mm) of vertical travel above and below level of driveway.
6. Full-Pit-Mounted Units: Designed for installation in a fully recessed pit, with top of platform in stored position flush with driveway.
    a. Provide removable plate for access to pit for service.
7. Hydraulic Operating System: Electric control from a remote-control station; fully hydraulic operation. Self-contained, electric-powered hydraulic raising and hydraulic lowering of lift.
    a. Remote-Control Station: Weatherproof, multibutton control station of the constant-pressure type with UP and DOWN push buttons. Controller shall consist of magnetic motor starter with three-pole adjustable overloads and 24-V control transformer with 4-A, fused secondary prewired to terminal strips and enclosed in NEMA ICS 6, Type 12, **as directed**, box.
        1) Upper-Travel-Limit Switch: Equip unit with manufacturer's standard, adjustable, upper-travel-limit switch.
8. Construction: Fabricate truck leveler from structural- and formed-steel shapes; fabricate platform from nonskid steel plate. Construct platform with notch at loading-dock end to provide clearance for truck restraint.
    a. Cylinders: Equip truck leveler with not less than two heavy-duty, high-pressure, hydraulic, ram-type cylinders. Rams shall be manufacturer's standard, either direct-displacement plunger or rod-and-piston type with positive internal stops. Cylinder rods shall be chrome plated and polished.
9. Truck-Leveler Finish: Manufacturer's standard finish.

H. Truck Restraints
1. General: Manufacturer's standard device designed to engage truck's rear-impact guard and hold truck at loading dock. Restraint shall consist of an iron or steel restraining arm that raises until contacting rear-impact guard. Arm shall move vertically, automatically adjusting to varying height of truck due to loading and unloading operations.
2. Standard: Comply with MH 30.3.
3. Rated Capacity: Capable of supporting total gross load of <**Insert capacity**> without permanent deflection or distortion.
4. Operating Range: Capable of restraining rear-impact guards within a range from:
    a. Vertical: 12 inches (305 mm) **OR** 30 inches (762 mm) **OR** As indicated on Drawings, **as directed**, above driveway.

b. Horizontal: 12 inches (305 mm) **OR** As indicated on Drawings, **as directed**, in front of dock bumpers.

5. Power Operating System: Manufacturer's standard electromechanical or hydraulic unit.
   a. Remote-Control Station: Single-button station of the constant-pressure type, enclosed in NEMA ICS 6, Type 12, **as directed**, box. Restraint is engaged by depressing and holding button; restraint is released by releasing button.
   b. Interlock: Leveler will not operate while truck restraint is not engaged.
6. Mechanical Operating System: Restraint operates by use of a lifting rod or hook to raise engagement device.
7. Rear-Impact-Guard Sensor: Detects presence of rear-impact guard and automatically returns to stored position if rear-impact guard is not engaged, **as directed**.
8. Caution Signs: Exterior, surface mounted; designed to inform both dock attendant and truck driver; with sign copy as follows. Provide one sign at each truck-restraint location.
   a. Sign Copy in Forward and Reverse Text: Manufacturer's standard text permitting truck movement with green light, **as directed**.
   b. Interior Sign Copy: Manufacturer's standard text permitting truck movement with green light, **as directed**.
9. Light-Communication System: Red and green illuminated signal-light sets, with lens approximately 4 inches (102 mm) in diameter, designed to indicate status to both dock attendant and truck driver. Equip system with steel control panel located at interior of dock that includes illuminated lights indicating **OR** indicates, **as directed**, status of exterior signal lights. Provide signal-light set and control panel at each location indicated for light-communication system. Enclose exterior signal-light sets in steel or plastic housing with sunshade.
   a. Manual Operation: System is activated by push button or switch located on interior **OR** truck-restraint, **as directed**, control panel.
   b. Automatic Operation: System is activated automatically by limit switch **OR** photoelectric sensor **OR** magnetic switch, **as directed**, mounted on overhead door track. Provide on-off switch located on light-communication system **OR** truck-restraint, **as directed**, control panel.
   c. Automatic Operation: System is activated automatically when device engages rear-impact guard. Provide on-off switch located on truck-restraint control panel.
   d. Mounting: Wall **OR** Driveway **OR** Pit, **as directed**.
10. Alarm: Audible **OR** Visual **OR** Audible and visual, **as directed**, system indicating that rear-impact guard is not engaged, with manual reset.
11. Accessories: Interlock to dock leveler **OR** Key switch, **as directed**.
12. Truck-Restraint Finish: Painted **OR** Hot-dip galvanized, **as directed**.

I. Light-Communication Systems
   1. General: Provide communication system consisting of signal-light sets, caution signs, alarms, and controls for each location indicated.
   2. Caution Signs: Surface mounted; designed to inform both dock attendant and truck driver; with sign copy as follows:
      a. Exterior Sign Copy in Forward and Reverse Text: Manufacturer's standard text permitting truck movement with green light, **as directed**.
      b. Interior Sign Copy: Manufacturer's standard text permitting truck movement with green light, **as directed**.
   3. Signal-Light Sets: Red and green illuminated signal-light sets, with lens approximately 4 inches (102 mm) in diameter, designed to indicate status to both dock attendant and truck driver. Equip system with steel control panel that includes illuminated lights indicating **OR** indicates, **as directed**, status of exterior signal lights; located at interior of dock. Provide signal-light set and control panel at each location indicated for light-communication system. Enclose signal lights in steel or plastic housing, with exterior signal-light sets equipped with sunshade.
      a. Manual Operation: Lights are activated by push button or switch located on interior signal-light enclosure **OR** control panel, **as directed**.

b. Automatic Operation: Lights are activated automatically by limit switch **OR** photoelectric sensor **OR** magnetic switch, **as directed**, mounted on overhead door track. Provide on-off switch located on control panel.

J. Dock Bumpers

1. Laminated-Tread Dock Bumper: Fabricated from multiple, uniformly thick plies cut from fabric-reinforced rubber tires. Laminate plies under pressure on not less than two 3/4-inch- (19-mm-) diameter, steel supporting rods that are welded at one end to 1/4-inch- (6-mm-) thick, structural-steel end angle and secured with a nut and angle at the other end. Fabricate angles with predrilled anchor holes and sized to provide not less than 1 inch (25 mm) of tread plies extending beyond the face of closure angles.
   a. Thickness: 4-1/2 inches (114 mm) **OR** 6 inches (152 mm) **OR** As indicated on Drawings, **as directed**.
   b. Horizontal Style: 6 inches (152 mm) **OR** 10 inches (250 mm) **OR** 12 inches (305 mm), **as directed**, high by length indicated on Drawings, **as directed**.
   c. Vertical Style: 8 inches (203 mm) wide by 20 inches (508 mm) high **OR** 24 inches (610 mm) high **OR** 36 inches (914 mm) high **OR** height indicated on Drawings, as directed.
2. Molded-Rubber Bumpers: Fabricated from molded-rubber compound reinforced with nylon, rayon, or polyester cord; with Type A Shore durometer hardness of 80, plus or minus 5, when tested according to ASTM D 2240; of size and configuration indicated. Fabricate units with not less than two predrilled anchor holes.
   a. Configuration: T shape **OR** Inverted-L shape **OR** Square **OR** Rectangular **OR** As indicated on Drawings, **as directed**.
   b. Thickness: 2 inches (50 mm) **OR** 3 inches (76 mm) **OR** 4 inches (102 mm) **OR** 6 inches (152 mm) **OR** As indicated on Drawings, **as directed**.
3. Extruded-Rubber Bumpers: Fabricated from ASTM D 2000, extruded synthetic rubber with Type A Shore durometer hardness of 75, plus or minus 5, when tested according to ASTM D 2240; of size and configuration indicated. Furnish units with predrilled anchor holes and concealed, flat, steel mounting bar.
   a. Configuration: Flat or ribbed, with 2-inch (50-mm) nominal thickness and 9-inch (229-mm) height **OR** 4-1/2-inch- (114-mm-) wide base and 4-inch (102-mm) depth with half-oval shape that compresses and returns to original shape **OR** As indicated on Drawings, **as directed**.
4. Steel-Face, Laminated-Tread Bumpers: Fabricated from multiple, uniformly thick plies cut from fabric-reinforced rubber tires and with 3/8-inch (9.5-mm) steel face plate of same size as rubber surface. Laminate plies under pressure on not less than two 3/4-inch- (19-mm-) diameter, steel supporting rods that are welded at one end to 1/4-inch- (6-mm-) thick, structural-steel end angle and secured with a nut and angle at the other end. Fabricate angles with predrilled anchor holes and sized to provide not less than 1 inch (25 mm) of tread plies extending beyond the face of closure angles. Weld face plate to two steel support brackets, which shall extend back to and engage 3/4-inch- (19-mm-) diameter support rods in elongated holes, allowing steel face to float on impact.
   a. Thickness: 4-1/2 inches (114 mm) **OR** 6 inches (152 mm) **OR** As indicated on Drawings, **as directed**.
   b. Horizontal Style: 6 inches (152 mm) **OR** 10 inches (250 mm) **OR** 12 inches (305 mm), **as directed**, high by length indicated, **as directed**.
   c. Vertical Style: 8 inches (203 mm) wide by 20 inches (508 mm) high **OR** 24 inches (610 mm) high **OR** 36 inches (914 mm) high **OR** height indicated, **as directed**.
5. Anchorage Devices: Hot-dip galvanized-steel anchor bolts, nuts, washers, bolts, sleeves, cast-in-place plates, and other anchorage devices as required to fasten bumpers securely in place and to suit installation type indicated.

K. Dock Lifts

1. General: Built-in, scissors-type, single-leg, hydraulic dock lift of capacity, size, and construction indicated; complete with controls, safety devices, and accessories required.
2. Standard: MH 29.1.

3. Rated Capacity: Lifting capacity of not less than 8000 lb (3629 kg) with 6500-lb (2948-kg) **OR** indicated on Drawings, **as directed**, axle load at ends and 5000-lb (2268-kg) **OR** indicated on Drawings, **as directed**, axle load at sides.
4. Platform: Nonskid, safety-tread **OR** Smooth-surface, **as directed**, heavy steel deck plate.
   a. Platform Size: As indicated on Drawings, **as directed**.
   b. Platform Guarding: Bevel toe guards **OR** Toe sensor **OR** Indicator bar **OR** Skirts **OR** Enclosure, **as directed**, to comply with requirements in MH 29.1.
   c. Removable **OR** Fixed, **as directed**, Handrails: Equip lift with handrails on two sides of platform with a single, removable chain across each end. Provide handrails not less than 39 inches (991 mm) high with midrail and 4-inch- (102-mm-) high kick plate at bottom. Mount rail sockets flush with platform surface, **as directed**.
5. Bridge: Nonskid, safety-tread steel **OR** High-tensile aluminum, **as directed**, plate.
   a. Hinged Bridge: Hinged, throw-over bridge bolted to full-length, heavy-duty, piano-type hinge welded to toe guard at end of platform. Provide bridge complete with heavy-duty lifting chains. Chamfer edge of bridge to minimize obstructing wheels of material-handling vehicles.
   b. Size: 18 inches (457 mm) long by 60 inches (1524 mm) wide **OR** 18 inches (457 mm) long by 72 inches (1829 mm) wide **OR** As indicated on Drawings, **as directed**.
   c. Locations: Ends **OR** Sides **OR** As indicated on Drawings, **as directed**.
6. Function: Dock lifts shall compensate for differences in height between truck bed and loading platform.
   a. Vertical Travel: Maximum of 60 inches (1524 mm), **as directed**, from a lowered height of 12 inches (305 mm), **as directed**, for a total raised height of 72 inches (1829 mm), **as directed**.
   b. Travel Speed: Nominal raising speed of 8 fpm (0.04 m/s) **OR** 10 fpm (0.05 m/s) **OR** 12 fpm (0.06 m/s), **as directed**.
   c. Vertical Travel and Travel Speed: As indicated on Drawings, **as directed**.
   d. Hinged Throw-Over Bridges Operation: Manual **OR** Manual-assist bridge winch **OR** Automatic powered, **as directed**.
7. Hydraulic Operating System: Self-contained, electric, hydraulic power unit for raising and lowering lift; of size, type, and operation needed for capacity of lift indicated; controlled from a remotely located push-button station.
   a. Power Unit: Consisting of continuous-duty motor, high-pressure gear pump, valve manifold, oil-line filters, and oil reservoir.
      1) Equip manifold with relief valve, check valve, pressure-compensated flow-control valve, and solenoid valve and with provisions for lowering lift manually if power fails.
      2) Equip reservoir, valve manifold, and pressure line with oil-line filters.
   b. Cylinders: Equip lift with not less than two heavy-duty, high-pressure, hydraulic, ram-type cylinders. Rams shall be manufacturer's standard, either direct-displacement plunger or rod-and-piston type with positive internal stops. Cylinder rods shall be chrome plated and polished.
      1) Rate of Descent Protection: Pressure-compensated flow control or hydraulic velocity fuse to limit down speed for each cylinder.
   c. Remote-Control Station: Multibutton control station of the constant-pressure type with UP and DOWN push buttons. Controller shall consist of magnetic motor starter with three-pole adjustable overloads and 24-V control transformer with 4-A, fused secondary prewired to terminal strips and enclosed in NEMA ICS 6, Type 12, **as directed**, box.
      1) Upper-Travel-Limit Switch: Equip unit with manufacturer's standard, adjustable, upper-travel-limit switch.
8. Construction: Fabricate lift from structural-steel shapes rigidly welded and reinforced for maximum strength, safety, and stability. Design assembly to withstand deformation during both operating and stored phases of service. Provide mounting brackets and removable lifting eyes for ease of installation.
   a. Scissors Mechanism: Fabricate leg members from heavy, steel-formed tube or plate members to provide maximum strength and rigidity.

b. Scissors Configuration: Single leg **OR** Multiple width **OR** Multiple length, **as directed**.
c. Bearings: Pivot points with permanently lubricated antifriction bushings or sealed ball-bearings for minimum maintenance.
d. Maintenance Leg: Removable, safety maintenance leg or hinged, safety maintenance bars.
e. Mounting: Surface **OR** Pit, **as directed**.

9. Dock Lift Finish: Painted **OR** Hot-dip galvanized, **as directed**.
   a. Toe Guards: Paint yellow **OR** orange, **as directed**, to comply with ANSI Z535.1.

L. Foam-Pad Dock Seals
1. General: Dock seals consisting of fabric-covered foam pads designed to compress 4 to 5 inches (102 to 127 mm) under pressure of truck body to form an airtight seal at jambs and head of loading dock openings; of type, size, and construction indicated.
2. Door Opening Size: As indicated on Drawings, **as directed**.
3. Stationary Head Pad: 8 inches (203 mm) **OR** 12 inches (305 mm) **OR** 18 inches (457 mm) **OR** 24 inches (610 mm), **as directed**, high and same depth as jamb pads; beveled, **as directed**; sized for opening width.
4. Adjustable Head Pad: 18 inches (457 mm) **OR** 24 inches (610 mm) **OR** 30 inches (762 mm), **as directed**, high and same depth as jamb pads; sized for opening width; with manufacturer's standard hardware and tension spring or counterweight mechanism for adjusting height of pad.
5. Jamb Pads: Square **OR** Beveled; tapered to reduce opening width, **as directed**.
   a. Nominal Size: 12 inches (305 mm) **OR** As indicated on Drawings, **as directed**, wide and sized for opening height.
6. Construction: Consisting of single- or double-ply, coated, fabric-covered, urethane-foam core with supporting frame. Fabricate jamb and head pads of same depth and sized for opening width.
   a. Pressure-Treated, **as directed**, Wood Support Frame: Factory painted; with steel mounting hardware.
   b. Steel Support Frame: Steel channel frame of manufacturer's standard weight, shape, and finish; with steel mounting hardware.
   c. Tapered Side Panels: Taper side panels to angle required to accommodate sloped loading dock approach grades and make sealing edge of dock shelter parallel to back edge of truck. Taper for declined **OR** inclined, **as directed**, approach.
   d. Cover Fabric: Vinyl-coated nylon or polyester with minimum total weight of 22 oz./sq. yd. (746 g/sq. m) **OR** 40 oz./sq. yd. (1356 g/sq. m), **as directed**.
      1) Color: Black **OR** Green **OR** Blue **OR** Brown **OR** Tan **OR** As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.
   e. Cover Fabric: Neoprene-coated nylon with minimum total weight of 16 oz./sq. yd. (543 g/sq. m) **OR** 40 oz./sq. yd. (1356 g/sq. m) **OR** 45 oz./sq. yd. (1526 g/sq. m), **as directed**.
      1) Color: Black **OR** Green **OR** Blue **OR** Brown **OR** Tan **OR** As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.
   f. Cover Fabric: Hypalon-coated nylon with minimum total weight of 16 oz./sq. yd. (543 g/sq. m) **OR** 40 oz./sq. yd. (1356 g/sq. m), **as directed**.
      1) Color: Black **OR** Green **OR** Blue **OR** Brown **OR** Tan **OR** As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.
   g. Cover Fabric: Manufacturer's proprietary cover fabric complying with the following minimum requirements:
      1) Tearing strength of not less than 300 by 300 lbf (1334 by 1334 N) when tested according to ASTM D 2261.
      2) Abrasion resistance of not less than 6000 cycles when tested according to FED-STD-191A-5306.
      3) Tensile strength of not less than 1200 by 1200 lbf (5338 by 5338 N) when tested according to FED-STD-191A-5100.

4) Cold resistance to minus 40 deg F (minus 40 deg C) when tested according to FED-STD-191A-5874.
5) Color: Black **OR** Green **OR** Blue **OR** Brown **OR** Tan **OR** As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.

h. Guide Strips: 4-inch- (102-mm-) wide, coated, nylon guide strips on jamb pads.

i. Pleated Protectors: On face of jamb pads of overlapping layers of coated fabric attached to base fabric; 4-inch (102-mm) **OR** 8-inch (203-mm) **OR** 16-inch (406-mm), **as directed**, wear exposure.

M. Inflatable Dock Seals

1. General: Inflatable dock seals consisting of one-piece jamb, sill, **as directed**, and header seals designed to inflate by motor/blower and compress against truck bodies to form airtight seals at loading dock openings; of type, size, and construction indicated.
2. Door Opening Size: As indicated on Drawings, **as directed**.
3. Head Members: One **OR** Two, **as directed**.
4. Jamb Members: One **OR** Two, **as directed**.
5. Construction: Fabricate header seal full width over jamb seals. Mount seals on pressure-treated wood frame with hot-dip galvanized-steel mounting hardware. Inflate seals by use of 1/2-hp motor/blower with on-off switch, mounted above header seal in galvanized-steel hood. Provide bottom of header and jamb seals with grommets to allow for release of moisture and excess air.

a. Fabric: Neoprene-coated nylon with minimum total weight of 14 oz./sq. yd. (475 g/sq. m).
1) Color: Black **OR** Gray **OR** Blue **OR** Brown **OR** As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.

b. Fabric: Manufacturer's proprietary fabric complying with the following minimum requirements:
1) Tearing strength of not less than 110 by 85 lbf (489 by 378 N) when tested according to ASTM D 2261.
2) Abrasion resistance of not less than 490 cycles when tested according to FED-STD-191A-5306.
3) Tensile strength of not less than 500 by 440 lbf (2224 by 1957 N) when tested according to FED-STD-191A-5100.1.
4) Cold resistance to minus 40 deg F (minus 40 deg C) when tested according to FED-STD-191A-5874.
5) Color: Black **OR** Gray **OR** Blue **OR** Brown **OR** As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.

N. Frame-Type Dock Shelters

1. General: Dock shelters designed to form a seal with sides and top of truck body while leaving entire width and height of truck's rear opening unobstructed; of type, size, and construction indicated.
2. Door Opening Size: As indicated on Drawings, **as directed**.
3. Rigid-Frame Type: Fabricated from translucent, fabric-covered **OR** fiberglass, **as directed**, side and top panels attached to fixed supporting framework. Provide head and side curtains with built-in flexible stays, wind straps between head curtain and side frame, pleated protectors on head curtain, and a yellow aim patch on side curtains. Slope head frame from center for drainage. Provide replaceable, fabric-covered, tapered, foam-bottom pads and protective steel bumpers of size and type required for application shown.
4. Flexible-Frame Type: Fabricated from fabric-covered side and top panels attached to retractable supporting framework with independent spring-tension extension arms. Provide head and side curtains with built-in flexible stays, pleated protectors on head curtain, and a yellow aim patch on side curtains. Provide replaceable, fabric-covered, tapered, foam-bottom pads of size and type required for application shown.

5. Head-Pad Height: 12 inches (305 mm) **OR** 18 inches (457 mm) **OR** 24 inches (610 mm) **OR** 30 inches (762 mm), **as directed**.
6. Construction: Fabricate framework, pads, bumpers, fabric for curtains and panels, and other components to sizes and shapes indicated or required to fit door opening sizes shown and allow for not less than 18 inches (457 mm) of truck-body penetration when truck is docked.
   a. Wood Framework: Factory painted, mechanically fastened together using nails and lag bolts or metal connectors to form a rigid assembly.
   b. Steel Framework: Zinc-plated steel tubing of size and thickness standard with manufacturer, with joints welded.
   c. Top and Side Panels: White, translucent fiberglass, 0.045 inch (1.1 mm) thick, weighing 6 oz./sq. ft. (1831 g/sq. m).
   d. Top and Side Panels: White, translucent vinyl, weighing 14 oz./sq. ft. (4272 g/sq. m).
   e. Tapered Side Panels: Taper side panels to angle required to accommodate sloped loading dock approach grades and make sealing edge of dock shelter parallel to back edge of truck. Taper for declined **OR** inclined, **as directed,** approach.
   f. Cover Fabric: Vinyl-coated nylon with minimum total weight of 22 oz./sq. yd. (746 g/sq. m) **OR** 40 oz./sq. yd. (1356 g/sq. m), **as directed**.
      1) Color: Black **OR** Green **OR** Blue **OR** Brown **OR** Tan **OR** As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.
   g. Cover Fabric: Polyurethane-coated nylon with minimum total weight of 25 oz./sq. yd. (848 g/sq. m).
      1) Color: Black **OR** Green **OR** Blue **OR** Brown **OR** Tan **OR** As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.
   h. Cover Fabric: Neoprene-coated nylon with minimum total weight of 16 oz./sq. yd. (543 g/sq. m) **OR** 40 oz./sq. yd. (1356 g/sq. m) **OR** 45 oz./sq. yd. (1526 g/sq. m), **as directed**.
      1) Color: Black **OR** Green **OR** Blue **OR** Brown **OR** Tan **OR** As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.
   i. Cover Fabric: Hypalon-coated nylon with minimum total weight of 16 oz./sq. yd. (543 g/sq. m) **OR** 40 oz./sq. yd. (1356 g/sq. m), **as directed**.
      1) Color: Black **OR** Green **OR** Blue **OR** Brown **OR** Tan **OR** As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.
   j. Cover Fabric: Manufacturer's proprietary cover fabric complying with the following minimum requirements:
      1) Tearing strength of not less than 300 by 300 lbf (1334 by 1334 N) when tested according to ASTM D 2261.
      2) Abrasion resistance of not less than 6000 cycles when tested according to FED-STD-191A-5306.
      3) Tensile strength of not less than 1200 by 1200 lbf (5338 by 5338 N) when tested according to FED-STD-191A-5100.1.
      4) Cold resistance to minus 40 deg F (minus 40 deg C) when tested according to FED-STD-191A-5874.
      5) Color: Black **OR** Green **OR** Blue **OR** Brown **OR** Tan **OR** As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.
   k. Pleated Protectors: Overlapping layers of same fabric as cover.
7. Accessories:
   a. Buffer flaps.
   b. Bottom filler curtain.
   c. Bottom seal pads.

O. Inflatable Dock Shelters

1. General: Inflatable dock shelters designed to inflate by motor/blower and compress against truck bodies to form airtight seals at loading dock openings; of type, size, and construction indicated.
2. Door Opening Size: As indicated on Drawings, **as directed**.
3. Rigid Canopy: Consisting of rigid canopy, fabric-covered header curtain, and one-piece inflatable header and jamb seals. Fabricate canopy from white, translucent plastic attached to rigid support framework.
4. Rigid Canopy and Sides: Consisting of rigid canopy and sides, fabric-covered header curtain, and one-piece, inflatable header and jamb seals. Fabricate canopy and sides from white, translucent plastic attached to rigid support framework.
5. Construction: Fabricate header seal full width over jamb seals. Mount seals on pressure-treated wood frame with hot-dip galvanized-steel mounting hardware. Provide header curtain with built-in flexible stays and two yellow aim patches. Slope canopy frame from center for drainage. Provide two protective steel bumpers of size and type required for application shown. Inflate seals by use of a 1/2-hp motor/blower with on-off switch, mounted under canopy frame. Provide bottom of header and jamb seals with grommets to allow for release of moisture and excess air.
   a. Shape and Size: Fabricate framework, fabric for curtains, and other components to sizes and shapes indicated or required to fit door opening sizes shown and allow for not less than 12 inches (305 mm) of truck-body penetration when truck is docked.
   b. Wood Framework: Fasten members together mechanically using nails and lag bolts or metal connectors to form a rigid assembly.
   c. Steel Framework: Zinc-plated steel tubing of size and thickness standard with manufacturer, with joints welded.
   d. Fabric: Polyurethane **OR** Vinyl, **as directed**,-coated nylon with minimum total weight of 14 oz./sq. yd. (475 g/sq. m).
      1) Color: Black **OR** Green **OR** Blue **OR** Brown **OR** As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.
   e. Fabric: Manufacturer's proprietary fabric complying with the following minimum requirements:
      1) Tearing strength of not less than 110 by 85 lbf (489 by 378 N) when tested according to ASTM D 2261.
      2) Abrasion resistance of not less than 490 cycles when tested according to FED-STD-191A-5306.
      3) Tensile strength of not less than 500 by 440 lbf (2224 by 1957 N) when tested according to FED-STD-191A-5100.1.
      4) Cold resistance to minus 40 deg F (minus 40 deg C) when tested according to FED-STD-191A-5874.
      5) Color: Black **OR** Green **OR** Blue **OR** Brown **OR** As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.

P. Transparent-Strip Door Curtains
1. General: Door curtains consisting of overlapping strips suspended from top of opening to form a sealed door curtain. Provide strips of length required to suit opening height and with sufficient number in unit to close opening width with overlap indicated.
2. Strip Material: Curved, clear, transparent, extruded PVC. Fabricate strips for manufacturer's standard method of attachment to overhead mounting system indicated.
   a. Standard Grade: Designed to withstand temperature range of 0 to plus 150 deg F (minus 18 to plus 66 deg C).
   b. Low-Temperature Grade: USDA accepted, designed to withstand temperature range of minus 30 to plus 150 deg F (minus 34 to plus 66 deg C).
   c. Strip Width and Thickness:
      1) 6 inches (152 mm) wide and 0.060 inch (1.5 mm) thick.
         OR
         8 inches (203 mm) wide and 0.080 inch (2 mm) thick.

OR
12 inches (305 mm) wide and 0.120 inch (3 mm) thick.
OR
16 inches (406 mm) wide and 0.160 inch (4 mm) thick.

d. Overlap: None **OR** One-third **OR** One-half **OR** Two-thirds **OR** Three-quarters **OR** Full, **as directed**.

3. Header Mounting: Consisting of an angle bolted or welded to opening lintel; equip angle with permanently attached mounting pins and a steel-angle or -plate retaining strip attached to angle with wing nuts.
4. Wall Surface Mounting:
   a. Consisting of a steel plate bolted to side of lintel; equip plate with permanently attached, threaded, mounting pins and steel-angle or -plate retaining strip attached to plate with wing nuts.
   OR
   Consisting of steel pipe attached to side of lintel by manufacturer's standard, winged-U-type suspension brackets.
   OR
   Consisting of a rigid, vinyl wall-mounting unit bolted to side of lintel above opening; equip unit with a similarly formed, rigid, vinyl retainer attached to unit with wing nuts.

Q. General Finish Requirements
1. Finish loading dock equipment after assembly and testing.

R. Steel Finishes
1. Galvanizing: Hot-dip galvanize components as indicated to comply with the following:
   a. ASTM A 123/A 123M for iron and steel loading dock equipment.
   b. ASTM A 153/A 153M or ASTM F 2329 for iron and steel hardware for loading dock equipment.
2. Galvanized-Steel and Steel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat in manufacturer's standard color.

1.3 EXECUTION

A. Preparation
1. Coordinate size and location of loading dock equipment indicated to be attached to or recessed into concrete or masonry, and furnish anchoring devices with templates, diagrams, and instructions for their installation.
2. Set curb angles in concrete edges of dock-leveler recessed pits with tops flush with loading platform. Fit exposed connections together to form hairline joints.
3. Set curb angles in concrete edges of truck-leveler recessed pits with tops flush with driveway. Fit exposed connections together to form hairline joints.
4. Place self-forming pan system for recessed dock **OR** edge-of-dock, **as directed**, levelers in proper relation to loading platform before pouring concrete.
5. Clean recessed pits of debris.

B. Installation
1. General: Install loading dock equipment, including motors, pumps, control stations, wiring, safety devices, light-communication systems, and accessories as required for a complete installation.
   a. Rough-in electrical connections according to requirements specified in Division 15..
2. Recessed Dock Levelers: Attach dock levelers securely to loading dock platform, flush with adjacent loading dock surfaces and square to recessed pit.
3. Edge **OR** Top, **as directed**,-of-Dock Levelers: Attach dock levelers to loading dock platform in a manner that complies with requirements indicated for arrangement and position relative to top of platform.

a. Weld anchor holes in contact with continuous embedded loading dock edge channel. Weld or bolt bumper blocks to face of loading dock.

4. Truck Levelers: Attach truck levelers securely to driveway construction with expansion anchors and bolts.
5. Truck Restraints: Attach truck restraints in a manner that complies with requirements for arrangement and height required for device to engage vehicle rear-impact guard. Interconnect control panel and signals with dock leveler, **as directed**.
   a. Wall-Mounted Units: Weld truck restraints to steel curb angle **OR** edge channel **OR** mounting plate, **as directed**, embedded in loading dock edge.
   b. Wall-Mounted Units: Anchor truck restraints to face of loading dock with expansion anchors and bolts.
   c. Driveway-Mounted Units: Anchor truck restraints to driveway with expansion anchors and bolts.
   d. Pit-Mounted Units: Anchor truck restraints to concrete pit with expansion anchors and bolts.
6. Dock Bumpers: Attach dock bumpers to face of loading dock in a manner that complies with requirements indicated for spacing, arrangement, and position relative to top of platform and anchorage.
   a. Welded Attachment: Plug-weld anchor holes in contact with steel inserts and fillet weld at other locations.
   b. Bolted Attachment: Attach dock bumpers to preset anchor bolts embedded in concrete or to cast-in-place inserts or threaded studs welded to embedded-steel plates or angles. If preset anchor bolts, cast-in-place inserts, or threaded studs welded to embedded-steel plates or angles are not provided, attach dock bumpers by drilling and anchoring with expansion anchors and bolts.
   c. Screw Attachment: Attach dock bumpers to wood construction with lag bolts as indicated.
7. Dock Lifts: Attach dock lifts securely to loading platform **OR** floor of recessed pit **OR** surface of driveway, **as directed**.
8. Dock Seals: Attach dock-seal support frames securely to building structure in proper relation to openings, dock bumpers, and dock levelers to ensure compression of dock seals when trucks are positioned against dock bumpers.
9. Dock Shelters: Attach dock shelters securely to building structure in proper relation to openings, dock bumpers, and dock levelers to ensure an effective seal of dock-shelter curtains with sides and top of truck body when trucks are positioned against dock bumpers.
10. Transparent-Strip Door Curtains: Attach door-curtain mounting system to lintel with screw anchors or toggle bolts. Mount curtain strips to achieve overlap indicated.

C. Adjusting
1. Adjust loading dock equipment to function smoothly and safely, and lubricate as recommended by manufacturer.
2. Test dock levelers and lifts for vertical travel within operating range indicated.
3. After completing installation of exposed, factory-finished loading dock equipment, inspect exposed finishes and repair damaged finishes.

END OF SECTION 11161

Task	Specification	Specification Description
11162	11161	Loading Dock Equipment
11163	11161	Loading Dock Equipment
11167	11161	Loading Dock Equipment
11168	11161	Loading Dock Equipment

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SECTION 11191 - DETENTION FURNITURE

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for detention furniture. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section Includes:
a. Gun lockers.
b. Security key cabinets.
c. Detention bunks.
d. Detention mattresses.
e. Detention desks.
f. Detention tables.
g. Detention seating.

C. Submittals
1. Product Data: For each type of product indicated.
2. LEED Submittal:
a. Product Data for Credit EQ 4.1: For security sealants, including printed statement of VOC content.
3. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
4. Samples: For factory-applied color finishes.
5. Samples for Verification:
a. Furniture: Full-size units. Approved Samples may become part of the completed Work.
b. Detention Mattresses: Not less than 6 inches (152 mm) square by full depth, including core and cover fabric.
6. Welding certificates.
7. Product certificates.
8. Maintenance data.
9. Other Informational Submittals:
a. Field quality-control reports documenting inspections of installed products.
b. Field quality-control certification signed by Contractor and Detention Specialist, **as directed**.

D. Quality Assurance
1. Welding Qualifications: Qualify procedures and personnel according to the following:
a. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
b. AWS D1.3, "Structural Welding Code - Sheet Steel."
c. AWS D1.6, "Structural Welding Code - Stainless Steel."
2. Preinstallation Conference: Conduct conference at Project site.

E. Delivery, Storage And Handling
1. Detention Mattresses: Deliver wrapped to provide protection during transit and Project-site storage. Protect from contact with moisture.

1.2 PRODUCTS

A. Materials

1. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, CS (Commercial Steel), Type B; suitable for exposed applications.
3. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, CS (Commercial Steel), Type B; free of scale, pitting, or surface defects; pickled and oiled.
4. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666 or ASTM A 240/A 240M, austenitic stainless steel, Type 304.
5. Steel Tubing: ASTM A 513, Type B unless otherwise indicated; thickness indicated or required by structural loads.
6. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless another weight is indicated or required by structural loads.
7. Concealed Bolts: ASTM A 307, Grade A unless otherwise indicated.
8. Cast-in-Place Anchors in Concrete: Fabricated from corrosion-resistant materials capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency; of type indicated below.
   a. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed; hot-dip galvanized per ASTM A 153/A 153M or ASTM F 2329.
9. Embedded Plate Anchors: Fabricated from steel shapes and plates, minimum 3/16 inch (4.8 mm) thick; with minimum 1/2-inch- (12.7-mm-) diameter headed studs welded to back of plate.
10. Proprietary Built-in Masonry Anchors: Fabricated from 0.134-inch (3.42-mm) nominal-thickness steel sheet **OR** 1/4-inch (6-mm) nominal-thickness steel plate **OR** 1/2-inch (12.7-mm) nominal-thickness steel plate, **as directed**, into 6-inch- (152-mm-) **OR** 8-inch- (203-mm-), **as directed**, deep blocks matching size of concrete masonry units; with weld nuts attached on inside to receive field-bolted attachments, **as directed**.
    a. Finish: Factory primed for field painting for anchors with field-welded attachments **OR** Polyester powder coat for anchors with bolted attachments **OR** Epoxy paint for anchors with bolted attachments, **as directed**.
11. Welding Rods and Bare Electrodes: Select according to AWS specifications.

B. Security Sealants
1. Manufacturer's standard, high-modulus, nonsag, two-part, pick-proof, epoxy sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), recommended for sealing nonmoving interior joints in security applications.

C. Security Fasteners
1. Fasteners operable only by tools produced by fastener manufacturer or other licensed fabricator for use on specific type of fastener.
2. Provide drive-system type, head style, material, and protective coating as required for assembly, installation, and strength, and as follows:
   a. Drive-System Type: Pinned Torx-Plus **OR** Pinned Torx, **as directed**.
   b. Fastener Strength: 120,000 psi (827 MPa).
   c. Socket Button Head Fasteners:
      1) Heat-treated alloy steel, ASTM F 835 (ASTM F 835M).
      2) Stainless steel, ASTM F 879 (ASTM F 879M), Group 1 CW.
   d. Socket Flat Countersunk Head Fasteners:
      1) Heat-treated alloy steel, ASTM F 835 (ASTM F 835M).
      2) Stainless steel, ASTM F 879 (ASTM F 879M), Group 1 CW.
   e. Socket Head Cap Fasteners:
      1) Heat-treated alloy steel, ASTM A 574 (ASTM A 574M).
      2) Stainless steel, ASTM F 837 (ASTM F 837M), Group 1 CW.
   f. Protective Coatings for Heat-Treated Alloy Steel:
      1) Zinc and clear trivalent chromium where indicated.
      2) Zinc phosphate with oil, ASTM F 1137, Grade I, or black oxide unless otherwise indicated.

D. Gun Lockers
1. Pistol Lockers:
a. Cabinet: Minimum 20 inches (508 mm) wide by 15 inches (381 mm) high by 10 inches (254 mm) deep; formed from 0.134-inch (3.42-mm) **OR** 0.075-inch (1.90-mm), **as directed**, nominal-thickness steel sheet. Line each compartment with mothproofed felt or nonabsorbing, closed-cell padding.
1) Compartments: Six.
b. Doors: Formed from same material as cabinet, supported by heavy-duty continuous bottom hinge.
c. Locks: Snap **OR** Cylinder, **as directed**, type, keyed differently and master keyed, **as directed**; provide one lock for each compartment.
d. Mounting: Surface **OR** Recessed, with mounting flange formed from same material as body, **as directed**.
e. Finish: Factory primed for field painting **OR** Baked enamel or powder coat, **as directed**.
2. Tilt-Out, Pistol Locker:
a. Cabinet: Minimum 39 inches (991 mm) wide by 15 inches (381 mm) high by 6 inches (152 mm) deep; formed from 0.134-inch (3.42-mm) **OR** 0.075-inch (1.90-mm), **as directed**, nominal-thickness steel sheet. Line each compartment with mothproofed felt or nonabsorbing, closed-cell padding.
1) Compartments: Six.
b. Doors: Formed from same material as cabinet, supported by heavy-duty continuous bottom hinge, with attached tilt-out compartment with formed metal sides.
c. Locks: Snap **OR** Cylinder, **as directed**, type, keyed differently and master keyed, **as directed**; provide one lock for each compartment.
d. Mounting: Surface **OR** Recessed, with mounting flange formed from same material as body, **as directed**.
e. Finish: Factory primed for field painting **OR** Baked enamel or powder coat, **as directed**.

E. Security Key Cabinets
1. Cabinet: Minimum 16 inches (406 mm) wide by 24 inches (610 mm) high by 6-1/2 inches (165 mm) deep; formed from 0.134-inch (3.42-mm) nominal-thickness steel sheet. Provide 0.060-inch (1.52-mm) nominal-thickness, steel sheet interior panels, supported on pivots, for mounting 150 **OR** 300, **as directed**, paracentric or mogul keys.
2. Doors: Formed from same material as cabinet, supported by heavy-duty continuous side hinge welded to cabinet and door; with tumbler deadlock.
3. Cross-Index System: Set up by key control manufacturer; include labels, two sets of key tags with self-locking key holders, key-gathering envelopes, temporary and permanent markers, and the following:
a. Card Index: Furnish four sets of index cards for recording key information. Include three receipt forms for each key-holding hook.
b. Computer Software: Furnish cross-index software for recording and reporting key-holder listings, tracking keys and lock and key history, and printing receipts for transactions. Include instruction manual.
4. Finish: Factory primed for field painting **OR** Baked enamel or powder coat, **as directed**.

F. Detention Bunks
1. Freestanding Single Bunks:
a. Bunk Pan: Formed from 0.134-inch (3.42-mm) **OR** 0.105-inch (2.66-mm), **as directed** nominal-thickness steel sheet, perforated with at least six holes, **as directed**.
1) Size: Minimum 27 inches (689 mm) wide by 76 inches (1930 mm) long with bunk pan 14 inches (356 mm) above floor.
2) Turn up edges of back and sides and turn down edge of front **OR** back, sides, and front, **as directed**, with minimum 2-inch (51-mm) flanges.
b. Drawer: Minimum 21 inches (533 mm) wide by 24 inches (610 mm) deep by 5 inches (127 mm) high, with full-width integral pull formed from steel sheet **OR** solid-steel bar pull, **as directed**; formed from 0.134-inch (3.42-mm) nominal-thickness steel sheet.

c. Legs and Frames: Formed from 2-by-2-by-3/16-inch (51-by-51-by-4.8-mm) steel angle welded at connections to each other and to bunk pan; provide four legs for each bunk.
d. Mounting Plates: Formed from 1/4-inch- (6-mm-) thick steel plate punched with one hole for floor anchorage; provide one mounting plate for each leg.
e. Finish: Factory primed for field painting **OR** Baked enamel or powder coat, **as directed**.

2. Freestanding Double Bunks:
   a. Bunk Pan: Formed from 0.134-inch (3.42-mm) **OR** 0.105-inch (2.66-mm), **as directed**, nominal-thickness steel sheet, each pan perforated with at least six holes, **as directed**.
      1) Size: Minimum 27 inches (689 mm) wide by 76 inches (1930 mm) long with lower bunk pan 14 inches (356 mm) above floor and upper bunk pan at least 49 inches (1245 mm) above floor.
      2) Upper and Lower Bunks: Turn up edges of back and sides and turn down edge of front **OR** back, sides, and front, **as directed**, with minimum 2-inch (51-mm) flanges.
      3) Upper Bunk: Turn up edges of back and sides and turn down edge of front **OR** back, sides, and front, **as directed**, with minimum 2-inch (51-mm) flanges.
      4) Lower Bunk: Turn up edges of back and sides and turn down edge of front, with minimum 2-inch (51-mm) flanges.
   b. Drawers: Two; minimum 21 inches (533 mm) wide by 24 inches (610 mm) deep by 5 inches (127 mm) high, with full-width integral pull formed from steel sheet **OR** solid-steel bar pull, **as directed**; formed from 0.134-inch (3.42-mm) nominal-thickness steel sheet.
   c. Legs and Frames: Formed from 2-by-2-by-3/16-inch (51-by-51-by-4.8-mm) steel angle welded at connections to each other and to bunk pan; provide four legs for each bunk.
   d. Mounting Plates: Formed from 1/4-inch- (6-mm-) thick steel plate punched with one hole for floor anchorage; provide one mounting plate for each leg.
   e. Assembly: Factory assembled **OR** Knocked down for field assembly, **as directed**.
   f. Finish: Factory primed for field painting **OR** Baked enamel or powder coat, **as directed**.
3. Wall-Mounted Bunks:
   a. Bunk Pan: Formed from 0.134-inch (3.42-mm) **OR** 0.105-inch (2.66-mm), **as directed**, nominal-thickness steel sheet, perforated with at least six holes, **as directed**.
      1) Size: Minimum 27 inches (689 mm) wide by 76 inches (1930 mm) long with bunk pan 2 inches (51 mm) from wall.
      2) Turn up edges of back and sides and turn down edge of front **OR** back, sides, and front, **as directed**, with minimum 2-inch (51-mm) flanges.
   b. Drawer: Minimum 21 inches (533 mm) wide by 24 inches (610 mm) deep by 5 inches (127 mm) high, with full-width integral pull formed from steel sheet **OR** solid-steel bar pull, **as directed**; formed from 0.134-inch (3.42-mm) nominal-thickness steel sheet.
   c. Combination End Panel/Mounting Plate: Formed from 3/16-inch- (0.048-mm-) thick steel sheet welded at connections to bunk pan, with 2-inch (51-mm) flange for wall mounting; provide two end panel/mounting plates for each bunk.
   d. Finish: Factory primed for field painting **OR** Baked enamel or powder coat, **as directed**.

G. Detention Mattresses
1. General: Comply with 16 CFR 1632 and California Technical Bulletin 121 as determined by testing identical products by a testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
2. Core: Fire-resistive solid foam **OR** Fire-resistive densified polyester **OR** Cotton, with 10 percent boric acid treatment, tufted to nylon netting to retain shape, **as directed**.
3. Cover Fabric: Vinyl bonded to nylon scrim; with a minimum total weight of 10 oz./sq. yd. (339 g/sq. m). Fabricate cover of four-corner box construction with seams facing inside of detention mattress except end closing seam located at foot of mattress; sew with nylon thread in a double-lock stitch.
4. Thickness: 4 inches (102 mm) **OR** 6 inches (152 mm), **as directed**.

H. Detention Desks

1. Single-Seat, Floor-Mounted Desks:
   a. Desk Top: Formed from 0.134-inch (3.42-mm) nominal-thickness steel **OR** 0.105-inch (2.66-mm) nominal-thickness steel **OR** 0.141-inch- (3.57-mm-) thick, stainless-steel **OR** 0.062-inch- (1.59-mm-) thick, stainless-steel, **as directed**, sheet, with minimum 1-1/2-inch (38-mm) flanged edges.
   b. Pedestal: Provide two storage shelves with sides and shelves formed from 0.134-inch (3.42-mm) nominal-thickness steel.
   c. Legs: Formed from 1-1/2-inch-square by 3/16-inch- (38-mm-square by 4.8-mm-) thick steel tubing welded to desk top and mounting plate for an overall desk height of not less than 30 inches (762 mm).
   d. Seat: 12-inch (305-mm) diameter, formed from 0.134-inch (3.42-mm) nominal-thickness steel **OR** 0.075-inch (1.90-mm) nominal-thickness steel **OR** 0.141-inch- (3.57-mm-) thick, stainless-steel **OR** 0.062-inch- (1.59-mm-) thick, stainless-steel, **as directed**, sheet; reinforced with 0.134-inch (3.42-mm) nominal-thickness steel sheet, with minimum 1-1/2-inch (38-mm) flanged edges.
   e. Swivel Seat Support: Formed from 1-by-2-by-0.075-inch (25-by-51-by-1.90-mm) nominal-thickness steel tubing, 2-inch-OD-by-0.075-inch (51-mm-OD-by-1.90-mm) nominal-thickness steel tubing, or 3/8-inch- (9.5-mm-) thick, steel plate bar; with 1/2-inch (12.7-mm) pivot pin welded to legs.
   f. Towel Bar: Formed from 1/4-by-1-1/2-inch (6-by-38-mm) steel **OR** stainless-steel, **as directed**, plate, mounted on one side of desk.
   g. Mounting Plates: Formed from 1/4-inch- (6-mm-) thick steel plate punched with one hole for floor anchorage; provide one mounting plate for each leg.
   h. Steel Finish: Factory primed for field painting **OR** Baked enamel or powder coat, **as directed**.
   i. Stainless-Steel Finish: No. 3.
      1) Size: Minimum 36 inches (914 mm) wide by 15-1/2 inches (381 mm) deep.
2. Wall-Mounted Desk and Seat:
   a. Desk: Formed from 0.134-inch (3.42-mm) nominal-thickness steel **OR** 0.141-inch- (3.57-mm-) thick, stainless-steel, **as directed**, sheet, with minimum 1-1/2-inch (38-mm) flanged edges.
      1) Size: Minimum 12 inches (305 mm) wide by 18 inches (457 mm) deep **OR** 18 inches (457 mm) wide by 18 inches (457 mm) deep **OR** 24 inches (610 mm) wide by 18 inches (457 mm) deep **OR** 30 inches (762 mm) wide by 20 inches (508 mm) deep, **as directed**.
   b. Seat: Minimum 12 inches (305 mm) wide by 16 inches (406 mm) **OR** 18 inches (457 mm), **as directed**, deep; formed from 0.134-inch (3.42-mm) nominal-thickness steel **OR** 0.141-inch- (3.57-mm-) thick, stainless-steel, **as directed**, sheet, with minimum 1-1/2-inch (38-mm) flanged edges.
   c. Steel Finish: Factory primed for field painting **OR** Baked enamel or powder coat, **as directed**.
   d. Stainless-Steel Finish: No. 3.

I. Detention Tables
1. Pedestal-Style Table:
   a. Tabletop: Formed from 0.134-inch (3.42-mm) nominal-thickness steel **OR** 0.105-inch (2.66-mm) nominal-thickness steel **OR** 0.109-inch- (2.78-mm-) thick, stainless-steel **OR** 0.078-inch- (1.98-mm-) thick, stainless-steel **OR** 0.062-inch- (1.59-mm-) thick, stainless-steel, **as directed**, sheet; reinforced with steel shapes or steel plate, with minimum 1-1/2-inch (38-mm) flanged edges.
      1) Size: Minimum 30 inches (762 mm) **OR** 40 inches (1016 mm), **as directed**, wide by length required for capacity by 30 inches (762 mm) **OR** 35 inches (889 mm), **as directed**, high.
      2) Game Top: Engrave, or otherwise integrally incorporate, checkerboard into tabletop.

b. Seats: 12-inch (305-mm) diameter, formed from 0.105-inch (2.66-mm) nominal-thickness steel **OR** 0.075-inch (1.90-mm) nominal-thickness steel **OR** 0.078-inch- (1.98-mm-) thick, stainless-steel **OR** 0.062-inch- (1.59-mm-) thick, stainless-steel, **as directed**, sheet; reinforced with 0.134-inch (3.42-mm) nominal-thickness steel plate, with minimum 1-1/2-inch (38-mm) flanged edges.

c. Pedestal Supports: Formed from 3-inch-square by 3/16-inch- (76-mm-square by 4.8-mm-) **OR** 4-inch-square by 0.134-inch- (102-mm-square by 3.42-mm-), **as directed**, thick steel tubing welded to top and base plate. Provide two pedestals for tables with capacity of more than four persons.

d. Seat Framing: Formed from 3-inch-square by 0.134-inch- (76-mm-square by 3.42-mm-) **OR** 3-by-2-by-3/16-inch- (76-by-51-by-4.8-mm-), **as directed**, thick steel tubing welded to pedestal supports.

e. Base Plate: Minimum 16-inch- (406-mm-) square, 1/4-inch- (6-mm-) thick steel plate punched with four holes for floor anchorage.

f. Capacity: Four persons **OR** Six persons **OR** Eight persons **OR** As indicated on Drawings, **as directed**.

g. Steel Finish: Factory primed for field painting **OR** Baked enamel or powder coat, **as directed**.

h. Stainless-Steel Finish: No. 3.

2. Bench-Style Table:

a. Tabletop: Formed from 0.134-inch (3.42-mm) nominal-thickness steel **OR** 0.105-inch (2.66-mm) nominal-thickness steel **OR** 0.109-inch- (2.78-mm-) thick, stainless-steel, **as directed**, sheet; reinforced with steel channel frame or steel plate, with minimum 1-1/2-inch (38-mm) flanged edges.

1) Size: Minimum 24 inches (610 mm) wide by length required for capacity by 30 inches (762 mm) **OR** 35 inches (889 mm), **as directed**, high.

b. Benches: 12 inches (305 mm) deep by length of tabletop, formed from 0.134-inch (3.42-mm) nominal-thickness steel **OR** 0.105-inch (2.66-mm) nominal-thickness steel **OR** 0.109-inch- (2.78-mm-) thick, stainless-steel **OR** 0.062-inch- (1.59-mm-) thick, stainless-steel, **as directed**, sheet, with minimum 1-1/2-inch (38-mm) flanged edges.

c. Vertical Supports: Formed from 8-inch (203-mm) hot-rolled steel channels or 0.164-inch- (4.18-mm-) thick, formed-steel channels; braced and welded, with steel base plates punched for floor anchorage. Provide three supports for tables with capacity of more than four persons.

d. Bench Supports: Formed from 2-by-2-1/2-by-1/4-inch- (51-by-64-by-6-mm-) thick steel angle or 2-inch-square by 1/4-inch- (51-mm-square by 6-mm-) thick steel tubing; welded to vertical supports.

e. Floor Anchor: Formed from steel angle punched for floor anchorage.

f. Capacity: Four persons **OR** Six persons **OR** Eight persons **OR** As indicated on Drawings, **as directed**.

g. Steel Finish: Factory primed for field painting **OR** Baked enamel or powder coat, **as directed**.

h. Stainless-Steel Finish: No. 3.

J. Detention Seating

1. Floor-Mounted Stool:

a. Seats: Minimum 12-inch (305-mm) diameter, formed from 0.134-inch (3.42-mm) nominal-thickness steel **OR** 0.075-inch (1.90-mm) nominal-thickness steel **OR** 0.125-inch- (3.18-mm-) thick, stainless-steel **OR** 0.062-inch- (1.59-mm-) thick, stainless-steel, **as directed**, sheet; reinforced with 0.134-inch- (3.42-mm-) thick steel sheet cut to interior dimension of seat, with minimum 1-1/2-inch (38-mm) flanged edges.

b. Seat Support: Formed from steel pipe or 2-inch-OD-by-0.075-inch- (51-mm-OD-by-1.90-mm-) thick steel tubing welded to seat reinforcement and base plate for an overall stool height of not less than 18 inches (457 mm).

c. Base Plate: Minimum 6-by-1/4-inch- (152-by-6-mm-) thick, square **OR** round, **as directed**, steel punched with four holes for floor anchorage.
d. Steel Finish: Factory primed for field painting **OR** Baked enamel or powder coat, **as directed**.
e. Stainless-Steel Finish: No. 3.

2. Wall-Mounted Stool:
   a. Seat: Minimum 12-inch (305-mm) diameter, formed from 0.134-inch (3.42-mm) nominal-thickness steel **OR** 0.075-inch (1.90-mm) nominal-thickness steel **OR** 0.125-inch- (3.18-mm-) thick, stainless-steel **OR** 0.078-inch- (1.98-mm-) thick, stainless-steel, **as directed**, sheet; reinforced with 0.134-inch- (3.42-mm-) thick steel sheet cut to interior dimension of seat, with minimum 1-1/2-inch (38-mm) flanged edges.
   b. Seat Support: Formed from 1-by-2-by-0.075-inch- (25-by-51-by-1.90-mm-) thick steel tubing, 2-inch-OD-by-0.075-inch- (51-mm-OD-by-1.90-mm-) thick steel tubing or 3/8-inch- (9.5-mm-) thick, steel plate bar; welded to seat reinforcement and wall bracket.
   c. Swivel Wall Bracket: Minimum 1/2-inch (12.7-mm) pivot pin, with 3/8-inch- (9.5-mm-) thick steel plate for welding to embedded steel plate **OR** for welding to steel wall **OR** punched with four holes for wall anchorage, **as directed**.
   d. Steel Finish: Factory primed for field painting **OR** Baked enamel or powder coat, **as directed**.
   e. Stainless-Steel Finish: No. 3.
3. Floor-Mounted Bench:
   a. Bench Top: Formed from 0.134-inch (3.42-mm) nominal-thickness steel **OR** 0.105-inch (2.66-mm) nominal-thickness steel **OR** 0.141-inch- (3.57-mm-) thick, stainless-steel **OR** 0.109-inch- (2.78-mm-) thick, stainless-steel, **as directed**, sheet, with minimum 1-1/2-inch (38-mm) flanged edges.
      1) Size: Minimum 12 inches (305 mm) deep by 48 inches (1219 mm) **OR** 60 inches (1524 mm) **OR** 72 inches (1829 mm) **OR** 96 inches (2438 mm), **as directed**, long.
   b. Supports: Formed from 0.164-inch- (4.18-mm-) thick, formed-steel channels 2-1/2-inch-OD-by-0.0677-inch- (64-mm-OD-by-1.7-mm-) thick steel tubing; welded to bench and base plate for an overall bench height of not less than 18 inches (457 mm). Provide three supports for benches with length of more than 72 inches (1829 mm).
   c. Base Plates: Minimum 8-inch-square by 1/4-inch- (203-mm-square by 6-mm-) thick steel plate punched with four holes for floor anchorage.
   d. Capacity: Four persons **OR** Six persons **OR** Eight persons **OR** As indicated on Drawings, **as directed**.
   e. Steel Finish: Factory primed for field painting **OR** Baked enamel or powder coat, **as directed**.
   f. Stainless-Steel Finish: No. 3.

K. Fabrication
1. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
2. Coordinate dimensions and attachment methods of detention furniture with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.
3. Shear and punch metals cleanly and accurately. Remove burrs.
4. Form and grind edges and corners to be free of sharp edges or rough areas.
   a. Fabricate detention furniture with no more than 1/32-inch (0.8-mm) gap between component materials. Weld edges that cannot be crimped to meet tolerance so as to provide a seamless joint with no place for concealment of contraband.
5. Form metal in maximum lengths to minimize joints. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.
6. Weld corners and seams continuously to comply with referenced AWS standard and the following:

a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
b. Obtain fusion without undercut or overlap.
c. Remove welding flux immediately.
d. Finish exposed welds and surfaces smooth and blended at exposed connections so that no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
e. Weld before finishing components to greatest extent possible. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

7. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure detention furniture rigidly in place and to support expected loads. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce formed-metal units as needed to attach and support other construction.
8. Cut, reinforce, drill, and tap detention furniture as indicated to receive hardware, security fasteners, and similar items.
9. Form exposed work true to line and level with accurate angles, surfaces, and straight sharp edges.
10. Form exposed connections with hairline joints, flush and smooth using concealed fasteners where possible. Use exposed security fasteners of type indicated or, if not indicated, flat-head (countersunk) security fasteners. Locate joints where least conspicuous.
11. Attach drawer slides **OR** shelves, **as directed**, to furniture by welding **OR** with security fasteners, **as directed**.

L. Steel Finishes
1. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning" or SSPC-SP 8, "Pickling". After cleaning, apply a conversion coating suited to the organic coating to be applied over it.
2. Factory Prime Finish: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
3. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).
a. Color and Gloss: As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.

M. Stainless-Steel Finishes
1. General: Remove tool and die marks and stretch lines or blend into finish. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
2. Intermediate Polish Finish: No. 3 unless otherwise indicated.
3. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

1.3 EXECUTION

A. Installation
1. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing detention furniture to in-place construction. Include threaded fasteners for concrete and masonry inserts, security fasteners, and other connectors.
2. Cutting, Fitting, and Placement: Obtain manufacturer's written approval for cutting, drilling, and fitting required for installing detention furniture. Set detention furniture accurately in location,

alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

3. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry or similar construction.
4. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
5. Field Welding: Comply with the following requirements:
   a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   b. Obtain fusion without undercut or overlap.
   c. Remove welding flux immediately.
   d. Finish exposed welds and surfaces smooth and blended at exposed connections so that no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
   e. Fillet Welds: Minimum size of 1/8 inch by 1-1/2 inches (3 mm by 38 mm) long, spaced not greater than 12 inches (305 mm) o.c. Fill spaces between welds with security sealant **OR** auto body filler, **as directed**, where weld is exposed.
      OR
      Fillet Welds: Continuous.
6. Adjust doors and latches of detention gun lockers and key cabinets to operate easily without binding. Verify that integral locking devices operate properly.
7. Assemble detention furniture requiring field assembly with security fasteners with no exposed fasteners on exposed faces and frames.
8. Anchor furniture with security fasteners **OR** by welding **OR** as indicated on Drawings, **as directed**, to floors and walls at intervals required by expected loads, but not more than 12 inches (305 mm) o.c.
   a. Install anchors through backup reinforcing plates where necessary to avoid metal distortion.
   b. Use security fasteners with head styles appropriate for installation requirements, strength, and finish of adjacent materials, except that a maximum of two different sets of tools shall be required to operate security fasteners for Project. Provide stainless-steel security fasteners in painted materials.
   c. Weld nuts onto cast-in-place anchors after installation so as to be nonremovable.
9. Apply security sealant **OR** auto body filler, **as directed**, at all exposed gaps between detention furniture and adjacent construction greater than 1/16 inch (1.6 mm).
10. Install one detention mattress for each detention bunk.

B. Field Quality Control
   1. Detention Specialist shall inspect **OR** Inspect, **as directed**, installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.
   2. Prepare field quality-control certification endorsed by Detention Specialist, **as directed**, that states installed products and their installation comply with requirements in the Contract Documents.

C. Cleaning And Protection
   1. Touchup Painting: Immediately after erection, clean bolted connections and abraded areas of shop paint, and paint exposed areas with same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

END OF SECTION 11191

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Task	Specification	Specification Description
11191	08320a	Detention Doors And Frames
11191	08710a	Detention Door Hardware

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SECTION 11410 - FOOD SERVICE EQUIPMENT

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for food service equipment. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section Includes:
a. Fabricated equipment.
b. Food waste machines.
c. Cooking equipment.
d. Self-contained refrigeration equipment.
e. Walk-in refrigeration equipment.
f. Powered food-preparation equipment.
g. Warewashing equipment.
h. Serving equipment.
i. Utility distribution systems.
2. Owner-Furnished Equipment: Where indicated, Owner will furnish equipment for installation by Contractor.

C. Submittals
1. Product Data: For each type of product indicated. Include the following:
a. Manufacturer's model number.
b. Accessories and components that will be included for Project.
c. Clearance requirements for access and maintenance.
d. Utility service connections for water, drainage, power, and fuel; include roughing-in dimensions.
2. Shop Drawings: For fabricated equipment. Include plans, elevations, sections, roughing-in dimensions, fabrication details, utility service requirements, and attachments to other work.
3. Samples: For each factory-applied color finish required, in manufacturer's standard sizes.
4. Coordination Drawings: For foodservice facilities.
a. Indicate locations of foodservice equipment and connections to utilities.
b. Key equipment using same designations as indicated on Drawings.
c. Include plans and elevations; clearance requirements for equipment access and maintenance; details of equipment supports; and utility service characteristics.
d. Include details of seismic bracing for equipment.
5. Operation and Maintenance Data: For foodservice equipment to include in emergency, operation, and maintenance manuals. Include the following:
a. Product Schedule: For each foodservice equipment item, include the following:
1) Designation indicated on Drawings.
2) Manufacturer's name and model number.
3) List of factory-authorized service agencies including addresses and telephone numbers.
6. Warranty: Samples of special warranty.

D. Quality Assurance
1. NSF Standards: Provide equipment that bears NSF Certification Mark or UL Classification Mark certifying compliance with applicable NSF standards.
2. BISSC Standards: Provide bakery equipment that complies with BISSC/Z50.2.

a. Provide BISSC-certified equipment, with certification verified by a third-party agency, **as directed**.

3. UL Certification: Provide electric and fuel-burning equipment and components that are evaluated by UL for fire, electric shock, and casualty hazards according to applicable safety standards, and that are UL certified for compliance and labeled for intended use.
4. Steam Equipment: Provide steam-generating and direct-steam heating equipment that is fabricated and labeled to comply with ASME Boiler and Pressure Vessel Code.
5. Regulatory Requirements: Install equipment to comply with the following:
   a. ASHRAE 15, "Safety Code for Mechanical Refrigeration."
   b. NFPA 54, "National Fuel Gas Code."
   c. NFPA 70, "National Electrical Code."
   d. NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations."
6. Seismic Restraints: Comply with SMACNA's "Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines," Appendix A, "Seismic Restraint Details," unless otherwise indicated.
7. Preinstallation Conference: Conduct conference at Project site.

E. Project Conditions
1. Field Measurements: Verify actual dimensions of construction contiguous with foodservice equipment by field measurements before fabrication. Indicate measurements on Coordination Drawings.

F. Coordination
1. Coordinate foodservice equipment layout and installation with other work, including layout and installation of lighting fixtures, HVAC equipment, and fire-suppression system components.
2. Coordinate locations and requirements of utility service connections.
3. Coordinate sizes, locations, and requirements of the following:
   a. Overhead equipment supports.
   b. Equipment bases.
   c. Floor depressions.
   d. Insulated floors.
   e. Floor areas with positive slopes to drains.
   f. Floor sinks and drains serving foodservice equipment.
   g. Roof curbs, equipment supports, and penetrations.

G. Warranty
1. Refrigeration Compressor Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace compressors that fail in materials or workmanship within specified warranty period.
   a. Failure includes, but is not limited to, inability to maintain set temperature.
   b. Warranty Period: Five years from date of Substantial Completion.

1.2 PRODUCTS

A. Fabricated Equipment
1. Stainless-Steel Sinks:
   a. Description: One **OR** Two **OR** Three **OR** Four, **as directed**,-compartment sink(s). Fabricate units of welded stainless steel, sound deadened.
      1) Bowls: Stainless steel, Type 304, 0.078 inch (1.98 mm) **OR** 0.062 inch (1.59 mm), **as directed**, thick.
      2) Integral Drainboards: Stainless steel, Type 304, 0.078 inch (1.98 mm) **OR** 0.062 inch (1.59 mm), **as directed**, thick.
      3) Body: Stainless steel, Type 304, 0.078 inch (1.98 mm) **OR** Type 304, 0.062 inch (1.59 mm) **OR** Type 430, 0.062 inch (1.59 mm), **as directed**, thick.

a) Back Splash: Manufacturer's standard height **OR** 13 inches (330 mm) **OR** 18 inches (457 mm), **as directed**.
b) Side Splash: Manufacturer's standard height **OR** 13 inches (330 mm) **OR** 18 inches (457 mm), **as directed**.

4) Legs and Feet: Stainless-steel tubing legs with adjustable bullet feet.
5) Accessories:
a) Faucets and Spouts: as directed by the Owner.
b) Prerinse Faucet: as directed by the Owner.
c) Vacuum breaker.
d) Lever waste with **OR** without, **as directed**, overflow.
e) Basket strainer.
f) Continuous waste.
g) Scrap trough.
h) Control bracket for food waste disposer controls.
i) Scrap block and hole.
j) Stainless-steel pot rack.

b. Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, type as indicated.
c. Fabrication: Prepare sink for installation of the following equipment items:
1) Water heater.
2) Food waste disposer; weld disposer cone or collar into sink.
3) Undercounter dishwasher.
d. Stainless-Steel Finish: Directional satin finish, No. 4.

2. Stainless-Steel Tables:
a. Description: Flat-countertop **OR** Prep **OR** Equipment-stand **OR** Mixer-stand **OR** Dish, **as directed**, table.
1) Tops: Stainless steel, Type 304, 0.078 inch (1.98 mm) **OR** Type 304, 0.062 inch (1.59 mm) **OR** Type 430, 0.062 inch (1.59 mm), **as directed**, thick, reinforced and sound deadened.
a) Back Splash: Manufacturer's standard height **OR** 1-1/2 inches (38 mm) **OR** 5 inches (127 mm), **as directed**.
b) Edge: Bullnose on four sides **OR** Bullnose on front edge, straight on sides and back **OR** Marine edge, **as directed**.
2) Welded **OR** Adjustable, **as directed**, Undershelf: Stainless steel, Type 304, 0.050 inch (1.27 mm) thick **OR** Metallic-coated steel, 0.052-inch (1.32-mm) nominal thickness, **as directed**.
3) Crossbracing: Stainless-steel **OR** Metallic-coated steel, **as directed**, tubing, bolted **OR** welded, **as directed**, to legs.
4) Cabinet:
a) Body: Stainless steel, Type 430, 0.050 inch (1.27 mm) thick.
b) Doors: Sliding **OR** Hinged, **as directed**, stainless steel, Type 304, 0.038 inch (0.95 mm) thick.
c) Drawers: Stainless-steel drawer and faceplate **OR** Galvanized-steel drawer and stainless-steel faceplate **OR** Stainless-steel front and liner **OR** Stainless-steel front and galvanized-steel liner, **as directed**.
5) Sink: Stainless steel, Type 304, 0.078 inch (1.98 mm) thick, welded into tabletop and including the following:
a) Faucet and Spout: as directed by the Owner.
b) Vacuum breaker.
c) Leverwaste with **OR** without, **as directed**, overflow.
d) Basket strainer.
e) Tail piece.
6) Legs: Stainless-steel **OR** Metallic-coated steel, **as directed**, tubing.
7) Feet: Stainless-steel adjustable bullets **OR** Plastic adjustable bullets **OR** Stainless-steel, flanged, adjustable bullets **OR** Casters, **as directed**.
8) Accessories:
a) Control panel.

b) Control bracket for food waste disposer controls.
c) Aluminum pan rack slides, six **OR** three, **as directed**, slides each.
d) Urn trough.
e) Spice bins.

b. Materials:
1) Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, type as indicated.
2) Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G90 (Z275) coating.

c. Fabrication: Prepare table for installation of the following equipment items:
1) Food waste disposer; weld disposer cone or collar into sink.
2) Heat lamp.

d. Stainless-Steel Finish: Directional satin finish, No. 4.

3. Stainless-Steel Shelf Units:
a. Description: Table mounted, single deck **OR** Table mounted, double deck **OR** Wall mounted, **as directed**. Fabricate units of stainless steel, Type 304, 0.062 inch (1.59 mm) **OR** Type 304, 0.050 inch (1.27 mm) **OR** Type 430, 0.050 inch (1.27 mm), **as directed**, thick.
b. Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, type as indicated.
c. Stainless-Steel Finish: Directional satin finish, No. 4.

4. Pot Racks:
a. Description: Wall mounted **OR** Ceiling hung **OR** Corner, **as directed**. Fabricate units of stainless steel **OR** painted, cold-rolled steel, **as directed**.
1) Bars: Double **OR** Single, **as directed**.
2) Hooks: 18 per unit.

b. Materials:
1) Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, Type 304.
2) Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.

c. Finishes:
1) Stainless Steel: Directional satin finish, No. 4.
2) Cold-Rolled Steel: Powder-coat painted finish.

5. Stainless-Steel Hand Sinks:
a. Description: Lavatory sink. Fabricate units of stainless steel, Type 304, 0.050 inch (1.27 mm) **OR** 0.038 inch (0.95 mm), **as directed**, thick.
1) Operation: Electronic **OR** Knee valve **OR** Foot pedal **OR** Wrist handle **OR** Handle, **as directed**.
2) Faucet and Spout: as directed by the Owner.
3) Accessories:
a) Chrome-plated tail piece and P trap, NPS 1-1/2 (DN 40), with 0.045-inch (1.1-mm) minimum wall thickness.
b) Strainer basket with metal post.
c) Liquid soap dispenser, splash **OR** deck, **as directed**, mounted.
d) Liquid soap and towel dispenser.
e) Towel dispenser.
f) Tubular wall supports.
g) Skirt assembly for support.
h) Side splashes.

b. Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, type as indicated.
c. Stainless-Steel Finish: Directional satin finish, No. 4.

6. Floor Troughs **OR** Water Receptacles, **as directed**:
a. Description: 4-inch (102-mm) **OR** 2-inch (50-mm), **as directed**, nominal depth excluding tailpiece.
1) Body: Stainless steel, Type 304, 0.078 inch (1.98 mm) thick.
2) Grate: Stainless-steel bar, Type 304 **OR** Fiberglass, **as directed**.

3) Waste Connection: NPS 3 (DN 80).

b. Materials:

1) Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, type as indicated.

2) Stainless-Steel Bars: ASTM A 276, austenitic stainless steel, type as indicated.

c. Stainless-Steel Finish: Directional satin finish, No. 4.

B. Food Waste Machines

1. Food Waste Disposer Units:

a. Description: 3 **OR** 5 **OR** 7, **as directed**, hp, with dual-direction shredding elements, and the following:

1) Stainless-steel **OR** Corrosion-resistant, **as directed**, housing.

2) Flow control.

3) Solenoid valve.

4) Vacuum breaker.

5) Fixed nozzle.

6) Control Panel:

a) Autoreversing and internal timed water flush.

b) Stainless-steel mounting bracket.

7) Prerinse: Backsplash mounted with hot- and cold-water mixing valve and with stainless-steel **OR** corrosion-resistant, **as directed**, exposed metal parts and the following:

a) Wall support bracket.

b) Flexible, 3/8-inch (10-mm) metal-encased hose with a minimum length of 29 inches (737 mm) and supported by spiral spring.

c) Spray-head assembly with lockable lever handle.

8) Accessories:

a) Collar adaptor for sink **OR** trough, **as directed**.

b) Cone with adaptor ring.

i. Size: 12 inches (305 mm) **OR** 15 inches (381 mm) **OR** 18 inches (457 mm), **as directed**.

c) Cone cover in size that matches cone.

d) Silver accumulator.

9) Electrical Service: Equip unit for connection to service indicated on Drawings.

2. Food Waste Pulper and Water Extractor Systems:

a. Description: Stainless-steel pulper unit, extractor unit, and control panel with water-level control and push-button start.

1) Capacity: Not less than 600 lb (272 kg) **OR** 700 lb (318 kg) **OR** 900 lb (408 kg), **as directed**, of waste per hour.

2) Accessories:

a) Feed trough connection.

b) Feed tray.

c) Feed hood assembly.

d) Under-dish-table lid.

e) Remote Water Extractor:

i. Dam, to prevent siphoning of water from pulper tank.

ii. Remote piping system, overhead **OR** below floor, **as directed**.

3) Electrical Service: Equip unit for connection to service indicated on Drawings.

3. Food Waste Grinder and Water Extractor Systems:

a. Description: Stainless-steel construction; with off and on controls on unit, food waste hopper, silver saver, internal disposer, removable water extraction auger with internal water sprays, and discharge chute.

1) Capacity: Not less than 600 lb (272 kg) **OR** 700 lb (318 kg), **as directed**, of waste per hour.

2) Accessories:

a) Reel rinse unit with spray valve.

b) Recirculation water pump.
c) Trough mount.
3) Electrical Service: Equip unit for connection to service indicated on Drawings.
4. Undercounter Food Waste Grinder and Water Extractors:
a. Description: Stainless-steel, undercounter, cleanable assembly including the following:
1) Capacity: Not less than 600 lb (272 kg) **OR** 700 lb (318 kg), **as directed**, of waste per hour.
2) Separate water-extractor and disposer units.
a) Disposer: Corrosion-resistant housing, dual-direction shredding elements.
3) Piping between disposer and water extractor.
4) Vacuum breaker.
5) Solenoid valve.
6) Flow control.
7) Time-delayed relay.
8) Control Panel:
a) Autoreversing and internal timed water flush.
b) Stainless-steel mounting bracket.
9) Prerinse: Backsplash mounted with hot- and cold-water mixing valve and with stainless-steel **OR** corrosion-resistant, **as directed**, exposed metal parts and the following:
a) Wall support bracket.
b) Flexible, 3/8-inch (10-mm) metal-encased hose with a minimum length of 29 inches (737 mm) and supported by spiral spring.
c) Spray-head assembly with lockable lever handle.
10) Accessories:
a) Cone with adaptor ring.
i. Size: 12 inches (305 mm) **OR** 15 inches (381 mm) **OR** 18 inches (457 mm), **as directed**.
b) Cone cover in size that matches cone.
c) Silver sorter.
d) Trough collar connection.
11) Electrical Service: Equip unit for connection to service indicated on Drawings.

C. Cooking Equipment
1. Ranges:
a. Description:
1) Top Configuration:
a) Open-Burner Unit:
i. Standard Burners: Four **OR** Six **OR** Eight **OR** Four, step-up type, **as directed**.
ii. Wok **OR** Saute, **as directed**, Head: as directed by the Owner.
b) Griddle: Flat **OR** Raised, **as directed**.
c) Radiant Broiler: as directed by the Owner.
2) Base Configuration:
a) Standard Oven(s): One **OR** Two, **as directed**.
b) Convection Oven(s): One **OR** Two, **as directed**.
c) Storage Base: One.
3) Accessories:
a) High **OR** Double-deck, **as directed**, back shelf.
b) Stainless-steel sides.
c) Stainless-steel back.
d) Legs for curb base.
e) Toe Base: 4 inches (102 mm) high.
f) Casters: as directed by the Owner.
g) Oven Rack(s): One for each oven.

4) Electrical Service: Equip unit for connection to service indicated on Drawings.
5) Gas Service: Natural **OR** Liquefied propane, **as directed**, gas.

2. Deep Fat Fryers:
   a. Description: Electric fryer, solid-state controls **OR** Electric, programmable computer controls **OR** Gas fryer, **as directed**.
      1) Oil Capacity: 40 lb (18 kg) **OR** 85 lb (39 kg), **as directed**.
      2) Accessories:
         a) Stainless-steel sides.
         b) Stainless-steel fry tank.
         c) Stainless-steel fry tank cover.
         d) Casters: as directed by the Owner.
         e) Automatic basket lifts.
         f) Single Fry Baskets: as directed by the Owner.
         g) Twin Fry Baskets: as directed by the Owner.
         h) Triple Fry Baskets: as directed by the Owner.
         i) Quick gas-service disconnect and flexible hose.
      3) Electrical Service: Equip unit for connection to service indicated on Drawings.
      4) Gas Service: Natural **OR** Liquefied propane, **as directed**, gas.
3. Steam Jacketed Kettles:
   a. Description: Stainless steel, Type 304.
      1) Type: Stationary **OR** Tilting, **as directed**.
      2) Steam Source: Electrically heated, self-contained **OR** Direct, **as directed**.
         a) Maximum **OR** Operating, **as directed**, Steam Pressure: 50 psig (345 kPa) **OR** 25 psig (172 kPa), **as directed**.
      3) Capacity: 10 quarts (9.5 L) **OR** 20 gal. (76 L), **as directed**.
      4) Accessories:
         a) Basket insert.
         b) Lift-off cover.
         c) Single **OR** Double, **as directed**,-pantry water filler.
         d) Tangent Drawoff: 2 inches (50 mm) **OR** 3 inches (76 mm), **as directed**.
         e) Disc Strainer: 1/8 inch (3 mm), perforated **OR** solid, **as directed**.
         f) Interior Finish: Manufacturer's standard **OR** Stainless steel, Type 316, **as directed**.
         g) Cold-water jacket cooling.
         h) Steam trap assemblies.
         i) Kettle brush kit.
      5) Electrical Service: Equip unit for connection to service indicated on Drawings.
   b. Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, type as indicated.
   c. Stainless-Steel Finish: Directional satin finish, No. 4.
4. Ovens:
   a. Description: Electric convection **OR** Gas convection **OR** Rotisserie, **as directed**.
      1) Single deck **OR** Double deck **OR** Single deck with open stand, **as directed**.
      2) Accessories:
         a) Oven Rack(s): One per oven chamber.
         b) Stainless-steel drip pan.
         c) Down-draft flue diverter.
         d) Stacking kit.
      3) Electrical Service: Equip unit for connection to service indicated on Drawings.
      4) Gas Service: Natural **OR** Liquefied propane, **as directed**, gas.
5. Microwave Ovens:
   a. Description: 1200-W cooking power.
      1) Electrical Service: Equip unit with plug and cord for 120-V service.
6. Coffee Urns:
   a. Description: Single **OR** Twin **OR** Triple, **as directed**, urn.
      1) Capacity: 3 gal. (11 L) **OR** 6 gal. (23 L) **OR** 10 gal. (38 L), **as directed**, per liner.
      2) Type: Electric **OR** Gas **OR** Steam, **as directed**, heated.

3) Agitator: Automatic **OR** Push button, **as directed**.
4) Spray Arm: With **OR** Without, **as directed**, bypass.
5) Timer: Digital **OR** Electromechanical, **as directed**.
6) Accessories:
a) Fill/Dispense: as directed by the Owner.
b) Multiple Faucet: as directed by the Owner.
c) Filtering: Permanent, stainless-steel, woven-wire cloth **OR** Disposable filter paper, **as directed**.
d) Finish: Manufacturer's standard **OR** Brass body and trim **OR** Copper body and brass trim, **as directed**.

b. Electrical Service: Equip unit for connection to service indicated on Drawings.
c. Gas Service: Natural **OR** Liquefied propane, **as directed**, gas.
d. Operating Steam Pressure: As indicated on Drawings **OR** As directed.

D. Self-Contained Refrigeration Equipment
1. Refrigerators **OR** Freezers, **as directed**:
a. Description: Reach-in **OR** Roll-in **OR** Pass-through, **as directed**, type.
1) Exterior Finish: Stainless steel.
2) Interior Finish: Stainless steel **OR** Manufacturer's standard, **as directed**.
3) Doors: Full length **OR** Half length **OR** In configuration shown on Drawings, **as directed**.
4) Accessories:
a) Casters.
b) Stainless-steel back with rear louvers.
c) Re-hinging feature for doors.
d) Hinged glass doors and fluorescent fixtures.
e) Tray Slides: For sheet pans.
f) Chrome-Plated **OR** Stainless-Steel, **as directed**, Shelves: Quantity, as directed by the Owner.
g) Loading Rack: as directed by the Owner.
h) Transfer Carriage: as directed by the Owner.
5) Electrical Service: Equip unit with plug and cord for service indicated on Drawings.
2. Undercounter Refrigerators **OR** Freezers, **as directed**:
a. Description: Compact unit with rear-mounted, self-contained refrigeration system.
1) Accessories:
a) Stainless-steel top with backsplash.
b) Stainless-steel back panel.
c) Casters: 6 inches (152 mm) **OR** 4 inches (102 mm) **OR** 3-1/2 inches (89 mm), **as directed**, high.
d) Utility Base: 6 inches (152 mm) high.
e) Shelves: Description and quantity, as directed by the Owner.
f) Stacking kit.
2) Electrical Service: Equip unit with plug and cord for service indicated on Drawings.
3. Merchandiser Refrigeration Units:
a. Description: Curved-glass, self-contained refrigerator **OR** Sliding-glass, self-contained refrigerator **OR** Sliding-glass, self-contained freezer, **as directed**.
1) Exterior Finish: Manufacturer's standard **OR** Stainless steel, **as directed**.
2) Interior Finish: Manufacturer's standard **OR** Stainless steel **OR** White, **as directed**.
3) Accessories:
a) Door locks.
b) Fluorescent Light Fixtures: Quantity, as directed by the Owner.
c) Base: as directed by the Owner.
d) Casters: as directed by the Owner.
e) Legs: as directed by the Owner.
f) Chrome-Plated Shelves: Quantity, as directed by the Owner.

4) Electrical Service: Equip unit with plug and cord for service indicated on Drawings.

4. Ice-Making Machine:
   a. Description: Undercounter **OR** Freestanding, **as directed**, units.
      1) Production: Ice cubes **OR** cubes, dice **OR** cubes, half dice **OR** flakes **OR** chiplets (compacted flake ice), **as directed**.
      2) Capacity: as directed by The Owner per 24-hour period.
      3) Accessories:
         a) Storage Bin: as directed by the Owner..
            i. Stainless-steel stand and legs.
         b) Water filter.
      4) Electrical Service: Equip unit for connection to service indicated on Drawings.

E. Walk-In Refrigeration Equipment
   1. Walk-in Refrigeration Units:
      a. Description: Cooler **OR** Freezer **OR** Two-compartment unit, with cooler and freezer compartments, **as directed**.
         1) Wall and Ceiling Panels: Interlocking insulating panels.
         2) Floors: Insulated floor panels **OR** Field installed; provide manufacturer's standard insulated floor screed, **as directed**.
         3) Doors:
            a) Hinges: Two per door **OR** Self-closing and spring loaded; three per door,. **As directed**.
            b) Latch: Edge-mounted, positive-type latch with cylinder lock.
            c) Include safety-release handle that opens door from inside when door is locked.
         4) Door Accessories:
            a) Vision port.
            b) Pressure relief port.
            c) Threshold: Stainless steel, factory installed.
            d) Anticondensate heater at freezer doors.
         5) Vaporproof Lighting Fixtures: Incandescent fixture with 100-W lamp.
            a) Control: Neon pilot light and toggle switch located on exterior of door panel.
            b) Quantity: One per compartment, located on door panel.
         6) Refrigeration System: Self-contained, mounted on unit **OR** Remote system with preassembled condensing unit and evaporator assemblies.
            a) Exterior Condensing Units: Include winter control, crankcase heater, and enclosed weatherproof housing.
            b) Operating Temperature: as directed by the Owner.
         7) Temperature Monitoring System: Electronic monitoring and remote audible alarm system that warns when temperatures register 10 deg F (6 deg C) above or below set temperature.
         8) Closure Panels and Trim: Include closure panels and trim.
         9) Electrical Service: Equip unit for connection to service indicated on Drawings.
      b. Finishes:
         1) Exposed Exterior Finish: Stucco-patterned aluminum **OR** Smooth, mill-finished aluminum **OR** White-painted aluminum, **as directed**.
         2) Unexposed Exterior Finish: Stucco-patterned, metallic-coated steel.
         3) Interior Finish: Stucco-patterned aluminum **OR** Smooth, mill-finished aluminum **OR** White-painted aluminum, **as directed**.
         4) Closure Panels and Trim: Matched to exposed exterior finish of panels.

F. Powered Food-Preparation Equipment
   1. Mixers **OR** Slicers **OR** Meat Saws **OR** Peelers, **as directed**:
      a. Description: as directed by the Owner.
      b. Accessories: as directed by the Owner.
      c. Electrical Service: Equip unit with plug and cord for service indicated on Drawings.

G. Warewashing Equipment
1. Warewashing Machines:
a. Description: Dishwashing, single tank **OR** Dishwashing, double tank **OR** Dishwashing, rackless conveyor **OR** Dishwashing, with circular conveyor table **OR** Pot and pan washing, two racks **OR OR** Pot and pan washing, one rack, **as directed**.
1) Capacity: as directed by the Owner.
2) Accessories: as directed by the Owner.
3) Electrical Service: Equip unit for connection to service indicated on Drawings.

H. Serving Equipment
1. Modular Counters:
a. Description: Hot food **OR** Refrigerated salad **OR** Ice-cooled salad **OR** Sliding-glass door refrigerated **OR** Frost-top **OR** Sandwich **OR** Pizza **OR** Refrigerated-chest **OR** Dual-temperature **OR** Tray-starter **OR** Storage **OR** Cashier, **as directed**, module.
1) Cabinet Face Panels: Manufacturer's standard.
2) Accessories:
a) Tray slide.
b) Work shelf.
c) Casters.
d) Electrical receptacle.
e) Cam-action latch locks with trigger release to mate with adjoining modular counters.
f) Tempered-glass, food-protector shield.
3) Electrical Service: Equip unit for connection to service indicated on Drawings.
4) Color: As selected from manufacturer's full range.

I. Utility Distribution Systems
1. Utility Distribution Systems:
a. Description: Overhead **OR** Counter **OR** Island **OR** Tray-slide **OR** Steam **OR** Wall-mounted, **as directed**, system.
b. Accessories: as directed by the Owner.

J. Miscellaneous Materials
1. Installation Accessories, General: NSF certified for end-use application indicated.
2. Elastomeric Joint Sealant: ASTM C 920; silicone **OR** urethane, **as directed**. Type S (single component), Grade NS (nonsag), Class 25, Use NT (nontraffic) related to exposure, and Use M, G, A, or O as applicable to joint substrates indicated.
a. Public Health and Safety Requirements:
1) Sealant is certified for compliance with NSF standards for end-use application indicated.
2) Washed and cured sealant complies with the FDA's regulations for use in areas that come in contact with food.
b. Cylindrical Sealant Backing: ASTM C 1330, Type C, closed-cell polyethylene, in diameter greater than joint width.

K. Finishes
1. Stainless-Steel Finishes:
a. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
b. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
1) Run grain of directional finishes with long dimension of each piece.
2) When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2. Powder-Coat Finishes: Immediately after cleaning and pretreating, electrostatically apply manufacturer's standard, baked-polymer, thermosetting powder finish. Comply with resin manufacturer's written instructions for application, baking, and minimum dry film thickness.

1.3 EXECUTION

A. Installation
1. Install foodservice equipment level and plumb, according to manufacturer's written instructions.
   a. Connect equipment to utilities.
   b. Provide cutouts in equipment, neatly formed, where required to run service lines through equipment to make final connections.
2. Complete equipment assembly where field assembly is required.
   a. Provide closed butt and contact joints that do not require a filler.
   b. Grind field welds on stainless-steel equipment until smooth and polish to match adjacent finish.
3. Install equipment with access and maintenance clearances that comply with manufacturer's written installation instructions and with requirements of authorities having jurisdiction.
4. Install cabinets and similar equipment on bases in a bed of sealant.
5. Install closure-trim strips and similar items requiring fasteners in a bed of sealant.
6. Install joint sealant in joints between equipment and abutting surfaces with continuous joint backing unless otherwise indicated. Produce airtight, watertight, vermin-proof, sanitary joints.

B. Cleaning And Protecting
1. After completing installation of equipment, repair damaged finishes.
2. Clean and adjust equipment as required to produce ready-for-use condition.
3. Protect equipment from damage during remainder of the construction period.

C. Demonstration
1. Train Owner's maintenance personnel to adjust, operate, and maintain foodservice equipment.

END OF SECTION 11410

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Task	Specification	Specification Description
11412	11410	Food Service Equipment

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SECTION 11415 - UNIT KITCHENS

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for unit kitchens. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section includes factory-fabricated and -assembled unit kitchens with metal, laminate-clad and wood cabinets, countertops, fixtures, appliances, and accessories.

C. Submittals
1. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, finishes, furnished specialties, and accessories. Include rated capacities, operating characteristics, and utility requirements of appliances.
2. LEED Submittals:
   a. Product Data for Credit EQ 4.4: For composite wood products, documentation indicating that product contains no urea formaldehyde.
   b. Certificates for Credit MR 7: Chain-of-custody certificates certifying that cabinets and countertops comply with forest certification requirements. Include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating costs for each certified wood product.
   c. Product Data for Credit EA 1.4: For appliances, documentation indicating that products are ENERGY STAR rated.
3. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   a. Wiring Diagrams: For power, signal, and control wiring.
4. Samples: For each type of exposed finish required, prepared on Samples of size indicated below:
   a. Metal finish for cabinets and countertops, 8 by 10 inches (200 by 250 mm).
   b. Wood finish for cabinets, 8 by 10 inches (200 by 250 mm).
   c. Plastic laminate for cabinets and countertops, 8 by 10 inches (200 by 250 mm).
   d. Solid surfacing for countertops, 6 inches (150 mm) square.
   e. One full-size unit of each type of exposed hardware.
5. Product Certificates: For each type of unit kitchen, from manufacturer.
6. Manufacturer Certificate: Signed by manufacturer certifying that units comply with requirements.
7. Maintenance Data: For unit kitchen appliances to include in maintenance manuals.
8. Warranty: Sample of special warranty.

D. Quality Assurance
1. Manufacturer Qualifications: A qualified manufacturer that fabricates unit kitchens and their components.
2. Source Limitations: Obtain unit kitchens from single source from single manufacturer.
3. Regulatory Requirements: Where unit kitchens are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines, ICC/ANSI A117.1 and HUD's "Fair Housing Accessibility Guidelines".
4. Forest Certification: Provide cabinets and countertops made from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
5. 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.

a. Built-in Refrigerators: Listed and labeled for recessed installation. Mount label to be visible after installation of unit; include electrical rating, type of refrigerant, and minimum installation clearances.
b. Refrigerated Unit Kitchens and Wet Bars: Listed and labeled for entire unit as a single integrated system. Mount label to be visible after installation of unit; include electrical rating, type of refrigerant, and minimum installation clearances.

6. Wood and Laminate-Clad Cabinet Fabrication Standard:
   a. KCMA A161.1. Provide cabinets with KCMA's "Certified Cabinet" seal affixed to a semiexposed location of each unit and showing compliance with standard.
   b. AWI 400B, Custom grade.
   c. Either fabrication standard above.
7. Appliance Standards:
   a. Refrigerators and Freezers: UL 250 or AHAM ER-1.
   b. Electric Ranges: UL 858 or AHAM HRF-1.
   c. Microwave Ovens: UL 923.
   d. Gas-Burning Appliances: ANSI Z21 Series, and certified by CSA International, UL, or another testing and inspecting agency acceptable to authorities having jurisdiction.
8. ENERGY STAR Rating: Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.

E. Delivery, Storage, And Handling
1. Deliver factory-assembled units, individually factory packaged and protected. Label with manufacturer's name, product name, and model number.

F. Project Conditions
1. Environmental Limitations: Do not deliver or install unit kitchens until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Field Measurements: Verify actual dimensions of construction contiguous with unit kitchens by field measurements before fabrication.

G. Coordination
1. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that unit kitchens can be supported and installed as indicated.
2. Coordinate wiring requirements and current characteristics of unit kitchens with building electrical system. See Division 15.
3. Coordinate layout and installation of plumbing, mechanical, and electrical services for unit kitchens.

H. Warranty
1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace hermetically sealed refrigerator compressor system of unit kitchens that fail within specified warranty period.
   a. Warranty Period: Five years from date of Substantial Completion.

1.2 PRODUCTS

A. Materials
1. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.

2. Porcelain-Enamel-Finished Steel Sheet: ASTM A 424, enameling-grade steel, uncoated thickness indicated; with exposed face and edges coated with primer, ground coat, and color cover coat; and concealed face coated with primer and ground coat; acid resistant.
3. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
4. Medium-Density Fiberboard: ANSI A208.2, Grade 130, made with binder containing no urea-formaldehyde resin.
5. Particleboard: ANSI A208.1, Grade M-2 **OR** Grade M-2-Exterior Glue **OR** Grade M-2, made with binder containing no urea-formaldehyde resin, **as directed**.
6. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, Type I, made with adhesive containing no urea formaldehyde.
7. Solid Wood: Clear hardwood lumber of species indicated, free of defects, selected for compatible grain and color, and kiln dried to 7 percent moisture content.
8. High-Pressure Decorative Laminate: NEMA LD 3.
9. Solid-Surfacing Material: Homogenous solid sheets fabricated from reacted monomers and resins, mineral fillers, and pigments; in thickness indicated; complying with ISSFA-2.
10. Adhesives: Do not use adhesives that contain urea formaldehyde.

B. Metal Cabinets
1. Steel Base Cabinets: Fabricate frames and sides from 0.036-inch (0.91-mm) **OR** 0.030-inch (0.76-mm), **as directed**, nominal-thickness, cold-rolled steel sheet; welded and reinforced with internal gussets and bracing; with baked-enamel finish.
   a. Door and Drawer Fronts: 0.036-inch (0.91-mm) **OR** 0.030-inch (0.76-mm), **as directed**, nominal-thickness, cold-rolled steel sheet, textured or smooth; welded, reinforced, and sound-deadened; with baked-enamel finish.
      OR

      Door and Drawer Fronts: 0.038-inch- (0.95-mm-) thick, stainless-steel sheet; welded, reinforced, and sound deadened.
2. Stainless-Steel Base Cabinets: Fabricate frames and sides from 0.038-inch- (0.95-mm-) thick, stainless-steel sheet; welded and reinforced with internal gussets and bracing.
   a. Door and Drawer Fronts: 0.038-inch- (0.95-mm-) thick, stainless-steel sheet; welded, reinforced, and sound deadened.
3. Undercounter Storage Cabinet: Same material and finish as base cabinets, with adjustable shelf and drawer or with two drawers.
4. Wall Cabinets: Same material and finish as base cabinets, with flush double bottoms and adjustable shelves.
   a. Wall Shields: Fabricated from textured, cold-rolled steel sheet with baked-enamel finish, color to match cabinets **OR** textured, cold-rolled steel sheet with baked-enamel finish, color to match countertop **OR** stainless-steel sheet, **as directed**. Provide wall shields for back wall and side walls, **as directed**, between countertop splash and wall cabinets.
5. Shelves: Manufacturer's standard rolled-front shelves, fixed **OR** adjustable, **as directed**, of same material and finish as cabinets.
6. Wire Pulls: Brushed-chrome **OR** Polished-chrome **OR** Brushed-brass **OR** Polished-brass, **as directed**, finish.

C. Laminate-Clad Cabinets
1. Framed-Style Base Cabinets:
   a. Face Frames: 3/4-inch- (19-mm-) thick plywood or solid wood.
   b. Back Panels: 3/8-inch- (10-mm-) thick particleboard with melamine bonded to inside surface.
   c. Top, Bottom, and End Panels: 3/8-inch- (10-mm-) thick particleboard with melamine bonded to both sides.
   d. Door and Drawer Fronts: 3/4-inch- (19-mm-) thick, medium-density fiberboard with 16-mil- (0.4-mm-) thick vinyl film (Thermofoil) bonded to exposed surfaces and melamine bonded to inside surfaces.
      OR

Door and Drawer Fronts: 5/8-inch- (16-mm-) thick particleboard with melamine bonded to both sides.

e. Drawers: Four sided, with 1/2-inch- (13-mm-) thick particleboard fronts, backs, and sides, and 1/4-inch- (6-mm-) thick particleboard bottom.

f. Shelves: 5/8-inch- (16-mm-) thick particleboard with melamine bonded to both sides and PVC edges.

2. Frameless-Style Base Cabinets:

a. Back Panels: 1/4-inch- (6-mm-) thick plywood or particleboard with melamine bonded to inside surface.

b. Top and Bottom Panels: 3/4-inch- (19-mm-) thick particleboard with melamine bonded to both sides.

c. End Panels: 5/8-inch- (16-mm-) thick particleboard with melamine bonded to both sides.

d. Door and Drawer Fronts: 3/4-inch- (19-mm-) thick plywood with Grade HGS high-pressure decorative laminate bonded to front and edges, and Grade CLS high-pressure decorative laminate bonded to inside surface.

OR

Door and Drawer Fronts: 5/8-inch- (16-mm-) thick particleboard with melamine bonded to both sides.

OR

Door and Drawer Fronts: 5/8-inch- (16-mm-) thick particleboard with melamine bonded to both sides. Provide continuous bevel edge at tops and bottoms of doors and bottom of drawer fronts in wood-grain laminate **OR** solid wood, **as directed**.

e. Drawers: Four sided, with 1/2-inch- (13-mm-) thick particleboard fronts, backs, and sides, and 1/4-inch- (6-mm-) thick particleboard bottom.

f. Shelves: 3/4-inch- (19-mm-) thick particleboard with melamine bonded to both sides and PVC edges.

3. Wall Cabinets: Same material and finish as base cabinets, with adjustable shelves.

a. Wall Shields: Fabricated from high-pressure decorative laminate of grade and color to match cabinets **OR** high-pressure decorative laminate of grade and color to match countertop **OR** stainless-steel sheet, **as directed**. Provide wall shields for back wall and side walls, **as directed**, between countertop splash and wall cabinets.

4. Scribe Strips for Recessed Cabinets: Same material, finish, and color as cabinet.

5. Wire Pulls: Brushed-chrome **OR** Polished-chrome **OR** Brushed-brass **OR** Polished-brass, **as directed**, finish.

D. Wood Cabinets

1. Base Cabinets: Birch **OR** Maple **OR** Oak **OR** Cherry **OR** Ash, **as directed**.

a. Face Frames: 3/4-inch- (19-mm-) thick, hardwood-veneer plywood or solid wood.

b. Back Panels: 3/8-inch- (10-mm-) thick particleboard with melamine bonded to inside surface.

c. Top, Bottom, and End Panels: 3/8-inch- (10-mm-) thick particleboard with melamine bonded to both sides.

d. Shelves: 5/8-inch- (16-mm-) thick particleboard with melamine bonded to both sides and PVC edges.

e. Door and Drawer Fronts: 5/8-inch- (16-mm-) thick, hardwood-veneer plywood with matching hardwood edges.

OR

Door and Drawer Fronts: 3/4-inch- (19-mm-) thick, solid wood stiles and rails, with solid wood center panels.

2. Wall Cabinets: Same material and finish as base cabinets, with adjustable shelves.

a. Wall Shields: Fabricated from high-pressure decorative laminate of grade and color to match countertop **OR** stainless-steel sheet, **as directed**. Provide wall shields for back wall and side walls, **as directed**, between countertop splash and wall cabinets.

3. Scribe Strips for Recessed Cabinets: Same material, finish, and color as cabinet.

4. Wire Pulls: Brushed-chrome **OR** Polished-chrome **OR** Brushed-brass **OR** Polished-brass, **as directed**, finish.

E. Countertops
1. Countertop and Integral Sink: Seamless, one-piece countertop and sink with integral embossed drainboard and backsplash and side splashes, **as directed**.
   a. Stainless Steel: 0.038-inch- (0.95-mm-) thick sheet bonded to 3/4-inch (19-mm) plywood.
   b. Porcelain-Enamel-Finished Steel: 0.0677 inch (1.7 mm) thick.
   c. Solid-Surfacing Material: Minimum 1/2 inch (13 mm) thick.
2. Countertop **OR** Countertop for Drop-in Sink, **as directed**: Seamless, one-piece countertop with integral backsplash and side splashes, **as directed**.
   a. Stainless Steel: 0.038-inch- (0.95-mm-) thick sheet bonded to 3/4-inch (19-mm) plywood.
   b. High-Pressure Decorative Laminate: Grade HGS, bonded to 3/4-inch (19-mm) plywood.
      OR
      High-Pressure Decorative Laminate: Grade HGP, post formed, bonded to 3/4-inch (19-mm) particleboard with Grade BKL unfinished backing sheet bonded to reverse side.
3. Countertop **OR** Countertop for Undercounter-Mounted Sink, **as directed**: Seamless, one-piece countertop with integral backsplash and side splashes, **as directed**; fabricated from 1/2-inch- (13-mm-) thick, solid-surfacing material.

F. Fixtures
1. Stainless-Steel Drop-in Sinks: 0.050 inch (1.27 mm) **OR** 0.038 inch (0.95 mm), **as directed**, thick; seamless; single compartment.
2. Porcelain-Enamel-Finished Steel Drop-in Sinks: 0.043 inch (1.09 mm) thick; seamless; single compartment.
3. Undercounter-Mounted Sinks: Solid-surfacing material; seamless; single compartment.
4. Supplies: NPS 3/8 (DN 12) **OR** NPS 1/2 (DN 15), **as directed**, chrome-plated copper with stops.
5. Sink Faucet: Single-lever control; polished chrome-plated mixing **OR** European-style, pull-out spray, **as directed**, faucet with limited-swing spout and aerator.
   OR
   Sink Faucet: Separate hot and cold controls with wrist-blade handles, **as directed**; polished chrome-plated mixing faucet with limited-swing spout **OR** gooseneck spout, **as directed**, and aerator.
6. Sink Outlet with Disposer: 3-1/2-inch- (89-mm-) diameter outlet.
7. Sink Outlet without Disposer: 3-1/2-inch- (89-mm-) diameter outlet with stainless-steel cup strainer and 1-1/2-inch- (38-mm-) diameter tailpiece.
8. Drain Piping: NPS 1-1/2 (DN 40) chrome-plated cast-brass trap, tubular brass waste to wall, and wall escutcheon.
9. Bar Sink Outlet: 2-inch- (51-mm-) diameter outlet with stainless-steel grid strainer.
10. Disposers: Continuous-feed, household, food-waste disposers. Include 115-V ac, 1725-rpm, 1/2-hp motor with overload protection and reset button; three-conductor, grounded power cord; wall switch; corrosion-resistant chamber with jam-resistant, cutlery- or stainless-steel grinder or shredder; NPS 1-1/2 (DN 40) outlet; quick-mounting, stainless-steel sink flange; antisplash guard; and combination cover/stopper.
11. Hot-Water Dispensers: Household type with instant on-off control; insulated, corrosion-resistant-metal storage tank that is open to atmosphere; electric, 115-V ac, heating element; three-conductor, grounded power cord; chrome-plated faucet or spout; removable strainer; thermostat control for water temperature up to 190 deg F (88 deg C); thermal-overload protection; and minimum 1/2-gal. (1.9-L) tank capacity dispensing approximately 60 cups (240 mL) of water per hour.

G. Appliances
1. Built-in Refrigerators: Fabricated with one-piece seamless steel or ABS plastic inner liner; refrigerator compartment with slide-out or removable shelves and meat tray; adjustable automatic temperature control; door with magnetic gaskets and storage shelves; interior light; closed

compartment for 25-lb (11-kg) minimum storage of prefrozen food and two ice cube trays; 115-V ac.

a. Minimum Capacity: 3.2 cu. ft. (0.091 cu. m) **OR** 5.5 cu. ft. (0.156 cu. m) **OR** 6.0 cu. ft. (0.169 cu. m), **as directed**.

b. Defrost System: Automatic defrost timer **OR** Push button or manual, **as directed**.

c. Compressor: Cushion-mounted, self-oiling, and hermetically sealed compressor; fan or gravity cooled.

d. Finish Panel: Manufacturer's standard door trim kit with filler panel or integral finish panel; match material and finish of base cabinets.

2. Freestanding, Upright Refrigerator-Freezers: Two-door combination unit with one-piece seamless steel or ABS plastic inner liner; automatic defrost; closed freezer compartment with two adjustable shelves and two ice cube trays, **as directed**; full-width vegetable crisper; dairy compartment; interior light; adjustable automatic temperature control; door with magnetic gaskets and storage shelves; 115-V ac, with three-conductor, grounded power cord.

a. Minimum Capacity: 12-cu. ft. (0.340-cu. m) refrigerator capacity with 100-lb (45-kg) freezer capacity **OR** 14-cu. ft. (0.396-cu. m) refrigerator capacity with 125-lb (57-kg) freezer capacity, **as directed**.

b. Icemaker: Built-in automatic unit, **as directed**.

c. Finish Panel: Manufacturer's standard door trim kit with filler panel or integral finish panel; match material and finish of base cabinets.

3. Automatic Icemakers: Built-in undercounter unit; capable of producing 22 lb (10 kg) of ice per day; with 12-lb (5.4-kg) **OR** 35 lb (15.9 kg) of ice per day; with 26-lb (11.8-kg) **OR** 50 lb (22.6 kg) of ice per day; with 35-lb (15.9-kg), **as directed**, storage bin; 115-V ac, with three-conductor, grounded power cord; with plumbed water supply.

4. Electric Cooktops: Porcelain-enamel-finished steel; coil-element burners with removable rings and reflector bowls, infinitely adjustable heating controls, and individual signal lights; with wiring terminated at factory-installed junction box.

a. Cooktop Burner: One element rated at 900 W; 115 **OR** 1250 W; 208/240, **as directed**,-V ac.

OR

Cooktop Burners: One element rated at 550 W and one element rated at 950 W; 115-V ac.

OR

Cooktop Burners: Two elements, each rated at 1250 W; 115 **OR** 208/240, **as directed**,-V ac.

OR

Cooktop Burners: Two elements rated at 1250 W and one element rated at 2100 W; 208/240-V ac.

5. Built-in Electric Ovens: Porcelain-enamel-finished steel exterior surfaces; coil-element burners with removable rings and reflector bowls, infinitely adjustable heating controls, and individual signal lights. Oven interior fabricated from one-piece porcelain-enamel-finished steel with rounded corners, with "Bake" and "Broil" oven elements, automatic heat control, signal light, and removable wire oven rack; textured baked-enamel- or porcelain-enamel-finished steel oven door; 208/240-V ac, with wiring terminated at factory-installed junction box.

a. Cooktop Burners: Three elements, each rated at 1250 W.

b. Oven Elements: 1500 W bake; 2000 W broil **OR** Manufacturer's standard, **as directed**.

6. Freestanding Electric Ranges: Porcelain-enamel-finished steel exterior surfaces; coil-element burners with removable rings and reflector bowls, infinitely adjustable heating controls, and individual signal lights; anti-tip anchors. Oven interior fabricated from one-piece porcelain-enamel-finished steel with rounded corners, with "Bake" and "Broil" oven elements, automatic heat control, signal light, two removable wire oven racks, and porcelain-on-steel broiler pan; textured baked-enamel- or porcelain-enamel-finished steel oven door; 208/240-V ac, with wiring terminated at factory-installed junction box.

a. Cooktop Burners: Three elements, each rated at 1250 W, and one element rated at 2100 W.

b. Oven Elements: Manufacturer's standard.

7. Gas Cooktops: Porcelain-enamel-finished steel; surface burners with removable cast-iron grates, lift-out burner bowls, and 115-V ac electronic ignition; with wiring terminated at factory-installed junction box, and burner control panel mounted at front of unit.
   a. Cooktop Burners: Two elements, each rated at 8000 Btu/h (8440 kJ) **OR** 10,000 Btu/h (10 550 kJ), **as directed**, for natural gas.
8. Built-in Gas Ovens: Stainless-steel **OR** Porcelain-enamel-finished steel, **as directed**, exterior surfaces; surface burners with removable cast-iron grates, lift-out burner bowls, and 115-V ac electronic ignition; with wiring terminated at factory-installed junction box. Oven interior fabricated from porcelain-enamel-finished steel with rounded corners; removable wire oven rack, automatic heat control, and combination surface burner and oven control panel mounted above oven door at front of unit.
   a. Cooktop Burners: Three elements, each rated at 5000 Btu/h (5275 kJ) for natural gas.
      OR
      Cooktop Burners: Four elements, each rated at 9000 Btu/h (9495 kJ) for natural gas.
   b. Oven Burner: Rated at 9000 Btu/h (9495 kJ) **OR** 18,000 Btu/h (18 990 kJ), **as directed**, for natural gas.
9. Freestanding Gas Ranges: Porcelain-enamel-finished steel exterior surfaces; surface burners with removable grates, lift-out burner bowls, and 115-V ac electronic ignition; with three-conductor, grounded power cord; anti-tip anchors. Oven interior fabricated from porcelain-enamel-finished steel with rounded corners; two removable wire oven racks, porcelain-on-steel broiler pan, automatic heat control, and combination surface burner and oven control panel mounted above oven door at front of unit.
   a. Cooktop Burners: Four elements, each rated at 9000 Btu/h (9495 kJ) for natural gas.
   b. Oven Burner: Rated at 18,000 Btu/h (18 990 kJ) for natural gas.
10. Freestanding Microwave Ovens: 0.7-cu. ft. (0.020-cu. m) capacity with 600 W **OR** 0.8-cu. ft. (0.023-cu. m) capacity with 700 W, **as directed**, cooking power; electronic touch controls, variable power control, digital clock timer, interior light, turntable, and tempered glass door; 115-V ac, with three-conductor, grounded power cord.
11. Built-in Microwave Ovens with Exhaust Hood: Undercabinet mounted, minimum 1.0-cu. ft. (0.028-cu. m) capacity with 800-W cooking power; electronic touch controls, variable power control, digital clock timer, interior light, turntable, tempered glass door, and exhaust hood with integral light and two-speed fan control; 115-V ac, with three-conductor, grounded power cord.
    a. Exhaust Hood: Recirculating, nonventing type, with replaceable charcoal filter.
       OR
       Exhaust Hood: Ventilating type, with permanent washable filter. Provide exhaust duct and wall **OR** roof, **as directed**, cap and shutter. See Division 15 Section "Metal Ducts".
12. Built-in Microwave/Convection Ovens with Exhaust Hood: Undercabinet mounted, minimum 1.0-cu. ft. (0.028-cu. m) capacity with 800-W cooking power; electronic touch controls, variable power control, digital clock timer, interior light, turntable, convection rack, tempered glass door, and exhaust hood with integral light and two-speed fan control; 115-V ac, with three-conductor, grounded power cord.
    a. Exhaust Hood: Recirculating, nonventing type, with replaceable charcoal filter.
    b. Exhaust Hood: Ventilating type, with permanent washable filter. Provide exhaust duct and wall **OR** roof, **as directed**, cap and shutter. See Division 15 Section "Metal Ducts".
13. Ventilating Exhaust Hoods: Undercabinet mounted, 24 inches (610 mm) wide, stainless **OR** baked-enamel, **as directed**, steel; two-speed fan control, permanent washable filter, and built-in lighting; 115-V ac, with wiring terminated at factory-installed junction box.
    a. Provide exhaust duct and wall **OR** roof, **as directed**, cap and shutter. See Division 15 Section "Metal Ducts".
14. Recirculating, Nonventilating Exhaust Hoods: Undercabinet mounted, 24 inches (610 mm) wide, stainless **OR** baked-enamel, **as directed**, steel; two-speed fan control, replaceable charcoal filter, and built-in lighting; 115-V ac, with wiring terminated at factory-installed junction box.
15. Dishwashers: Built-in undercounter unit, 18 inches (457 mm) wide **OR** 24 inches (610 mm) wide **OR** width as indicated, **as directed**; multiple wash cycles, coated roll-out racks, detergent dispenser, and insulated cavity walls and door; 115-V ac, with wiring terminated at factory-installed junction box.

16. Automatic Coffeemakers: Stainless steel, with capacity for three pots of coffee; automatic brewing, nonstick warmer plates, and lighted on-off switch; 115-V ac, with three-conductor, grounded power cord; designed for permanent installation in countertop, with plumbed water supply. Provide glass coffee decanters in number to match capacity.

H. Accessories
1. Locks: Brass-cylinder type; furnish two keys per lock. Provide where indicated **OR** on base cabinet doors **OR** on refrigerator, **as directed**.
2. Fluorescent Light Fixtures: Surface mounted to underside of overhead cabinet; with 15-W lamp, on-off switch, grounded convenience receptacle, and translucent plastic lens.
3. Cutlery Drawers: Concealed drawer in undercounter storage compartment with pull-out divided tray.
4. Cutting Boards: Pull-out hardwood board.
5. Heat Shields: Minimum 12 inches high by 24 inches (305 mm high by 610 mm) wide, 0.025-inch- (0.64-mm-) thick stainless steel over 1/4-inch- (6-mm-) thick board insulation.

I. Fabrication
1. General: Factory fabricate and assemble unit kitchens, with base cabinets, sink **OR** refrigerator, **as directed**, and countertop shipping as a one-piece assembly. Securely fasten components, fixtures, and appliances together.
   a. Provide manufacturer's standard hardware including concealed, adjustable plated-steel hinges; steel drawer slides with nylon rollers; and catches and rubber bumpers on doors and drawers. Unless otherwise indicated, provide chromium-plated metal or satin-finished stainless steel for exposed hardware.
2. Accessible Units: Fabricate unit kitchens to comply with accessibility regulations as follows:
   a. Standard, Accessible Countertops: Fabricate unit kitchens with one-piece countertop located at height of 34 inches (864 mm) above floor.
      OR
      Adjustable, Accessible Countertops: Fabricate unit kitchens with two-piece countertop that allows countertop over sink, including backsplash, side splashes, and sink assembly, to be adjusted between 29 and 36 inches (735 and 915 mm) above finished floor.
   b. Removable, Accessible Cabinets: Fabricate cabinet under sink to allow removal for future accessibility conversion. Fabricate cabinet to allow access to plumbing and electrical connections after conversion.
   c. Knee and Toe Clearance: Provide minimum 30-inch- (760-mm-) wide open space beneath countertop with a minimum clear height of 27 inches (685 mm) above floor for first 8 inches (205 mm) of depth, then reduce clearance at a rate of 1 inch (25 mm) in depth for each 6 inches (150 mm) in height, to a minimum clear height of 9 inches (230 mm) above floor at a depth of 11 inches (280 mm).
   d. Pipe Enclosure Panels: Provide manufacturer's standard panels to enclose plumbing under countertop, of same material and finish as cabinets. Install panel to prevent exposure of sharp or abrasive surfaces under countertop.
   e. Operable Parts: Locate operable parts no higher than 48 inches (1219 mm) and no lower than 15 inches (380 mm) above floor. Provide operable parts that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22.2 N).
   f. Range or Cooktop: Provide top surface 34 inches (865 mm) above floor, with controls that do not require reaching across burners. Provide knee and toe clearance beneath range or cooktop; insulate underside of cooktop to prevent burns, shocks, or abrasions.
   g. Refrigerator/Freezer: Provide 50 percent of freezer space no higher than 54 inches (1370 mm) off floor.
   h. Oven: Provide work surface adjacent to one side of bottom-hinged doors. Locate controls on front panel.

J. General Finish Requirements

1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

K. Finishes
1. Stainless-Steel Finishes: Remove tool and die marks and stretch lines, or blend into finish. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
   a. Bright, Directional Polish: No. 4 finish.
2. Wood Finishes: Factory finished with manufacturer's standard stain, sealer, and clear finish coat. Defer only final touchup until after installation.

1.3 EXECUTION

A. Examination
1. Examine walls and floors, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
2. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
3. Examine walls and partitions for proper backing for unit kitchens.
4. Examine roughing-in for electrical power plumbing and mechanical system(s) to verify actual locations of connections before installation of unit kitchens.
5. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Installation
1. General: Install level, plumb, and true; shim as required, using concealed shims. Provide fasteners, clips, backing materials, brackets, anchors, fillers, scribes, trim, and accessories necessary for complete installation.
   a. Anchor unit kitchens at ends and at intervals recommended by manufacturer, but not more than 36 inches (910 mm) o.c. Install anchors through backup reinforcing plates, channels, or blocking as required to prevent material distortion; use concealed fasteners.
   b. Freestanding Ranges: Install anti-tip anchors at locations recommended by manufacturer.
2. Comply with requirements specified in Division 14 AND Division 15 for connecting unit kitchens to plumbing and mechanical system(s).
3. Comply with requirements specified in Division 15 for connecting unit kitchens to electrical power system.

C. Adjusting And Cleaning
1. Test, adjust, and verify operation of each appliance, plumbing fixture, and component of unit kitchens. Repair or replace items found to be defective or operating below rated capacity.
2. Verify that operating parts work freely and fit neatly and that clearances are adequate to properly and freely operate appliances.
3. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding. Verify that locking devices operate properly.
4. After completing unit kitchen installation, remove protective coverings if any.
5. Repair or replace damaged parts, dents, buckles, abrasions, and other defects affecting appearance or serviceability. Touch up factory-applied finishes to restore damaged or soiled areas.

END OF SECTION 11415

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Task	Specification	Specification Description
11420	11410	Food Service Equipment

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SECTION 11421 - RESIDENTIAL APPLIANCES

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for residential appliances. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. This Section includes:
a. Cooking appliances.
b. Kitchen exhaust ventilation.
c. Refrigeration appliances.
d. Cleaning appliances
e. Trash compactors.

C. Submittals
1. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, dimensions, furnished accessories, and finishes for each appliance.
2. LEED Submittal:
a. Product Data for Credit EA 1.4 or LEED for Homes Credit EA9: For appliances, documentation indicating that products are ENERGY STAR rated.
3. Samples: For each exposed finish.
4. Product Schedule: For appliances; use same designations indicated on Drawings.
5. Qualification Data: For qualified Installer or manufacturer.
6. Product Certificates: For each type of appliance, from manufacturer.
7. Field quality-control reports.
8. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.
9. Warranties: Special warranties specified in this Section.

D. Quality Assurance
1. Manufacturer Qualifications: Maintains a service center capable of providing training, parts, and emergency maintenance repairs.
2. Installer Qualifications: An employer of workers trained and approved by manufacturer for installation and maintenance of units required for this Project.
3. Source Limitations: Obtain residential appliances from single source and each type of residential appliance from single manufacturer.
4. High-Altitude and Propane Conversion: Provide gas-operated appliances with manufacturer's conversion kit installed by a qualified service agency according to manufacturer's written instructions for Project location and type of fuel.
5. Regulatory Requirements: Comply with the following:
a. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
b. ANSI: Provide gas-burning appliances that comply with ANSI Z21 Series standards.
6. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1," **as directed**.
7. Preinstallation Conference: Conduct conference at Project site.

E. Warranty

1. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period.
   a. Warranty Period: Two **OR** Five years, **as directed,** from date of Substantial Completion.
2. Electric Cooktop **OR** Range: Full warranty including parts and labor **OR** Limited warranty including parts and labor for first year and parts thereafter for on-site service on surface-burner elements, **as directed**.
   a. Warranty Period: Two **OR** Five years, **as directed,** from date of Substantial Completion.
3. Microwave Oven: Full warranty including parts and labor **OR** Limited warranty including parts and labor for first year and parts thereafter for on-site service on the magnetron tube, **as directed**.
   a. Warranty Period: Two **OR** Five years, **as directed,** from date of Substantial Completion.
4. Refrigerator/Freezer **OR** Freezer **OR** Icemaker, Sealed System: Full warranty including parts and labor **OR** Limited warranty including parts and labor for first year and parts thereafter for on-site service on the product, **as directed**.
   a. Warranty Period for Sealed Refrigeration System: Two **OR** Five years, **as directed,** from date of Substantial Completion.
   b. Warranty Period for Other Components: Two years from date of Substantial Completion.
5. Dishwasher: Full warranty including parts and labor **OR** Limited warranty including parts and labor for first year and parts thereafter for on-site service on the product, **as directed**.
   a. Warranty Period for Deterioration of Tub and Metal Door Liner: Three **OR** Five **OR** 10 years, **as directed,** from date of Substantial Completion.
   b. Warranty Period for Other Components: Two years from date of Substantial Completion.
6. Clothes Washer: Full warranty including parts and labor **OR** Limited warranty including parts and labor for first year and parts thereafter for on-site service on the product, **as directed**.
   a. Warranty Period: Two **OR** Three years, **as directed,** from date of Substantial Completion.

1.2 PRODUCTS

A. Cooktops:
1. Electric Cooktop:
   a. Width: 12 inches (305 mm) **OR** 30 inches (762 mm) **OR** 36 inches (914 mm), **as directed**.
   b. Electric Burner Elements: Two **OR** Four **OR** Six, **as directed**.
   c. Coil Type: Manufacturer's standard **OR** Two 1200 W and two 2200 W **OR** One 1200 W, one 2200-W dual element, and two 2200 W, **as directed**.
   d. Radiant Type: Two 1500 W and two 2000 W **OR** One 1200-W element, dual 1500-W/1500-W bridge element, and one 1200-W/2500-W expandable element **as directed**.
   e. Induction Type: Manufacturer's standard **OR** Two 1200 W and two 1800 W **OR** One 1200 W, one 1800 W, one 2700 W, and one 3300 W, **as directed**.
   f. Controls: Digital panel controls, located on front **OR** on left side **OR** on right side **OR** remotely, where indicated, **as directed**.
   g. Downdraft Ventilation: Manufacturer's standard **OR** 550 cfm (260 L/s) **as directed**, built-in downdraft ventilation, with remote blower and exterior weatherproof wall cap.
   h. Other Features: Grill **OR** deep fryer **OR** wok burner and wok ring, **as directed**.
   i. Electric Power Supply: 240 V, 60 Hz, 1 phase, 30 A, **as directed**.
   j. Top Material: Manufacturer's standard **OR** Ceramic glass **OR** Porcelain-enamel steel **OR** Stainless steel, **as directed**.
      1) Color/Finish: White **OR** Black, **as directed**.
2. Gas Cooktop
   a. Width: 12 inches (300 mm) **OR** 30 inches (760 mm) **OR** 36 inches (915 mm), **as directed**.
   b. Gas Burners: Two **OR** Four **OR** Six, **as directed**.
      1) Power Ratings: Manufacturer's standard **OR** One 5000 Btu/h (1500 W), two 9100 Btu/h (2700 W), and one 12,000 Btu/h (3500 W), **as directed**.
      2) Grates: Individual **OR** Continuous, **as directed**.

c. Controls: Digital panel **OR** Manual-dial controls, located on front **OR** left side **OR** right side, **as directed**.
d. Downdraft Ventilation: Manufacturer's standard **OR** 550 cfm (260 L/s), **as directed**, with remote, **as directed**, blower and exterior weatherproof wall cap.
e. Other Features: Sealed burners **OR** Auto-reigniting **OR** Grill **OR** deep fryer **OR** wok burner and wok ring, **as directed**.
f. Electric Power Supply: 120 V, 60 Hz, 1 phase, 30 A, **as directed**.
g. Top Materials: Porcelain-enamel steel **OR** Ceramic glass **OR** glass **OR** Stainless steel **OR** Manufacturer's standard, **as directed**.
1) Color/Finish: White **OR** Black, **as directed**.

B. Range:
1. Electric Range: Freestanding **OR** Slide-in **OR** Drop-in range, **as directed**, with one **OR** two oven(s), **as directed** and complying with AHAM ER-1.
a. Width: 30 inch (762 mm) **OR** 36 inch (914 mm), **as directed**.
b. Electric Burner Elements: Four **OR** Six, **as directed**.
1) Coil Type: Manufacturer's standard **OR** Two 1200 W and two 2200 W **OR** One 1200 W, one 2200-W dual element, and two 2200 W, **as directed**.
2) Radiant Type: Two 1500 W and two 2000 W **OR** One 1200-W element, dual 1500-W/1500-W bridge element, and one 1200-W/2500-W expandable element, **as directed**.
3) Induction Type: Manufacturer's standard **OR** Two 1200 W and two 1800 W **OR** One 1200 W, one 1800 W, one 2700 W, and one 3300 W, **as directed**.
4) Controls: Digital panel controls, located on front **OR** left side **OR** right side **OR** splash panel at rear of rangetop, **as directed**.
c. Oven Features:
1) Capacity: 3.3 cu. ft. (0.09 cu. m).
2) Operation: Baking **OR** convection **as directed**, and self-cleaning.
3) Broiler: Located in top of oven **OR** separate roll-out drawer on bottom **as directed**.
4) Oven Door(s): Counterbalanced, removable, with observation window and full-width handle.
5) Electric Power Rating:
a) Oven(s): Manufacturer's standard **OR** 2400 W **as directed**.
b) Broiler: Manufacturer's standard **OR** 3500 W **as directed**.
6) Controls: Digital panel controls and timer display, located on front **OR** left side **OR** right side **OR** splash panel at rear of rangetop, **as directed**.
d. Anti-Tip Device: Manufacturer's standard.
e. Electric Power Supply: 240 V, 60 Hz, 1 phase, 30 A.
f. Material Porcelain-enamel **OR** Stainless, **as directed**, with manufacturer's standard, **as directed**, cooktop.
a) Color/Finish: White **OR** Black, **as directed**.

2. Gas Range: Freestanding **OR** Slide-in range with one **OR** two ovens, **as directed**.
a. Width: 30 inch (762 mm) **OR** 36 inch (914 mm), **as directed**.
b. Gas Burners: Four **OR** Six, **as directed**.
1) Power Ratings: Manufacturer's standard **OR** One 5000 Btu/h (1500 W), **as directed**, two 9100 Btu/h (2700 W), and one 12,000 Btu/h (3500 W).
2) Controls: Digital panel **OR** Manual-dial controls, **as directed** located on front **OR** left side **OR** right side **OR** splash panel at rear of rangetop, **as directed**.
3) Grates: Individual **OR** Continuous, **as directed**.
4) Other Feature(s): Sealed burners **OR** auto-re-igniting burners, **as directed**, and grill.
c. Oven Features:
1) Capacity: 3.3 cu. ft. (0.09 cu. m).
2) Operation: Baking **OR** convection **as directed**, and self-cleaning.
3) Broiler: Located in top of oven **OR** separate roll-out drawer on bottom **as directed**.

4) Oven Door(s): Counterbalanced, removable, with observation window and full-width handle.
5) Electric Power Rating:
a) Oven(s): Manufacturer's standard **OR** 9100 Btu/h (2700 W) **as directed**.
b) Broiler: Manufacturer's standard **OR** 14,500 Btu/h (4200 W) **as directed**.
6) Controls: Digital panel controls and timer display, located on front **OR** left side **OR** right side **OR** splash panel at rear of rangetop, **as directed**.

d. Anti-Tip Device: Manufacturer's standard.
e. Electric Power Supply: 240 V, 60 Hz, 1 phase, 15 A.
f. Material Porcelain-enamel **OR** Stainless, **as directed**, with manufacturer's standard, **as directed**, cooktop.
a) Color/Finish: White **OR** Black, **as directed**.

3. Dual Fuel Range Freestanding **OR** Slide-in range, **as directed**, with gas burners and one **OR** two electric ovens, **as directed**.
a. Width: 30 inch (762 mm) **OR** 36 inch (914 mm), **as directed**.
b. Gas Burners: Four **OR** Six, **as directed**.
1) Power Ratings: Manufacturer's standard **OR** One 5000 Btu/h (1500 W), **as directed**, two 9100 Btu/h (2700 W), and one 12,000 Btu/h (3500 W)
2) Controls: Digital panel **OR** Manual-dial controls, **as directed** located on front **OR** left side **OR** right side **OR** splash panel at rear of rangetop, **as directed**.
3) Grates: Individual **OR** Continuous, **as directed**.
4) Other Feature(s): Sealed burners **OR** auto-re-igniting burners, **as directed**, and grill.
c. Oven Features:
1) Capacity: 3.3 cu. ft. (0.09 cu. m).
2) Operation: Baking **OR** convection **as directed**, and self-cleaning.
3) Broiler: Located in top of oven **OR** separate roll-out drawer on bottom **as directed**.
4) Oven Door(s): Counterbalanced, removable, with observation window and full-width handle.
5) Electric Power Rating:
a) Oven(s): Manufacturer's standard **OR** 2400 W **as directed**.
b) Broiler: Manufacturer's standard **OR** 3500 W **as directed**.
6) Controls: Digital panel controls and timer display, located on front **OR** left side **OR** right side **OR** splash panel at rear of rangetop, **as directed**.
d. Anti-Tip Device: Manufacturer's standard.
e. Electric Power Supply: 240 V, 60 Hz, 1 phase, 30 A.
f. Material Porcelain-enamel **OR** Stainless, **as directed**, with manufacturer's standard, **as directed**, cooktop.
1) Color/Finish: White **OR** Black, **as directed**.

C. Wall Oven:
1. Electric Wall Oven(s): One **OR** Two-oven unit, **as directed**.
a. Mounting: Built-in wall **OR** undercounter .
b. Capacity: 3.3 cu. ft. (0.09 cu. m).
c. Operation: Baking **OR** convection and self-cleaning, **as directed**.
d. Broiler: Located in top of oven **OR** separate roll-out drawer on bottom, **as directed**.
e. Oven Door(s): Counterbalanced, removable, with observation window and full-width handle.
f. Electric Power Rating:
1) Oven(s): Manufacturer's standard **OR** 2400 W, **as directed**.
2) Broiler: Manufacturer's standard **OR** 3500 W, **as directed**.
g. Electric Power Supply: 240 V, 60 Hz, 1 phase, 30 A
h. Controls: Digital panel **OR** Manual-dial controls and timer display, **as directed**.

i. Material: Porcelain-enameled steel **OR** Stainless steel **OR** Manufacturer's standard, **as directed**.
   1) Color/Finish: White **OR** Black, **as directed**.

2. Gas Wall Oven(s): One **OR** Two-oven unit, **as directed**.
   a. Mounting: Built-in wall **OR** undercounter .
   b. Capacity: 3.3 cu. ft. (0.09 cu. m).
   c. Operation: Baking **OR** convection and self-cleaning, **as directed**.
   d. Broiler: Located in top of oven **OR** separate roll-out drawer on bottom, **as directed**.
   e. Oven Door(s): Counterbalanced, removable, with observation window and full-width handle.
   f. Electric Power Rating:
      1) Oven(s): Manufacturer's standard **OR** 9100 Btu/h (2700 W), **as directed**.
      2) Broiler: Manufacturer's standard **OR** 14,500 Btu/h (4200 W), **as directed**.
   g. Electric Power Supply: 240 V, 60 Hz, 1 phase, 30 A
   h. Controls: Digital panel **OR** Manual-dial controls and timer display, **as directed**.
   i. Material: Porcelain-enameled steel **OR** Stainless steel **OR** Manufacturer's standard, **as directed**.
      1) Color/Finish: White **OR** Black, **as directed**.

D. Microwave Oven:
   1. Microwave Oven(s):
      a. Mounting: Undercabinet **OR** Wall cabinet, **as directed**.
      b. Type: Conventional **OR** Convection, **as directed**.
      c. Dimensions:
         1) Width: 24 inches (610 mm) **OR** 30 inches (762 mm), **as directed**.
         2) Depth: 19-1/2 inches (495 mm), **as directed**.
         3) Height: 14 inches (356 mm) **OR** 18 inches (457 mm), **as directed**.
      d. Capacity: 1.5 cu. ft. (0.04 cu. m) **OR** 2.0 cu. ft. (0.06 cu. m), **as directed**.
      e. Oven Door: Door with observation window and pull handle **OR** and push-button latch release, **as directed**.
      f. Exhaust Fan: Variable **OR** Two **OR** Four-speed fan, , **as directed**, vented to outside **OR** nonvented, **as directed**, recirculating type with charcoal filter and with manufacturer's standard **OR** 300-cfm (140-L/s) capacity, **as directed**.
      g. Microwave Power Rating: Manufacturer's standard **OR** 1000 W, **as directed**.
         1) Convection Element Power Rating: Manufacturer's standard **OR** 1450 W, **as directed**.
      h. Electric Power Supply: 120 V, 60 Hz, 1 phase, 15 A.
      i. Controls: Digital panel controls and timer display.
      j. Other Features: Turntable **OR** temperature probe, **as directed**, and lock-out feature.
      k. Material: Porcelain-enameled steel **OR** Stainless steel **OR** Manufacturer's standard, **as directed**.
         1) Color/Finish: White **OR** Black, **as directed**.

E. Kitchen Exhaust Ventilation:
   1. Overhead Exhaust Hood
      a. Type: Wall-mounted, **OR** Suspended-island-canopy, exhaust-hood system, **as directed**.
      b. Dimensions:
         1) Width: 30 inches (762 mm) **OR** 36 inches (914 mm) **OR** 48 inches (1219 mm), **as directed**.
         2) Depth: 30 inches (762 mm) **OR** 36 inches (914 mm) **OR** 48 inches (1219 mm), **as directed**.
      c. Exhaust Fan: Variable **OR** Two **OR** Three-speed fan, **as directed**, built into hood **OR** remotely located, , **as directed**, with separate housing and with manufacturer's standard **OR** 500-cfm (236-L/s) **OR** 900-cfm (425-L/s) capacity, **as directed**.
         1) Venting: Vented to outside through roof with weatherproof roof cap, backdraft damper, and rodent-proof screening **OR** Vented to outside through wall with

weatherproof wall cap, backdraft damper, and rodent-proof screening **OR** Nonvented, recirculating type with charcoal filter, **as directed**.

2) Fan Control: Hood **OR** Wall-mounted touch-pad to control fan switch, with separate hood-light control switch, **as directed**.

d. Duct Type: Manufacturer's standard **OR** 7-inch- (175-mm-) diameter round **OR** 3-1/4 by 10 inches (82 by 250 mm) rectangular, **as directed**.

e. Finish: Baked enamel **OR** Stainless steel, **as directed**.

1) Color: White **OR as directed**.

f. Features:

1) Permanent, washable aluminum mesh **OR** stainless-steel mesh **OR** baffle-type filter(s), **as directed**.

2) Built-in halogen **OR** incandescent **OR** fluorescent lighting, **as directed**.

3) Warming lamp socket(s).

2. Downdraft Exhaust:

a. Type: Retractable-downdraft exhaust system.

b. Width: 30 inches (762 mm) **OR** 36 inches (914 mm), **as directed**.

c. Exhaust Fan: Variable **OR** Two **OR** Three-speed fan built into cabinet below countertop **OR** remotely located, **as directed**, with separate housing and with manufacturer's standard **OR** 500-cfm (236-L/s) **OR** 900-cfm (425-L/s) capacity, **as directed**.

1) Venting: Vented to outside through roof with weatherproof roof cap, backdraft damper, and rodent-proof screening **OR** Vented to outside through wall with weatherproof wall cap, backdraft damper, and rodent-proof screening **OR** Nonvented, recirculating type with charcoal filter, **as directed**.

2) Fan Control: Countertop-mounted touch-pad to control fan switch.

d. Duct Type: Manufacturer's standard **OR** 7-inch- (175-mm-) diameter round **OR** 3-1/4 by 10 inches (82 by 250 mm) rectangular, **as directed**.

e. Finish: Baked enamel **OR** Stainless steel, **as directed**.

1) Color: White **OR as directed**.

f. Features:

1) Permanent, washable aluminum mesh **OR** stainless-steel mesh **OR** baffle-type filter(s), **as directed**.

F. Refrigerator/Freezers

1. Refrigerator/Freezer One-door refrigerator with inside freezer compartment **OR** Two-door, side-by-side refrigerator/freezer **OR** Two-door refrigerator/freezer with freezer on top **OR** Two-door refrigerator/freezer with freezer on bottom, **as directed** and complying with AHAM HRF-1.

a. Type: Freestanding **OR** Built in **OR** Undercounter.

b. Dimensions:

1) Width: 16 inches (406 mm) **OR** 24 inches (610 mm) **OR** 27 inches (686 mm) **OR** 30 inches (762 mm) **OR** 36 inches (914 mm) **OR** 42 inches (1067 mm) **OR** 48 inches (1220 mm), **as directed**.

2) Depth: 24 inches (610 mm) **OR** 27 inches (686 mm) **OR** 33-1/4 inches (845 mm), **as directed**.

3) Height: 34-1/2 inches (876 mm) **OR** 70 inches (1778 mm) **OR** 73 inches (1854 mm) **OR** 84 inches (2134 mm), **as directed**.

c. Storage Capacity:

1) Refrigeration Compartment Volume: 15.6 cu. ft. (0.44 cu. m).

2) Freezer Volume: 5.13 cu. ft. (0.15 cu. m).

3) Shelf Area: Three adjustable wire **OR** glass shelves, **as directed**, 26 sq. ft. (2.42 sq. m).

d. General Features:

1) Door Configuration: Framed **OR** Overlay.

2) Revise first option in first subparagraph below if either crushed or cubed ice is required.

3) Dispenser in door for ice and cold water dispenser lock.

4) Built-in water filtration system.
5) Dual refrigeration systems.
6) Separate touch-pad temperature controls for each compartment.

e. Refrigerator Features:
1) Interior light in refrigeration compartment.
2) Compartment Storage: Wine racks **OR** vegetable crisper **OR** meat compartment, **as directed**.
3) Door Storage: Glazed door without storage **OR** Modular compartments **OR** Gallon (3.8 L-) milk-container storage, **as directed**.
4) Temperature-controlled meat/deli bin.

f. Freezer Features: One **OR** Two freezer compartment(s) with door(s) **OR** configured as pull-out drawer(s), **as directed**.
1) Automatic **OR** Manual defrost, **as directed**.
2) Interior light in freezer compartment.
3) Automatic icemaker and storage bin.

g. Energy Performance, ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.

h. Front Panel(s): Manufacturer's standard **OR** Wood panel(s) to match kitchen cabinets **OR** Porcelain enamel **OR** Stainless steel **OR** Wood-panel insert(s) specified in Division 06 Section "Interior Architectural Woodwork" to match kitchen cabinets **OR** Wood-panel insert(s) specified in Division 12 Section "Residential Casework" to match kitchen cabinets **OR** Reversible panel(s) with choice of colors, **as directed**.
1) Panel Color: White **OR** Black, **as directed**.

i. Appliance Color/Finish: White **OR** Black **OR** Stainless steel, **as directed**.

G. Freezers

1. Freezer One **OR** Two freezer compartment(s) with door(s) **OR** configured as pull-out drawer(s), **as directed** and complying with AHAM HRF-1.

a. Type: Freestanding **OR** Built in **OR** Undercounter.

b. Dimensions:
1) Width: 27 inches (686 mm) **OR** 30 inches (762 mm) **OR** 36 inches (914 mm), **as directed**.
2) Depth: 24 inches (610 mm) **OR** 27 inches (686 mm), **as directed**.
3) Height: 34-1/2 inches (876 mm) **OR** 70 inches (1778 mm) **OR** 73 inches (1854 mm) **OR** 84 inches (2134 mm), **as directed**.

c. Storage Capacity:
1) Volume: 5.13 cu. ft. (0.15 cu. m) **OR** 15.0 cu. ft. (0.42 cu. m), **as directed**.
2) Shelf Area: Three adjustable wire **OR** glass shelves, **as directed**, 26 sq. ft. (2.42 sq. m).

d. Features:
1) Door Configuration: Framed **OR** Overlay, **as directed**.
2) Automatic **OR** Manual defrost, **as directed**.
3) Interior light in compartment.
4) Automatic icemaker and storage bin.
5) Temperature touch-pad controls for each compartment.
6) Defrost drain.
7) Lock with key.

e. Energy Performance, ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.

f. Front Panel(s): Manufacturer's standard **OR** Wood panel(s) to match kitchen cabinets **OR** Porcelain enamel **OR** Stainless steel **OR** Wood-panel insert(s) specified in Division 06 Section "Interior Architectural Woodwork" to match kitchen cabinets **OR** Wood-panel insert(s) specified in Division 12 Section "Residential Casework" to match kitchen cabinets, **as directed**.
1) Panel Color: White **OR** Black, **as directed**.

g. Appliance Color/Finish: White **OR** Black **OR** Stainless steel, **as directed**.

H. Icemakers
1. Icemaker:
a. Type: Undercounter.
b. Dimensions:
1) Width: 14-3/4 inches (375 mm) **OR** 15-1/4 inches (387 mm), **as directed**.
2) Depth: 24 inches (610 mm) **OR** 25-1/4 inches (641 mm), **as directed**.
3) Height: 33-5/8 inches (386 mm) **OR** 34-1/2 inches (876 mm), **as directed**.
c. Ice Capacity:
1) Production: 30 lb (13.6 kg) **OR** 50 lb (22.7 kg) per day, **as directed**.
2) Storage: 25 lb (11.3 kg) **OR** 35 lb (15.9 kg), **as directed**.
d. Features:
1) Door Configuration: Framed **OR** Overlay, **as directed**.
2) Automatic defrost.
3) Automatic shutoff.
4) Defrost drain with pump.
e. Front Panel: Manufacturer's standard **OR** Wood panel to match kitchen cabinets **OR** Porcelain enamel **OR** Stainless steel **OR** Wood-panel insert specified in Division 06 Section "Interior Architectural Woodwork" to match kitchen cabinets **OR** Wood-panel insert specified in Division 12 Section "Residential Casework" to match kitchen cabinets, **as directed**.
a) Panel Color: White **OR** Black, **as directed**.
f. Appliance Color/Finish: White **OR** Black **OR** Stainless steel, **as directed**.

I. Dishwashers
1. Dishwasher Complying with AHAM DW-1 and ASSE 1006.
a. Type: Built-in undercounter **OR** Built-in under sink **OR** Portable, **as directed**.
b. Dimensions:
1) Width: 18 inches (457 mm) **OR** 24 inches (610 mm), **as directed**.
2) Depth: 23 inches (584 mm) **OR** 25-3/4 inches (654 mm), **as directed**.
3) Height: 34-1/2 inches (876 mm), **as directed**.
c. Capacity:
1) International Place Settings of China: Eight **OR** 12 **OR** 14, **as directed**.
2) Water Consumption for Full Load: 3.2 gal. (12 L) per cycle.
d. Sound Level: Maximum 42 **OR** 48 dB, **as directed**.
e. Tub and Door Liner: Manufacturer's standard **OR** Porcelain-enameled steel **OR** Stainless steel **OR** Porcelain-enameled steel tub and molded-plastic door liner, **as directed** with sealed detergent and automatic rinsing-aid dispensers.
f. Rack System: Nylon **OR** PVC-coated sliding dish racks, **as directed**, with removable cutlery basket **OR** top cutlery tray **as directed**.
g. Controls: Touch-pad **OR** Rotary-dial controls, **as directed**, with four wash cycles and hot-air and heat-off drying cycle options.
h. Features:
1) Features in first three subparagraphs below are standard with most models.
2) Waste food disposer.
3) Self-cleaning food-filter system.
4) Hot-water booster heater for 140 deg F (60 deg C) **OR** 160 deg F (71 deg C) wash water with incoming water at 100 deg F (38 deg C).
5) Lock-out feature.
6) Half-load option.
7) Delay-wash option.
8) Digital display panel.
9) Water softener.
10) Soil-sensing water use control system.

i. Energy Performance, ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.

j. Front Panel: Manufacturer's standard **OR** Wood panel to match kitchen cabinets **OR** Porcelain enamel **OR** Stainless steel **OR** Wood-panel insert specified in Division 06 Section "Interior Architectural Woodwork" to match kitchen cabinets **OR** Wood-panel insert specified in Division 12 Section "Residential Casework" to match kitchen cabinets **OR** Reversible panel with choice of colors, **as directed**.

1) Panel Color: White **OR** Black, **as directed**.

k. Appliance Color/Finish: White **OR** Black **OR** Stainless steel, **as directed** .

J. Clothes Washers And Dryers

1. Clothes Washer Complying with ASSE 1007:

a. Type: Freestanding **OR** Stacking **OR** Undercounter, top **OR** front-loading unit.

b. Dimensions:

1) Width: 23-1/2 inches (597 mm) **OR** 27 inches (686 mm) **OR** 30 inches (762 mm), **as directed**.

2) Depth: 24 inches (610 mm) **OR** 29 inches (737 mm) **OR** 31 inches (787 mm), **as directed**.

3) Height: 34-1/2 inches (876 mm) **OR** 38 inches (965 mm) **OR** 45 inches (1143 mm), **as directed**.

c. Drum: Manufacturer's standard **OR** Perforated porcelain-enameled steel **OR** Perforated stainless steel, **as directed**.

1) Capacity: 2.7 cu. ft. (0.08 cu. m) **OR** 3.2 cu. ft. (0.09 cu. m) **OR** 3.8 cu. ft. (0.11 cu. m).

d. Controls: Touch-pad **OR** Rotary-dial controls, **as directed**, for water-fill levels, wash/rinse water temperatures, and variable-speed and fabric selectors.

1) Wash Cycles: Four **OR** Six **OR** 10 wash cycles, **as directed**, including regular, delicate, and permanent press.

2) Wash Temperatures: Three settings.

3) Speed Combinations: Two **OR** Four **OR** Five, **as directed**.

e. Electrical Power: 120 V, 60 Hz, 1 phase.

f. Motor: Manufacturer's standard with built-in overload protector.

g. Features:

1) Agitator: Center spindle **OR** Impeller (without spindle), **as directed**.

2) Self-cleaning lint filter.

3) Unbalanced-load compensator.

4) Inlet Hoses: Minimum length 60 inches (1525 mm).

5) Drain Hoses: Minimum length 48 inches (1220 mm).

6) Self-leveling legs.

7) Automatic dispenser for bleach **OR** fabric softener **OR** and **OR** detergent, **as directed**.

8) Spin-cycle safety switch.

9) End-of-cycle signal.

10) Extra-rinse option.

11) Delay-wash option.

12) Electronic temperature control.

13) Water levels automatically set.

14) Pedestal: 8-inch- (203-mm-) high **OR** 15-inch- (381-mm-) high **OR** Manufacturer's standard height laundry pedestal , **as directed**, with storage drawer, matching appliance finish.

h. Energy Performance, ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.

i. Water-Efficient Clothes Washer: Provide clothes washer with modified energy factor greater than or equal to 2.0 and water factor less than 5.5.

j. Appliance Finish: Porcelain enamel on top and lid; baked enamel on front and sides **OR** Stainless steel, **as directed**.

1) Color: White **OR** Almond, **as directed**.

k. Front-Panel Finish: Manufacturer's standard **OR** Wood panel to match kitchen cabinets **OR** Porcelain enamel **OR** Stainless steel **OR** Wood-panel insert specified in Division 06 Section "Interior Architectural Woodwork" to match kitchen cabinets **OR** Wood-panel insert specified in Division 12 Section "Residential Casework" to match kitchen cabinets, **as directed**.

1) Panel Color: White **OR** Black, **as directed**.

2. Clothes Dryer Complying with AHAM HLD-1:

a. Type: Freestanding **OR** Stacking **OR** Undercounter, **as directed**, frontloading, gas **OR** electric **OR** electric, ventless unit, **as directed**..

b. Dimensions:

1) Width: 23-1/2 inches (597 mm) **OR** 27 inches (686 mm), **as directed**.

2) Depth: 24 inches (610 mm) **OR** 31 inches (787 mm), **as directed**.

3) Height: 34-1/2 inches (876 mm) **OR** 36 inches (914 mm), **as directed**.

c. Drum: Manufacturer's standard **OR** Perforated porcelain-enameled steel **OR** Perforated stainless steel, **as directed**.

1) Capacity: 5.7 cu. ft. (0.16 cu. m) **OR** 7.0 cu. ft. (0.20 cu. m), **as directed**.

d. Controls: Touch-pad **OR** Rotary-dial controls for drying cycle, **as directed**, temperatures, and fabric selectors.

e. Electric-Dryer Power: 240 V, 60 Hz, 1 phase, 30 A.

f. Gas-Dryer Power: 120 V, 60 Hz, 1 phase, 15 A electric; 22,000-Btu/h (6400-W) gas.

g. Features:

1) Features in first five subparagraphs below are standard with most manufacturers.

2) Removable lint filter.

3) Electronic temperature and moisture level sensor control.

4) End-of-cycle signal.

5) Interior drum light.

6) Self-leveling legs.

7) Antibacterial cycle.

8) Auxiliary drying rack.

9) Built-in electrical power fuse.

10) Stacking kit to stack dryer over washer.

11) Pedestal: 8-inch- (203-mm-) high **OR** 15-inch- (381-mm-) high **OR** Manufacturer's standard height laundry pedestal, **as directed**, with storage drawer, matching appliance finish.

h. Appliance Finish: Porcelain enamel on top and lid; baked enamel on front and sides **OR** Stainless steel, **as directed**.

1) Color: White **OR** Almond, **as directed**.

i. Front-Panel Finish: Manufacturer's standard **OR** Wood panel to match kitchen cabinets **OR** Porcelain enamel **OR** Stainless steel **OR** Wood-panel insert specified in Division 06 Section "Interior Architectural Woodwork" to match kitchen cabinets **OR** Wood-panel insert specified in Division 12 Section "Residential Casework" to match kitchen cabinets.

1) Panel Color: White **OR** Black, **as directed**.

K. Clothes Washer/Dryer Combinations

1. Clothes Washer/Dryer Combination Complying with ASSE 1007.

a. Type: Freestanding washer/dryer unit with dual-drum design and electric dryer **OR** dual-drum design and gas dryer **OR** all-in-one, single-drum design, **as directed**; washer is top **OR** front loading, **as directed**.

b. Dimensions:

1) Width: 23-1/2 inches (597 mm) **OR** 27 inches (686 mm), **as directed**.

2) Depth: 25 inches (635 mm) **OR** 32 inches (813 mm), **as directed**.

3) Height: 34-1/2 inches (876 mm) **OR** 71-1/2 inches (1816 mm), **as directed**.

c. Washer and Dryer Drums: Manufacturer's standard **OR** Perforated porcelain-enameled steel **OR** Perforated stainless steel, **as directed**.

1) Washer-Drum Capacity: 1.5 cu. ft. (0.04 cu. m) **OR** 2.0 cu. ft. (0.06 cu. m) **OR** 2.6 cu. ft. (0.07 cu. m), **as directed**.
2) Dryer-Drum Capacity: 2.0 cu. ft. (0.06 cu. m) **OR** 3.4 cu. ft. (0.10 cu. m) **OR** 5.9 cu. ft. (0.17 cu. m), **as directed**.

d. Washer/Dryer Drum: Manufacturer's standard **OR** Perforated stainless steel, **as directed**.
1) Drum Capacity: 2.3 cu. ft. (0.07 cu. m).

2. Washer Controls: Touch-pad **OR** Rotary-dial controls for water-fill levels, **as directed**, wash/rinse water temperatures and variable-speed and fabric selectors.
3. Dryer Controls: Touch-pad **OR** Rotary-dial controls for drying cycle, **as directed**, temperatures and fabric selectors.
   a. Wash Cycles: Three wash cycles including regular, delicate, and permanent press.
   b. Wash Temperatures: Three settings.
   c. Speed Combinations: Two.
4. Electric Washer/Dryer Power: 240 V, 60 Hz, 1 phase, 30 A **OR** 120 V, 60 Hz, 1 phase, 15 A, **as directed**.
5. Gas Washer/Dryer Power: 120 V, 60 Hz, 1 phase, 15 A electric; 22,000-Btu/h (6400-W) gas.
6. Motor: Manufacturer's standard with built-in overload protector.
7. Washing Features:
   a. Self-cleaning lint filter.
   b. Unbalanced-load compensator.
   c. Inlet Hoses: Minimum length 60 inches (1525 mm).
   d. Drain Hoses: Minimum length 48 inches (1220 mm).
   e. Self-leveling legs.
   f. Automatic dispenser for bleach, fabric softener and **OR** detergent.
   g. Spin-cycle safety switch.
8. Drying Features:
   a. Removable lint filter.
   b. Electronic temperature and moisture level sensor control.
   c. End-of-cycle signal.
   d. Interior drum light.
9. Energy Performance, ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.
10. Water-Efficient Clothes Washer: Provide clothes washer with modified energy factor greater than or equal to 2.0 and water factor less than 5.5.
11. Appliance Finish: Porcelain enamel on top and lid; baked enamel on front and sides **OR** Stainless steel, **as directed**.
    1) Color: White **OR** Almond, **as directed**.

L. Trash Compactors
   a. Type: Built in **OR** Convertible, **as directed**.
   b. Width: 15 inches (381 mm) **OR** 18 inches (457 mm), **as directed**.
   c. Capacity: 1.4 cu. ft. (0.04 cu. m) **OR** 1.7 cu. ft. (0.05 cu. m), **as directed**.
   d. Features:
      1) Key-operated starting switch.
      2) Rear wheels.
      3) Removable bag carrier.
      4) Retainer for disposable bags.
      5) Odor-control mechanism.
      6) Foot-operated drawer operator.

   e. Front Panel: Manufacturer's standard **OR** Wood panel to match kitchen cabinets **OR** Enameled steel **OR** Stainless steel **OR** Wood-panel insert specified in Division 06 Section "Interior Architectural Woodwork" to match kitchen cabinets **OR** Wood-panel insert specified in Division 12 Section "Residential Casework" to match kitchen cabinets, **as directed**.
      a) Panel Color: White **OR** Black, **as directed**.

M. General Finish Requirements
1. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
2. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

1.3 EXECUTION

A. Examine
1. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.
2. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.
3. Examine walls, ceilings, and roofs for suitable conditions where overhead exhaust hoods **OR** downdraft exhaust and microwave ovens with vented exhaust fans will be installed.
4. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
5. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Installation, General
1. General: Comply with manufacturer's written instructions.
2. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed.
3. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
4. Range Anti-Tip Device: Install at each range according to manufacturer's written instructions
5. Utilities: Refer to Division 15 AND Division 16 for plumbing and electrical requirements.

C. Field Quality Control
1. Perform tests and inspections.
   a. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
2. Tests and Inspections:
   a. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
   b. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
   c. Operational Test: After installation, start units to confirm proper operation.
   d. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.
3. An appliance will be considered defective if it does not pass tests and inspections.
4. Prepare test and inspection reports.

END OF SECTION 11421

Task	Specification	Specification Description
11421	11410	Food Service Equipment
11425	01352	No Specification Required
11425	11410	Food Service Equipment
11430	11410	Food Service Equipment
11435	11410	Food Service Equipment
11436	11410	Food Service Equipment
11460	11410	Food Service Equipment
11463	11410	Food Service Equipment
11465	11410	Food Service Equipment
11470	11410	Food Service Equipment
11471	11410	Food Service Equipment
11472	11410	Food Service Equipment
11473	11410	Food Service Equipment

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SECTION 11475 - RESIDENTIAL CASEWORK

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for residential casework. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. This Section includes the following:
a. Kitchen cabinets.
b. Vanity cabinets.
c. Plastic-laminate countertops and backsplashes.
d. Solid-surfacing-material countertops and backsplashes.

C. Definitions
1. Exposed Surfaces of Cabinets: Surfaces visible when doors and drawers are closed, including visible surfaces in open cabinets or behind glass doors.
2. Semiexposed Surfaces of Cabinets: Surfaces behind opaque doors or drawer fronts, including interior faces of doors and interiors and sides of drawers. Bottoms of wall cabinets are defined as "semiexposed."
3. Concealed Surfaces of Cabinets: Surfaces not usually visible after installation, including sleepers, web frames, dust panels, bottoms of drawers, and ends of cabinets installed directly against and completely concealed by walls or other cabinets. Tops of wall cabinets and utility cabinets are defined as "concealed."

D. Submittals
1. Product Data: For cabinets, countertop material, and cabinet hardware.
2. Shop Drawings: For cabinets and countertops. Include plans, elevations, details, and attachments to other work. Show materials, finishes, filler panels, hardware, edge and backsplash profiles, methods of joining countertops, and cutouts for plumbing fixtures.
3. Samples: For each type of material exposed to view.
4. LEED Submittals:
a. Product Data for Credit EQ 4.4: For adhesives and composite wood products, documentation indicating that product contains no urea formaldehyde.
b. Product Data for Credit MR 4.1 and MR 4.2, **as directed**: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
1) Include statement indicating costs for each product having recycled content.
c. Certificates for Credit MR 7: Chain-of-custody certificates certifying that wood used to produce cabinets and countertops complies with forest certification requirements. Include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.
1) Include statement indicating costs for each certified wood product.

E. Quality Assurance
1. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
2. Quality Standards: Unless otherwise indicated, comply with the following standards:
a. Cabinets: KCMA A161.1.

1) KCMA Certification: Provide cabinets with KCMA's "Certified Cabinet" seal affixed in a semiexposed location of each unit and showing compliance with the above standard.

b. Plastic-Laminate Countertops: KCMA A161.2.

1.2 PRODUCTS

A. Cabinet Materials

1. General:

a. Certified Wood Materials: Fabricate cabinets with wood and wood-based products produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

b. Adhesives: Do not use adhesives that contain urea formaldehyde.

c. Hardwood Lumber: Kiln dried to 7 percent moisture content.

d. Softwood Lumber: Kiln dried to 10 percent moisture content.

e. Hardwood Plywood: HPVA HP-1, made with adhesive containing no urea formaldehyde.

f. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.

OR

Particleboard: Straw-based particleboard complying with requirements of ANSI A208.1, Grade M-2, except for density.

g. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.

h. Hardboard: AHA A135.4, Class 1 Tempered.

2. Exposed Materials:

a. Exposed Wood Species: Oak **OR** Maple **OR** Alder **OR** Birch **OR** Hickory **OR** Cherry **OR** Manufacturer's standard domestic hardwood species, **as directed**.

1) Select materials for compatible color and grain. Do not use two adjacent exposed surfaces that are noticeably dissimilar in color, grain, figure, or natural character markings.

2) Staining and Finish: As selected from manufacturer's full range.

b. Solid Wood: Clear hardwood lumber of species indicated, free of defects.

c. Plywood: Hardwood plywood with face veneer of species indicated, with Grade A faces and Grade C backs of same species as faces.

1) Edge band exposed edges with minimum 1/8-inch- (3-mm-) thick, solid-wood edging of same species as face veneer.

d. Plastic Laminate: Particleboard faced with high-pressure decorative laminate complying with NEMA LD 3, Grade VGS **OR** HGL, **as directed**.

1) Where edges of solid-color plastic-laminate sheets will be visible after fabrication, provide through-color plastic laminate.

2) For doors and drawer fronts faced with plastic laminate, provide plastic-laminate edges of same grade, pattern, color, and texture of plastic laminate as for faces.

3) Colors, Textures, and Patterns: As selected from cabinet manufacturer's full range.

e. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

1) Provide material finished on both sides for doors and drawer fronts.

2) Provide PVC or polyester edge banding complying with LMA EDG-1 on components with exposed or semiexposed edges.

3) Colors: As selected from cabinet manufacturer's full range.

f. Thermoformed Vinyl-Faced Panels: Medium-density fiberboard, milled to required shapes, with a thermoformed vinyl overlay applied in a vacuum or membrane press.

1) Color: As selected from cabinet manufacturer's full range.

g. PVC Edge Molding: Rigid PVC extrusions, through color with satin finish, 3 mm thick at doors and drawer fronts, and 1 mm thick elsewhere.

1) Color: As selected from cabinet manufacturer's full range.

3. Semiexposed Materials: Unless otherwise indicated, provide the following:
   a. Solid Wood: Sound hardwood lumber, selected to eliminate appearance defects. Same species as exposed surfaces or stained to be compatible with exposed surfaces.
   b. Plywood: Hardwood plywood with Grade C faces and not less than Grade 3 backs of same species as faces. Face veneers of same species as exposed surfaces or stained to be compatible with exposed surfaces.
   c. Plastic Laminate: Particleboard faced with high-pressure decorative laminate complying with NEMA LD 3, Grade VGS **OR** CLS, **as directed**.
      1) For backs of doors and drawer fronts faced with plastic laminate, provide same grade, pattern, color, and texture of plastic laminate as for faces.
      2) For face frames faced with plastic laminate, provide plastic-laminate edges of same grade, pattern, color, and texture of plastic laminate as for faces.
      3) Colors, Textures, and Patterns: As selected from cabinet manufacturer's full range.
   d. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.
      1) Provide material finished on both sides for shelves, dividers, drawer bodies, and other components with two semiexposed surfaces.
      2) Provide PVC or polyester edge banding complying with LMA EDG-1 on components with semiexposed edges.
      3) Colors: As selected from cabinet manufacturer's full range.
   e. Vinyl-Faced Particleboard: Medium-density particleboard with embossed, wood-grain-patterned, **as directed**, vinyl film adhesively bonded to particleboard.
      1) Provide vinyl film on both sides of shelves, dividers, drawer bodies, and other components with two semiexposed surfaces and on semiexposed edges.
      2) Colors, Textures, and Patterns: As selected from cabinet manufacturer's full range.
4. Concealed Materials: Solid wood or plywood, of any hardwood or softwood species, with no defects affecting strength or utility; particleboard; medium-density fiberboard; or hardboard.

B. Cabinet Hardware
1. General: Manufacturer's standard units complying with BHMA A156.9, of type, size, style, material, and finish as selected from manufacturer's full range.
2. Pulls: Surface-mounted decorative pulls **OR** Back-mounted decorative pulls **OR** Back-mounted decorative pulls with backing plates **OR** Wire pulls **OR** Back-mounted Knobs **OR** Surface-mounted porcelain knobs, **as directed**.
3. Hinges: Decorative full-surface hinges **OR** Concealed butt hinges **OR** Semiconcealed (wraparound) butt hinges for overlay doors **OR** Pivot (knife) hinges **OR** Concealed European-style self-closing hinges, **as directed**.
4. Drawer Guides: Epoxy-coated-metal, self-closing drawer guides; designed to prevent rebound when drawers are closed; with nylon-tired, ball-bearing rollers; and complying with BHMA A156.9, Type B05011 or B05091.

C. Countertop Materials
1. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.
   a. Grade: HGS **OR** HGL **OR** HGP, **as directed**.
   b. Provide through-color plastic laminate.
   c. Grade for Backer Sheet: BKL.
   d. Colors, Textures, and Patterns: As selected from countertop manufacturer's full range.
2. Certified Wood Materials: Fabricate countertops with wood and wood-based products produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
3. Particleboard: ANSI A208.1, Grade M-2 **OR** M-2-Exterior Glue, **as directed**.
   OR
   Particleboard: Straw-based particleboard complying with requirements of ANSI A208.1, Grade M-2, except for density.

4. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.
5. Adhesives: Do not use adhesives that contain urea formaldehyde.
6. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.
   a. Type: Provide Standard Type or Veneer Type made from material complying with requirements for Standard Type, as indicated, unless Special Purpose Type is indicated.
   b. Integral Sink Bowls: Comply with ISSFA-2 and ANSI Z124.3, Type 5 or Type 6, without a precoated finish.
   c. Colors and Patterns: As selected from manufacturer's full range.
7. Solid Wood Edges and Trim: Clear red oak **OR** white oak **OR** hard maple **OR** cherry, **as directed**, lumber, free of defects, selected for compatible grain and color, and kiln dried to 7 percent moisture content.

D. Cabinets
1. Face Style: Flush overlay; door and drawer faces cover cabinet fronts with only enough space between faces for operating clearance.
   OR
   Face Style: Reveal overlay; door and drawer faces partially cover cabinet fronts.
   OR
   Face Style: Lipped overlay; door and drawer faces are rabbeted and partially inset within cabinet fronts with the lip of the rabbet overlapping cabinet body members or face frames.
   OR
   Face Style: Flush inset; door and drawer faces are set within cabinet fronts, flush with face.
2. Cabinet Style: Face Frame **OR** Frameless, **as directed**.
3. Door and Drawer Fronts: Solid-wood stiles and rails, 5/8 inch (16 mm) thick, with 3/4-inch- (19-mm-) thick, solid-wood center panels.
   OR
   Door and Drawer Fronts: Solid-wood stiles and rails, 3/4 inch (19 mm) thick, with 1/4-inch- (6.4-mm-) thick, veneer-faced plywood center panels.
   OR
   Door and Drawer Fronts: 1/2-inch- (12.7-mm-) thick, veneer-faced plywood.

   OR Door and Drawer Fronts: 1/2-inch- (12.7-mm-) thick plastic-laminate-faced particleboard, with continuous solid-wood pulls on one edge, **as directed**, with PVC edge banding, **as directed**.
   OR
   Door and Drawer Fronts: 1/2-inch- (12.7-mm-) thick thermoset decorative panels, with continuous solid-wood pulls on one edge, **as directed**.
   OR
   Door and Drawer Fronts: 1/2-inch- (12.7-mm-) thick, thermoformed-vinyl-faced panels with vinyl overlay on faces and edges and with thermoset decorative panel backs **OR** faces, backs, and edges, **as directed**.
4. Face Frames: 3/4-by-1-5/8-inch (19-by-41-mm) solid wood with glued mortise and tenon or doweled joints, **as directed**.
   OR
   Face Frames: 5/8-inch- (16-mm-) thick particleboard with plastic laminate on exposed and semiexposed surfaces.
   OR
   Face Frames: 5/8-inch- (16-mm-) thick thermoset-decorative-panel material.
   OR
   Face Frames: 1/2-inch- (12.7-mm-) thick, thermoformed-vinyl-faced panels with vinyl overlay on exposed and semiexposed surfaces.
5. Exposed Cabinet End Finish: Wood veneer **OR** Plastic laminate **OR** Thermoset decorative panels **OR** Thermoformed vinyl-faced panels, **as directed**.

6. Cabinet End Construction: 5/8-inch- (16-mm-) **OR** 1/2-inch- (12.7-mm-), **as directed**, thick particleboard or 1/2-inch- (12.7-mm-) **OR** 3/8-inch- (9.5-mm-), **as directed**, thick plywood.
7. Cabinet Tops and Bottoms: 5/8-inch- (16-mm-) thick particleboard or 1/2-inch- (12.7-mm-) thick plywood, fully supported by and secured in rabbets in end panels, front frame (if any), and back rail.
   OR
   Cabinet Tops and Bottoms: 1/2-inch- (12.7-mm-) thick particleboard or 3/8-inch- (9.5-mm-) thick plywood, fully supported by and secured in rabbets in end panels, front frame, and back rail.
8. Back, Top, and Bottom Rails: 3/4-by-2-1/2-inch (19-by-63-mm) solid wood, interlocking with end panels and rabbeted to receive top and bottom panels. Back rails secured under pressure with glue and with mechanical fasteners.
9. Wall-Hung-Unit Back Panels: 3/16-inch- (4.8-mm-) thick plywood fastened to rear edge of end panels and to top and bottom rails.
10. Base-Unit Back Panels: 3/16-inch- (4.8-mm-) thick plywood fastened to rear edge of end panels and to top and bottom rails.
11. Base-Unit Back Panels: 1/8-inch- (3.2-mm-) thick hardboard fastened to rear edge of end panels and to top and bottom rails.
12. Front Frame Drawer Rails: 3/4-by-1-1/4-inch (19-by-32-mm) solid wood mortised and fastened into face frame.
13. Drawers: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
    a. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners **OR** glued dovetail joints, **as directed**.
    b. Subfronts, Backs, and Sides: 3/4-inch- (19-mm-) **OR** 1/2-inch- (12.7-mm-), **as directed**, thick solid wood.
       OR
       Subfronts, Backs, and Sides: 1/2-inch- (12.7-mm-) thick solid wood or 3/8-inch- (9.5-mm-) thick plywood.
       OR
       Subfronts, Backs, and Sides: 3/8-inch- (9.5-mm-) thick particleboard.
    c. Bottoms: 1/4-inch- (6.4-mm-) **OR** 3/16-inch- (4.8-mm-), **as directed**, thick plywood.
       OR
       Bottoms: 1/4-inch- (6.4-mm-) thick hardboard **OR** particleboard, **as directed**.
14. Shelves: 3/4-inch- (19-mm-) thick particleboard or 5/8-inch- (16-mm-) thick plywood.
    OR
    Shelves: 5/8-inch- (16-mm-) thick particleboard or 1/2-inch- (12.7-mm-) thick plywood.
15. Joinery: Rabbet backs flush into end panels and secure with concealed mechanical fasteners. Connect tops and bottoms of wall cabinets and bottoms and stretchers of base cabinets to ends and dividers with mechanical fasteners. Rabbet tops, bottoms, and backs into end panels.
16. Factory Finishing: Finish cabinets at factory. Defer only final touchup until after installation.

E. Plastic-Laminate Countertops
1. Configuration: Provide countertops with the following front, cove (intersection of top with backsplash), backsplash, and endsplash style:
   a. Front: No drip (raised marine edge with rolled front) **OR** Rolled **OR** Bevel **OR** Self-edge **OR** Wood-trimmed edge as indicated, **as directed**.
   b. Cove: Cove molding (one-piece postformed laminate supported at junction of top and backsplash by wood cove molding) **OR** Applied (backsplash rests on top forming seam at inside corner), **as directed**.
   c. Backsplash: Curved or waterfall shape with scribe **OR** Square edge without scribe **OR** Sloped top edge without scribe **OR** Square edge with scribe, **as directed**.
   d. Endsplash: None **OR** Square edge without scribe **OR** Sloped top edge without scribe **OR** Square edge with scribe, **as directed**.
2. Plastic-Laminate Substrate: Particleboard not less than 3/4 inch (19 mm) thick.
   a. For countertops at sinks and lavatories, use Grade M-2-Exterior-Glue particleboard or exterior-grade plywood.

b. Build up countertop thickness to 1-1/2 inches (38 mm) at front, back, and ends with additional layers of particleboard laminated to top.

3. Backer Sheet: Provide plastic-laminate backer sheet on underside of countertop substrate.
4. Paper Backing: Provide paper backing on underside of countertop substrate.

F. Solid-Surfacing-Material Countertops

1. Configuration: Provide countertops with the following front and backsplash style:
   a. Front: Straight, slightly eased at top **OR** Bevel **OR** 3/4-inch (19-mm) bullnose **OR** Radius edge with apron, 2 inches (50 mm) high with 3/8-inch (9.5-mm) radius **OR** 1-1/2-inch (38-mm) laminated bullnose **OR** 1-inch (25-mm) laminated bullnose **OR** Wood-trimmed edge as indicated, **as directed**.
   b. Backsplash: Straight, slightly eased at corner **OR** Bevel **OR** Radius edge with 3/8-inch (9.5-mm) radius, **as directed**.
   c. Endsplash: Matching backsplash **OR** None, **as directed**.
2. Countertops: 1/2-inch- (12.7-mm-) **OR** 3/4-inch- (19-mm-), **as directed**, thick, solid-surfacing material with wood-trimmed edges, **as directed**.
   OR
   Countertops: 1/2-inch- (12.7-mm-) **OR** 3/4-inch- (19-mm-), **as directed**, thick, solid-surfacing material with front edge built up with same material.
   OR
   Countertops: 1/4-inch- (6.4-mm-) thick, solid-surfacing material laminated to 3/4-inch- (19-mm-) thick particleboard with wood-trimmed edges.
   OR
   Countertops: 1/4-inch- (6.4-mm-) thick, solid-surfacing material laminated to 3/4-inch- (19-mm-) thick particleboard with front edge built up with 3/4-inch- (19-mm-) thick, solid-surfacing material.
3. Backsplashes: 1/2-inch- (12.7-mm-) **OR** 3/4-inch- (19-mm-), **as directed**, thick, solid-surfacing material with wood-trimmed edges, **as directed**.
4. Fabrication: Fabricate tops in one piece with shop-applied edges and backsplashes, **as directed**, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
   a. Fabricate with loose backsplashes for field assembly.
   b. Install integral sink bowls in countertops in the shop.

1.3 EXECUTION

A. Installation

1. Install cabinets with no variations in flushness of adjoining surfaces; use concealed shims. Where cabinets abut other finished work, scribe and cut for accurate fit. Provide filler strips, scribe strips, and moldings in finish to match cabinet face.
2. Install cabinets without distortion so doors and drawers fit openings and are aligned. Complete installation of hardware and accessories as indicated.
3. Install cabinets and countertop level and plumb to a tolerance of 1/8 inch in 8 feet (3 mm in 2.4 m).
4. Fasten cabinets to adjacent units and to backing.
   a. Fasten wall cabinets through back, near top and bottom, at ends and not less than 24 inches (600 mm) o.c. with No. 10 wafer-head screws sized for 1-inch (25-mm) penetration into wood framing, blocking, or hanging strips.
   b. Fasten wall cabinets through back, near top and bottom, at ends and not less than 24 inches (600 mm) o.c., with toggle bolts through metal backing behind gypsum board.
5. Fasten plastic-laminate countertops by screwing through corner blocks of base units into underside of countertop. Form seams using splines to align adjacent surfaces, and secure with glue and concealed clamping devices designed for this purpose.
   a. Provide cutouts for sinks and lavatories, including holes for faucets and accessories.
   b. Seal edges of cutouts by saturating with varnish.

6. Fasten solid-surfacing-material countertops by screwing through corner blocks of base units into underside of countertop. Align adjacent surfaces, and form seams to comply with manufacturer's written instructions using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
   a. Install backsplashes and endsplashes to comply with solid-surfacing-material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
   b. Seal edges of cutouts by saturating with varnish.

B. Adjusting And Cleaning
   1. Adjust cabinets and hardware so doors and drawers are centered in openings and operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.
   2. Clean casework on exposed and semiexposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

END OF SECTION 11475

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Task	Specification	Specification Description
11475	11410	Food Service Equipment
11520	01352	No Specification Required

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SECTION 11910 - REFRIGERATORS

1.1 GENERAL

A. Summary
1. Section Includes:
a. Remove existing refrigerators.
b. Refrigerators supply and deliver only or supply and install as scheduled.
2. Related Requirements: Comply with requirements of following sections:
a. Contractor Use of Premises and Work Sequence
b. Section “Alteration Project Procedures.”
3. Related Sections:
a. Kitchen Renovation Requirements; “Summary of Work”
b. Reference Standards: Section “References.”

B. References
1. Reference Standards: See Section “References.” Comply with following:
a. Association of Home Appliance Manufacturers (AHAM) HRF-1 - Standard for Household Refrigerators and Household Freezers, 1988.
1) ASTM B 117 - Salt Spray (Fog) Testing.
b. ANSI/UL 250 - Household Refrigerators and Freezers, 1991.
c. Certification:
1) ANSI Z34.2 - Certification, Self-Certification by Producer or Supplier, 1987.

C. Definitions
1. Configurations:
a. SD: Single Door.
b. TF: Top Freezer.
c. BF: Bottom Freezer.
d. SS: Side-by-Side.
2. Defrost System:
a. M: Manual Defrost: Defrost system in which defrosting action for refrigerated surfaces is initiated manually.
b. P: Partial Automatic: Defrost system in which defrosting action for refrigerated surfaces in refrigerator compartment is initiated and terminated automatically and defrosting action for refrigerated surfaces in freezer is initiated manually.
c. A: Automatic Defrost: Defrost system in which defrosting action for all refrigerated surfaces is initiated and terminated automatically.
3. Efficiency Standards:
a. Refrigerator: Cabinet designed for refrigerated storage of food at temperatures above 0 degrees C (32 degrees F) and may include compartment for freezing and storage of food at temperatures below 0 degrees C (32 degrees F), but does not provide separate low temperature compartment designed for freezing and storage of food at temperatures below minus 13 degrees C (8 degrees F).
b. Refrigerator-freezer: Cabinet with two or more compartments with at least one compartment designed for refrigerated storage of food at temperatures above 0 degrees C (32 degrees F) and with at least one compartment designed for freezing and storage of food at temperatures below minus 13 degrees C (8 degrees F).
c. AV: Adjusted Volume:
1) Refrigerator: [1.44 x freezer volume (cubic feet)] + refrigerator volume (cubic feet).
2) Refrigerator-freezer: [1.63 x freezer volume (cubic feet)] + refrigerator volume (cubic feet).
4. Supply and Delivery Only: Include supply and delivery to site(s) FOB destination freight prepaid. Unless otherwise specified or scheduled, unloading and handling at site is by PHA/IHA.

D. System Description
1. Performance Requirements: Comply with following:
   a. Refrigerators: Capable of producing average cabinet air temperature in general food storage compartment of 2.2 degrees C (36 degrees F) in ambient of 21.1 degrees C (70 degrees F), and 3.3 degrees C (38 degrees F) in ambient of 43.3 degrees C (110 degrees F).
      1) Performance Test Procedures: As specified in AHAM HRF-1.
   b. Plastic Compartment and Door Liners: Not show any cracks or crazing when tested under Environment Cracking Resistance Test specified in AHAM HRF-1.
      1) Single-Piece Liners Testing: As specified in AHAM HRF-1, paragraph 10.6.
2. Efficiency Standards: Provide refrigerators which do not exceed following annual energy consumption in kWh:
   a. Refrigerators and Refrigerator-freezers with Manual Defrost: 13.5 AV plus 299.
   b. Refrigerator-freezers with Partial Automatic Defrost: 10.4 AV plus 398.
   c. Refrigerator-freezers with Automatic Defrost with Top Mounted Freezer without Through-the-door Ice Service: 16.0 AV plus 355.
   d. Refrigerator-freezers with Automatic Defrost with Side Mounted Freezer without Through-the-door Ice Service: 11.8 AV plus 501.
   e. Refrigerator-freezers with Automatic Defrost with Bottom Mounted Freezer without Through-the-door Ice Service: 16.5 AV plus 367.

E. Submittal
1. Product Data: Submit to Contracting Officer.
2. Samples:
   a. Production Sample: When requested, provide sample refrigerator to Contracting Officer for examination as to compliance with specifications.
   b. Color Samples: Submit samples of manufacturer s standard colors to Contracting Officer for selection.
3. Quality Assurance/Control Submittals: Submit following to Contracting Officer:
   a. Certificates: Manufacturer's written self certification that refrigerators meet or exceed specified requirements.
   b. Manufacturer's installation instructions.
4. Closeout Submittals: Submit following to Contracting Officer:
   a. Operation and Maintenance: Provide use and care information with each refrigerator. Include parts manual with diagrams and part numbers.
   b. Special warranty.

F. Quality Assurance
1. Qualifications: Manufacturer: Stock and sell parts for refrigerators supplied for five years from time of delivery.
2. Regulatory Requirements: Comply with following:
   a. EPA regulations regarding refrigerant.
   b. Accessibility:
      1) Architectural Barriers Act of 1968 as amended (42 USC 4152-4157) and HUD implementing regulations (24 CFR Part 40).
         a) Uniform Federal Accessibility Standards (UFAS).
      2) Section 504 of the Rehabilitation Act of 1973 as amended (29 USC 794) and HUD implementing regulations 24 CFR Part 8.
      3) Fair Housing Accessibility Guidelines (24 CFR Chapter 1).
      4) Americans with Disabilities Act of 1990 (ADA) (28 CFR Part 35).
3. Appliances shall meet or exceed requirements established by the Energy Star program and bear the Energy Star logo. Visit www.energystar.gov for a listing of products that qualify. Energy Star® is a voluntary partnership that includes the U.S. Department of Energy, the U.S. Environmental Protection Agency, product manufacturers, local utilities, and retailers, helps

promote efficient products by labeling them with the Energy Star logo and educating consumers about the benefits of energy efficiency.

G. Delivery, Storage, And Handling
1. Packing, Shipping, Handling, and Unloading: In accordance with standard commercial practices.
2. Acceptance at Site: Inspect refrigerators upon delivery. Replace damaged or defective appliances before installation.

H. Scheduling
1. Scheduling and Completion: Comply with requirements of Division 1.

I. Warranty
1. Special Warranties: Provide following written special warranties:
   a. Plastic parts of cabinet for period of two years.
   b. Sealed refrigerator cooling system for five years.
      1) Provide new or reconditioned cooling system units or components, replacing units and/or parts which become defective (excluding damage due to visible abuse) during five year period.
   c. Entire refrigerator for one year.
2. Special Warranty Periods: If refrigerator becomes inoperative, as defined in following paragraph, repair or replace and install any part (except enamel, porcelain or lacquer) necessary to make refrigerator operative within five working days of notification.
   a. Inoperative Refrigerator: When interior cabinet temperature rises above 10.0 degrees C (50 degrees F) and remains at such temperature for six or more consecutive hours after usual normal adjustments have been made or other mechanical and electrical trouble affecting normal operations has been corrected.
3. Special Warranties: Include labor, material and equipment to provide replacements and make repairs to refrigerators at no additional cost to PHA/IHA.
   a. Defective Units and/or Parts: Become property of Contractor.
   b. Submit name and address of local agent who will furnish service and replacement parts in connection with warranties to PHA/IHA.
      1) Charges by local service agent to PHA/IHA for services covered under special warranties not allowed.

1.2 PRODUCT

A. Refrigerators - General Requirements
1. Refrigerators: Household type, self-contained with electric-motor-driven condensing units and comply with Performance Requirements and Energy Standard Requirements.
2. Types, Sizes and Grades: As specified and scheduled.
3. Total Storage Volumes, Shelf Areas and Dimensions: In accordance with descriptions and computed in accordance with AHAM HRF-1.

B. Refrigerators Cabinets
1. Outer Shells (including Doors): Carbon-steel sheet finished in baked synthetic enamel.
   a. Colors: As scheduled from manufacturer s standard colors.
2. Exterior Doors: Provide with reversible hinges for right or left hand swing except on side-by-side (SS) configuration.
   a. Construction of Freezer or Evaporator Door and Hinging: Door may be operated without breaking, cracking, or distorting when freezer or evaporator is free from or has maximum thickness of 6 mm (1/4 inch) of frost on outer surface of evaporator adjacent to door.
   b. Exterior Doors: Equipped with magnetic gasket.
   c. Doors: Contain shelves.
3. Interior Liners of (including General and Low-Temperature) Storage Compartments and Doors: Porcelain enamel on carbon-steel or molded plastic.

a. Carbon-Steel Sheet Inner Liners: Porcelain enamel or baked synthetic enamel finish.
b. Color of Plastic Inner Liners: White or pastel.
c. Plastic Liners in Conjunction with Foamed-In-Place Polyurethane Employing Fluorinated Hydrocarbons: Isolate liner material from polyurethane foam or fabricate of acrylonitrile butadiene styrene (ABS) or High Impact Polystyrene (HIPS).
d. Breaker Strips: ABS plastic, polypropylene, or HIPS when insulation is foamed-in-place polyurethane with fluorinated hydrocarbons.

4. Drawers and Trays:
   a. Vegetable Drawers or Crisper Trays: Provide one or more trays occupying full width of food compartment and readily removable.
   b. Drawers or Trays: Constructed of steel finished with porcelain enamel, anodized aluminum, or durable plastic; durable glass; or non-corrosive metal.
   c. Ice Cube Trays: Provide minimum of two standard size ice cube trays.
   d. Defrosting or Chiller Tray: Made of material suitable for intended service and of adequate size to receive drip from cooling unit during defrosting.
5. Hardware Components: Sturdy construction and made of material that are durable and structurally correct for application.
   a. Hardware Attachment Devices (screws, bolts and nuts): Of material and finish consistent with material of components and parts which they are used.
   b. Hardware Finish: Remain intact after being subjected to salt spray test for period of 25 hours in accordance with ASTM B 117.
      1) Center Section of Door Handle: Vinyl covered steel is acceptable.
   c. Food Compartment Door Hinges: May be same finish as specified for outer panel of food compartment door.
   d. Hardware: Securely attached in substantial manner and to extent that removal may not be accomplished without use of tools.
6. Manual Defrost and Partial Defrost Refrigerators: Provide clear and legible caution similar to following: Do not use implements to defrost or to remove ice trays or other material from freezer section.
   a. Location: Print or impress on freezer door or on name plate securely fastened in another prominent position easily read by user.

C. Refrigerators Components
1. Electrical Components and Parts: Locate and mount controls, lamp socket, relay, switches, thermostat, wiring harness, cables and leads and their accessories in manner that their replacement may be readily accomplished.
   a. Electrical Assemblies and Harness: Design and manufacture so that replacement of complete assembly or harness is not necessary when any component part of assembly becomes defective or inoperative.
   b. Individual Components and Parts of Assemblies and Harness: Obtainable for relatively simple replacement purposes.
2. Temperature Control: Equip refrigerators with off position and contact points or setting positions for wide range of degrees of temperature, which may be selected by readily accessible knob, properly marked with settings available, mounted on temperature control shaft.
   a. Relay: Quality and rating which under normal operating conditions shall function properly for at least one year period and which is consistent with requirements specified and its companion components and parts in electrical circuit.
3. Motor: For 115 volt, plus or minus 10 percent, 60 HZ, single phase, alternating current operation and capable of starting in ambient temperature of 37.8 degrees C (100 degrees F) on voltages between 90 percent and 100 percent of rated voltage.
   a. Thermal Overload Protection: Automatic re-set type to prevent excess temperature rise of motor windings.
   b. Three-Wire Cord with Three-Prong Attachment Plug: Provide grounding of refrigerator and extend five feet to nine feet beyond point at which it is attached to back of cabinet.

c. Motor: Type, speed, load and horsepower ratings consistent with other requirements specified.

4. Refrigeration Unit: Compressor, motor and housing of hermetically sealed type with reciprocating or rotary-type compressor.
   a. Compressor: Equipped with means of unloading, such as automatic unloader or capillary tube.
   b. Sealed Refrigerating System: Serviceable by complete unit replacement or replacement of component parts such as motor compressor assembly, evaporator, condenser and heat exchanger.
   c. Hermetic Compressor Unit: Quiet in operation, free from excessive vibration and entirely automatic in operation.

D. Workmanship
1. Welding and Brazing: Complete; uniform and properly fused; with no holes, slag inclusions, scale, or flux deposits; and not cracked, fractured or undercut.
2. Soldering: Complete, clean, adherent and without pin-holes.
3. Fasteners: Not be broken, fractured, stripped, or loose.
   a. Structural Parts Subject to Vibration: Provide lock washers or self-locking washers.

1.3 EXECUTION

A. Examination
1. Site Verification of Conditions:
   a. Utilities: Verify that required utilities are available, in proper locations, and ready for use.

B. Preparation
1. Existing Refrigerators: Remove existing refrigerators and debris from site.

C. Installation
1. General: Install refrigerators in accordance with manufacturer's recommendations.
   a. Make adjustments to feet of refrigerators for a level installation.
   b. Install in manner to ensure proper ventilation space is present.

D. Cleaning
1. Cleaning: Comply with requirements of Section 01120.

E. Schedules
1. Provide refrigerators as selected in following schedule:

_____ Remove existing refrigerators.

_____ Supply and Deliver Only to_____.

_____ Unloading and handling included.

_____ Supply and Install.

SELECTION	SIZE	COLOR	TYPE
_____	0.28 cu m (10.0 CU FT) Minimum	_____	SD/M/S: Small, Single Door, Manual Defrost.
_____	0.37 cu m (13.0 CU FT) Minimum	_____	SD/M/L: Large, Single Door, Manual Defrost.
_____	0.28 - 0.34 cu m (10.0 - 11.9) CU FT	_____	TF/P/S: Small, Top Freezer, Partial Automatic Defrost.
_____	0.34 - 0.39 cu m (12.0 - 13.9 CU FT)	_____	TF/P/M: Medium, Top Freezer, Partial Automatic Defrost.

_____ 0.40 cu m (14.0 CU FT) Minimum	_____TF/P/L: Large, Top Freezer, Partial Automatic Defrost.
_____ 0.28 - 0.34 cu m (10.0 - 11.9 CU FT)	_____TF/A/S: Small, Top Freezer, Automatic Defrost.
_____ 0.34 - 0.39 cu m (12.0 - 13.9 CU FT)	_____TF/A/M: Medium, Top Freezer, Automatic Defrost.
_____ 0.40 - 0.45 cu m (14.0 - 15.9 CU FT)	_____TF/A/ML: Medium/Large, Top Freezer, Automatic Defrost.
_____ 0.45 - 0.51 cu m (16.0 - 17.9 CU FT)	_____TF/A/L: Large, Top Freezer, Automatic Defrost.
_____ 0.51 cu m (18.0 CU FT) Minimum	_____TF/A/EL: Extra Large, Top Freezer, Automatic Defrost.
_____ 0.45 cu m (16.0 CU FT) Minimum	_____BF/A for Accessible Units: Bottom Freezer, Automatic Defrost in accordance with UFAS requirements.
_____ 0.45 cu m (16.0 CU FT) Minimum	_____SS/A for Accessible Units: Side-by-Side, Automatic Defrost in accordance with UFAS requirements.

END OF SECTION11910

SECTION 11910a - GAS RANGES

GENERAL

Summary

1. Section Includes:
   a. Remove existing ranges.
   b. Gas ranges, supply and deliver only or supply and install as scheduled.
2. Related Requirements: Comply with requirements of following sections:
   a. Contractor Use of Premises and Work Sequence; “Summary of Work”
   b. Section “Alteration Project Procedures.”
3. Related Sections:
   a. Kitchen Renovation Requirements: Section “Summary of Work”
   b. Reference Standards: Section “References.”
   c. Electric Ranges: Section “Electric Ranges.”
   d. Gas Line Relocation: Section “Plumbing.”

References

4. Reference Standards: See Section “References.” Comply with following:
   a. American National Standard Institute (ANSI) Z21.1 - Household Cooking Gas Appliances,1990, including addenda Z21.1a, 1991.
      1) ANSI Z21.20 - Automatic Gas Ignition Systems and Components, 1989, including addenda Z21.20a, 1991, and Z21.20b, 1992.
   b. Certification:
      1) ANSI Z34.1 - Certification, Third-Party Certification Program, 1987.
      2) ANSI Z34.2 - Certification, Self-Certification by Producer or Supplier, 1987.

Definitions

5. Types:
   a. Type A: Economy or Builder's Model
   b. Type C: Quality Model with hinged top.
6. Supply and Delivery Only: Include supply and delivery to site(s) FOB destination freight prepaid. Unless otherwise specified or scheduled, unloading and handling at site is by PHA/IHA.

Submittals

7. Product Data: Submit to the Owner.
8. Samples:
   a. Production Sample: When requested, provide sample gas range to the Owner for examination as to compliance with specifications.
   b. Color Samples: Submit samples of manufacturer’s standard colors to the Owner for selection.
9. Quality Assurance/Control Submittals: Submit following to the Owner:
   a. Certificates: Manufacturer's written certification that ranges have been tested and comply with ANSI Z21.1 for operation with natural or LP gas.
      1) Certification by American Gas Association (AGA) Laboratories, or Third Party Certifier in accordance with ANSI Z34.1.
      2) Acceptable Evidence of Meeting Applicable Requirements of Standard: Photostatic copy of American Gas Association (AGA) Laboratories Appliance Certificate or listing including igniter device in American Gas Association (AGA) Laboratories Directory of Certified Appliances and Accessories.
   b. Manufacturer's installation instructions.

10. Closeout Submittals: Submit following to the Owner:

a. Operation and Maintenance: Provide use and care information with each gas range. Include parts manual with diagrams and part numbers.
b. Special warranty.

Quality Assurance

11. Qualifications: Manufacturer: Stock and sell parts for ranges supplied for five years from time of delivery.
12. Regulatory Requirements: Comply with and following:
    a. Gas Connections: Comply with applicable codes and regulations.
    b. Accessibility:
        1) Architectural Barriers Act of 1968 as amended (42 USC 4152-4157) and HUD implementing regulations (24 CFR Part 40).
            a) Uniform Federal Accessibility Standards (UFAS).
        2) Section 504 of the Rehabilitation Act of 1973 as amended (29 USC 794) and HUD implementing regulations 24 CFR Part 8.
        3) Fair Housing Accessibility Guidelines (24 CFR Chapter 1).
        4) Americans with Disabilities Act of 1990 (ADA) (28 CFR Part 35).
13. Appliances shall meet or exceed requirements established by the Energy Star program and bear the Energy Star logo. Visit www.energystar.gov for a listing of products that qualify. Energy Star® is a voluntary partnership that includes the U.S. Department of Energy, the U.S. Environmental Protection Agency, product manufacturers, local utilities, and retailers, helps promote efficient products by labeling them with the Energy Star logo and educating consumers about the benefits of energy efficiency.

Delivery, Storage, And Handling

14. Packing, Shipping, Handling, and Unloading: In accordance with standard commercial practices.
15. Acceptance at Site: Inspect gas ranges upon delivery. Replace damaged or defective appliances before installation.

Scheduling

16. Scheduling and Completion: Comply with requirements of Division 1.

Warranty

17. Special Warranties: Provide following written special warranties:
    a. Entire gas range for one year.
18. Special Warranties: Include labor, material and equipment to provide replacements and make repairs to gas ranges at no additional cost to PHA/IHA.
    a. Defective Units and/or Parts: Become property of Contractor.
    b. Submit name and address of local agent who will furnish service and replacement parts in connection with warranties to PHA/IHA.
        1) Charges by local service agent to PHA/IHA for services covered under special warranties not allowed.

PRODUCTS

Gas Ranges - General Requirements

19. Ranges: ANSI Z21.1, current standard models of manufacturer except for additional requirements specified.
    a. Ranges: Floor mounted, free standing flush-to-wall, domestic gas ranges with open cooking top, oven and broiler below.
    b. Ranges of Same Size: Identical, including parts and assemblies.
20. Gas Valves: Provide with either:
    a. Convertible orifice set for gas specified on purchase order .
    b. Fixed orifice hood for use with gas specified on order.

21. Convertible Gas Pressure Regulators: Provide with each range.

Type A Ranges (Economy Or Builder S Model)

22. Burners: Provide cooking top with four burners.
    a. Each Burner: Rated at no less than 2 650 W (9000 BTU/H) for natural gas and 2 350 W (8000 BTU/H) for LP.
23. Manual Gas Valves: Limited displacement type complying with ANSI Z21.1.
24. Grates: Provide each top burner with porcelain enameled cast iron or steel grate.
25. Ignition: One of following:
    a. Automatic Ignition: Equip burners with means for automatic ignition of gas. Failure of oven burner pilot shall activate means for shutting off gas to oven burner.
    b. 2. Intermittent Ignition: Equip burners with means for automatic electric ignition of gas complying with applicable requirements of ANSI Z21.20. Electric Ignition System: May be either spark, coil, glow bar, or combination of these.
26. Oven Thermostat Control: Provide oven thermostat control for controlling oven temperatures down to "hold warm temperature", approximately 77 degrees C (170 degrees F).
27. F. Insulation: Glass fiber blanket type, installed in manner to prevent sagging, and of sufficient thermal efficiency to meet surface and handle temperature tests specified in ANSI Z21.1.
28. Oven and Broiler Sections: Porcelain enamel-coated steel.
    a. Broiling Section: Either drop door type, pull-out-type, or swing-door type with 3-position smokeless broiler pan and grill sliding on stationary runners.
    b. Provide stops so that oven racks cannot be completely pulled out by accident.
29. Oven Vents: Provide ovens with vent designed to deflect moisture and fumes away from wall behind range.
30. Oven Doors: Drop-shelf type, counter-balanced and provided with device to hold door fully closed.
    a. Hinges: Permit ready removal and replacement of hinge brackets and parts subject to wear.
    b. Provide oven doors with means for adjusting misaligned door.
31. Burner Bowls (Aeration Bowls): Corrosion-resisting steel, plated steel, or steel coated with porcelain enamel.
    a. Bowls: May be separate bowls or integral part of top.
32. Exterior Surfaces: Porcelain enamel, except body sides and front panels (including oven door) may be finished in synthetic baked-on enamel capable of withstanding 121 degrees C (250 degrees F).
    a. Trim: In accordance with manufacturer's standard practice.
    b. Backguard, Manifold Shield, Aeration Bowls, and Burners: May be porcelain enamel.
    c. Range Body Back Panel, Legs, and/or Base: Porcelain enamel, baked-on enamel, galvanized, or aluminized steel.
    d. Colors: As scheduled from manufacturer s standard colors.
33. Backguards: Equip each range with back guards not less than 100 mm (4 inches) higher than top cooking surface and extending full width of range top.
34. Equipment and Accessories: Provide accessories such as oven and broiler racks normally supplied with manufacturer's standard production for type range scheduled.
35. Name Plate: Permanent record of manufacturer's name and address, range model and serial number, and manufacturer's normal hourly W (BTU/H) input rating for oven, broiler and top burners.
    a. Securely fasten nameplate to main part of each range in accessible place.

Type C Ranges (Quality Model)

36. General Requirements: Comply with requirements for Type A Ranges except as modified by following requirements.
37. B. Range Top: Hinged at back or lift off for easy cleaning and access to burners, valves, and pilots.
    a. Hinge Top: May have supporting rod to hold top in raised position or be removable. Design supporting rod, when in raised position, to prevent accidental closing of range top. Counterbalanced top is also acceptable.

38. Cooking Top Burners/Low Setting: Equip each range with burners with low settings not in excess of 400 W (1400 BTU/H).
39. Leg levelers: Equip each range with at least two leg levelers.
40. Manifold Shield: Provide recessed or slanted manifold shield to minimize burning of burner knobs from heat from open oven doors.
41. Oven Door: Provide 610 mm (24 inch), 760 mm (30 inch) and 910 mm (36 inch) ranges with removable oven door.

EXECUTION

Examination

42. Site Verification of Conditions:
    a. Utilities: Verify that required utilities are available, in proper locations, and ready for use.

Preparation

43. Existing Ranges: Remove existing ranges and debris from site.

Installation

44. General: Install gas ranges in accordance with manufacturer's recommendations.
    a. Make connection to gas line in accordance with applicable codes.
    b. Make adjustments to feet of ranges for a level installation.

Cleaning

45. Cleaning: Comply with requirements of Division 1.

Schedules

46. Provide gas ranges as selected in following schedule:

_____ Remove existing ranges.

_____ Supply and Deliver Only to _____.

_____ Unloading and handling included.

_____ Supply and Install.

SELECTION	NUMBER OF	SIZE	COLOR	TYPE BURNERS
____	4 Burner	510 mm (20 Inch)	_____	Type A Economy or Builders Model.
____	4 Burner	610 mm (24 Inch)	_____	Type A Economy or Builders Model.
____	4 Burner	760 mm (30 Inch)	_____	Type A Economy or Builders Model.
____	4 Burner	910 mm (36 Inch)	_____	Type A Economy or Builders Model.
____	4 Burner	510 mm (20 Inch)	_____	Type C Quality Model.
____	4 Burner	610 mm (24 Inch)	_____	Type C Quality Model.
____	4 Burner	760 mm (30 Inch)	_____	Type C Quality Model.
____	4 Burner	910 mm (36 Inch)	_____	Type C Quality Model.

END OF SECTION11910a

SECTION 11910b - ELECTRIC RANGES

GENERAL

Summary

1. Section Includes:
   a. Remove existing ranges.
   b. Electric ranges, supply and deliver only or supply and install as scheduled.
2. Related Requirements: Comply with requirements of following sections:
   a. Contractor Use of Premises and Work Sequence: Section “Summary of Work.”
   b. Section “Alteration Project Procedures.”
3. Related Sections:
   a. Kitchen Renovation Requirements: Section “Summary of Work.”
   b. Reference Standards: Section “References.”
   c. Gas Ranges: Section “Gas Ranges.”
   d. Electrical Renovation: Section “Electrical Renovation.”

References

4. Reference Standards: See Section “References.” Comply with following:
   a. Association of Home Appliance Manufacturers (AHAM) ER-1 - American National Standard Household Electric Ranges, 1992.
   b. Federal Specification (FS): WR-101F dated March 13, 1970, and Interim Amendment 2 dated December 31, 1970.
   c. Underwriter's Laboratories (UL): ANSI/UL 858 - Household Electric Ranges, 1986.
   d. Certification:
      1) ANSI Z34.1 - Certification, Third-Party Certification Program, 1987.
      2) ANSI Z34.2 - Certification, Self-Certification by Producer or Supplier, 1987.

Definitions

5. Standard Ranges: Four Surface Cooking Units: Three - 150 mm (6 inch) and one - 200 mm (8 inch) with oven and broiler below.
   a. Type, Style, and Sizes as defined in FS W-R-101F:
      1) Type I: Freestanding range.
      2) Type II: Build-in (slide-in) range.
      3) Style 1: Single oven.
      4) Style 2: Double oven 1 020 mm (40 inches) wide.
      5) Size 1: 1 020 mm (40 inches) wide.
      6) Size 2: 910 mm (36 inches) wide.
      7) Size 3: 760 mm (30 inches) wide.
      8) Size 4: 610 mm (24 inches) wide.
      9) Size 5: 510 mm (20 inches) wide.
6. Supply and Delivery Only: Include supply and delivery to site(s) FOB destination freight prepaid. Unless otherwise specified or scheduled, unloading and handling at site is by PHA/IHA.

Submittals

7. Product Data: Submit to the Owner.
8. Samples:
   a. Production Sample: When requested, provide sample electric range to the Owner for examination as to compliance with specifications.
   b. Color Samples: Submit samples of manufacturer s standard colors to the Owner for selection.
9. Quality Assurance/Control Submittals: Submit following to the Owner:
   a. Certificates: Manufacturer's written certification that electric ranges meet or exceed specified requirements including UL requirements and requirements of FS WR-101F.

b. Manufacturer's installation instructions.

10. Closeout Submittals: Submit following to the Owner:
    a. Operation and Maintenance Instructions: Provide use and care information with each range. Include parts manual with diagrams and part numbers.
    b. Special warranty.

Quality Assurance

11. Qualifications: Manufacturer: Stock and sell parts for ranges supplied for five years from time of delivery.
12. Regulatory Requirements: Comply with following:
    a. Accessibility:
        1) Architectural Barriers Act of 1968 as amended (42 USC 4152-4157) and HUD implementing regulations (24 CFR Part 40).
            a) Uniform Federal Accessibility Standards (UFAS).
        2) Section 504 of the Rehabilitation Act of 1973 as amended (29 USC 794) and HUD implementing regulations 24 CFR Part 8.
        3) Fair Housing Accessibility Guidelines (24 CFR Chapter 1).
        4) Americans with Disabilities Act of 1990 (ADA) (28 CFR Part 35).
13. Appliances shall meet or exceed requirements established by the Energy Star program and bear the Energy Star logo. Visit www.energystar.gov for a listing of products that qualify. Energy Star® is a voluntary partnership that includes the U.S. Department of Energy, the U.S. Environmental Protection Agency, product manufacturers, local utilities, and retailers, helps promote efficient products by labeling them with the Energy Star logo and educating consumers about the benefits of energy efficiency.

Delivery, Storage, And Handling

14. Packing, Shipping, Handling, and Unloading: In accordance with standard commercial practices.
15. Acceptance at Site: Inspect electric ranges upon delivery. Replace damaged or defective appliances before installation.

Scheduling

16. Scheduling and Completion: Comply with requirements of Division 1.

Warranty

17. Special Warranties: Provide following written special warranties:
    a. Entire electric range for one year.
18. Special Warranties: Include labor, material and equipment to provide replacements and make repairs to electric ranges at no additional cost to PHA/IHA.
    a. Defective Units and/or Parts: Become property of Contractor.
    b. Submit name and address of local agent who will furnish service and replacement parts in connection with warranties to PHA/IHA.
        1) Charges by local service agent to PHA/IHA for services covered under special warranties not allowed.

PRODUCTS

Electric Ranges

19. Ranges: AHAM ER-1, ANSI/UL 858, and FS WR-101F, current standard models of manufacturer except for additional requirements specified.
    a. Ranges: Floor mounted, free standing flush-to-wall, domestic electric ranges with open cooking top, oven and broiler below.
    b. Ranges of Same Classification: Identical, including parts and assemblies.
    c. Ranges: UL listed and bear UL label.

20. Operating Service: 115/230 volts or 120/208 volts, 3-wire, single-phase, 60-HZ.
    a. Type of Service: As scheduled.
21. Ranges:
    a. Each Range: Equipped with at least two leg levelers.
    b. Oven Door: Equip 610 mm (24 inch), 760 mm (30 inch), and 910 mm (36 inch) ranges with removable oven door.
    c. Ranges without Storage Drawer: May be equipped with only one oven rack.

Ranges For Elderly Housing

22. Ranges for Elderly Housing: Same as above, Type I or II, Style 1, Sizes 4 and 5, standard electric ranges but, as minimum, include following additional items:
    a. Location of Controls for Ranges and Cook-Tops: Not require reaching across burners.
    b. Burner Indicator Lights: Provide light for each top burner and oven unit that will clearly indicate when burner is on.
        1) Indicator Light: Integral part of, or adjacent to, each control switch or adjacent to each top burner unit.
    c. Oven Interior Light: Provide light in each oven that will clearly illuminate interior when oven door is open.

EXECUTION

Examination

23. Site Verification of Conditions:
    a. Utilities: Verify that required utilities are available, in proper locations, and ready for use.

Preparation

24. Existing Ranges: Remove existing ranges and debris from site.

Installation

25. General: Install electric ranges in accordance with manufacturer's recommendations.
    a. Make adjustments to feet of ranges for a level installation.
    b. Electrical Renovation: See Section 16095.

Cleaning

26. Cleaning: Comply with requirements of Division 1.

Schedules

27. Provide electric ranges as selected in following schedule:

_____Remove existing ranges.

_____Supply and Deliver Only to_____.

_____Unloading and handling included.

_____Supply and Install.

SELECTION	NUMBER BURNERS	ELECTRIC SERVICE	COLOR	TYPE AND SIZE
_____	4 Burner	_____	_____	Type I, Style I, Size 1, 1 020 mm (40 inches) wide).
_____	4 Burner	_____	_____	Type I, Style I, Size 2, 910 mm (36 inches) wide.
_____	4 Burner	_____	_____	Type I, Style I, Size 3, 760 mm (30 inches) wide.
_____	4 Burner	_____	_____	Type I, Style I, Size 4, 610 mm (24 inches) wide.
_____	4 Burner	_____	_____	Type I, Style I, Size 5, 510 mm (20 inches) wide.
_____	4 Burner	_____	_____	Type I or II, Style I, Size 5, 510 mm (20 inches) wide with specified elderly housing requirements.

_____	4 Burner	_____	_____	Type I or II, Style I, Size 4, 610 mm (24 inches) wide with specified elderly housing requirements.

END OF SECTION11910b

SECTION 11910c - RANGE HOODS

GENERAL

Summary

1. Section Includes:
   a. Remove existing range hoods.
   b. Range hoods, supply and deliver only or supply and install as scheduled.
2. Related Requirements: Comply with requirements of following sections:
   a. Contractor Use of Premises and Work Sequence: Section “Summary of Work.”
   b. Section “Alteration Project Procedures.”
3. Related Sections:
   a. Kitchen Renovation Requirements: Section “Summary of Work.”
   b. Reference Standards: Section “References.”
   c. Gas Ranges: Section “Gas Ranges.”
   d. Electric Ranges: Section “Electric Ranges.”
   e. Residential Cabinets: Section “Residential Cabinets.”
   f. Electrical Hook-up: Section “ Electrical Renovation.”

References

4. Reference Standards: See Section “References.” Comply with following:
   a. National Fire Protection Association (NFPA): NFPA 70 - National Electrical Code (NEC).
   b. Certification:
      1) ANSI Z34.1 - Certification, Third-Party Certification Program, 1987.
      2) ANSI Z34.2 - Certification, Self-Certification by Producer or Supplier, 1987.

Definitions

5. Supply and Delivery Only: Include supply and delivery to site(s) FOB destination freight prepaid. Unless otherwise specified or scheduled, unloading and handling at site is by PHA/IHA.

Submittals

6. Product Data: Submit to the Owner.
7. Samples: Submit to the Owner.
   Production Sample: When requested, provide sample range hood to the Owner for examination as to compliance with specifications.
   a. Color Samples: Samples of manufacturer s standard colors for selection.
8. Quality Assurance/Control Submittals: Submit following to the Owner:
   a. Certificates: Manufacturer's written certification that range hoods meet or exceed specified requirements including UL requirements.
   b. Manufacturer's installation instructions.
   c. Appliances shall meet or exceed requirements established by the Energy Star program and bear the Energy Star logo. Visit www.energystar.gov for a listing of products that qualify. Energy Star® is a voluntary partnership that includes the U.S. Department of Energy, the U.S. Environmental Protection Agency, product manufacturers, local utilities, and retailers, helps promote efficient products by labeling them with the Energy Star logo and educating consumers about the benefits of energy efficiency.
   d. Closeout Submittals: Submit following to the Owner:
      1) Operation and Maintenance Instructions: Provide use and care information with each range hood. Include parts manual with diagrams and part numbers.
   e. Special warranty.

Quality Assurance

9. Qualifications: Manufacturer: Stock and sell parts for range hoods supplied for five years from time of delivery.

10. Regulatory Requirements: Comply with following:
    a. Accessibility:
        1) Architectural Barriers Act of 1968 as amended (42 USC 4152-4157) and HUD implementing regulations (24 CFR Part 40).
            a) Uniform Federal Accessibility Standards (UFAS).
        2) Section 504 of the Rehabilitation Act of 1973 as amended (29 USC 794) and HUD implementing regulations 24 CFR Part 8.
        3) Fair Housing Accessibility Guidelines (24 CFR Chapter 1).
        4) Americans with Disabilities Act of 1990 (ADA) (28 CFR Part 35).

Delivery, Storage, And Handling

11. Packing, Shipping, Handling, and Unloading: In accordance with standard commercial practices.
12. Acceptance at Site: Inspect range hoods upon delivery. Replace damaged or defective appliances before installation.

Scheduling

13. Scheduling and Completion: Comply with requirements of Division 1.

Warranty

14. Special Warranties: Provide following written special warranties:
    a. Entire range hood for one year.
15. Special Warranties: Include labor, material and equipment to provide replacements and make repairs to range hoods at no additional cost to PHA/IHA.

PRODUCTS

Range Hoods

16. Range Hoods: Ductless type with fan.
    a. Size: 610 mm (24 inches) or 760 mm (30 inches) wide as scheduled, by 150 mm (6 inches) high by 445 mm (17.5 inches) deep.
    b. Hoods: UL listed and bear UL label.
    c. Fan: 120 V, 60 HZ, two speed, 2.0 A fan.
    d. Light: Enclosed 75 watt.
    e. Filter: Washable filter.
    f. Color: As selected from manufacturer s standard colors.
17. Range Hood Shell: Same as range hoods above without fan and without light.
    a. Size: 610 mm (24 inches) or 760 mm (30 inches) wide as scheduled, by 150 mm (6 inches) high by 445 mm (17.5 inches) deep.
    b. Color: As selected from manufacturer standard colors.

EXECUTION

Examination

18. Site Verification of Conditions:
    a. Utilities: Verify that required utilities are available, in proper locations, and ready for use.
    b. Cabinets: Verify that adjacent residential cabinets and range hood are coordinated.

Preparation

19. Existing Range Hoods: Remove existing range hoods and debris from site.

Installation

20. General: Install range hoods in accordance with manufacturer's recommendations.
    a. Electrical Hook-up: See electrical specifications.

Cleaning

21. Cleaning: Comply with requirements of Division 1.

Schedules

22. Provide range hoods as selected in following schedule:

_____Remove existing range hoods.

_____Supply and Deliver Only to _____.

_____Unloading and handling included.

_____Supply and Install.

_____Range Hood (with fan, filter, and light).

_____760 mm (30 inches) wide.

_____610 mm (24 inches) wide.

_____Range Hood Shell.

_____760 mm (30 inches) wide.

_____610 mm (24 inches) wide.

END OF SECTION11910c

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Task	Specification	Specification Description
11910	11421	Residential Appliances
11920	11421	Residential Appliances
11940	01352	No Specification Required

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SECTION 12201 - DRAPERIES AND TRACKS

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for draperies and tracks. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. This Section includes draperies and drapery tracks.

C. Submittals
1. Product Data: For the following:
   a. Tracks: Include maximum weights of draperies that can be supported.
      1) Motorized Tracks: Indicate motor weights, motor-mounting requirements, and electrical requirements.
   b. Fabrics and textile treatments.
2. Shop Drawings: For tracks. Show installation and anchorage details, locations of components and controls, and field measurements.
   a. Draperies: Show sizes, locations, and details of installation.
3. Coordination Drawings: For track installation; reflected ceiling plans drawn to scale and coordinating track installation with openings and ceiling-mounted items.
4. Samples: For each drapery and for each fabric color and texture required.
5. Product Schedule: Use same designations indicated on Drawings.
6. Product Certificates: For each fabric treated with flame retardant, signed by fabric supplier.
7. Maintenance data.

D. Quality Assurance
1. Installer Qualifications: For draperies and tracks, fabricator of draperies.
2. Source Limitations: For draperies, obtain each color and pattern of fabric and trim from one dye lot.
3. Fire-Test-Response Characteristics: For fabrics treated with fire retardants, provide products that pass NFPA 701 as determined by testing of fabrics that were treated using treatment-application method intended for use for this Project by a testing and inspecting agency acceptable to authorities having jurisdiction.
4. 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.
5. Corded Window Covering Product Standard: Provide drapery tracks operated by pull cords complying with ANSI A100.1.

1.2 PRODUCTS

A. Drapery Tracks
1. Manually Operated Track:
   a. Construction: Extruded aluminum, slotted for mounting at interval of not more than 24 inches (610 mm) o.c., and bendable to radii indicated.
      1) Lengths and Configurations: As directed.
      2) Support Capability: Weight of drapery indicated **OR** 30 lb (14 kg) **OR** 45 lb (20 kg) **OR** 60 lb (27 kg) **OR** 80 lb (36 kg) **OR** 140 lb (64 kg) **OR** 210 lb (95 kg), **as directed,** mounted on track length indicated.

3) Finish: Manufacturer's standard **OR** White baked enamel **OR** Clear anodic coating, **as directed**.

b. Mounting Brackets: Aluminum, of type suitable for fastening track to surface indicated and designed to support weight of track assembly and drapery plus force applied to operate track.

1) Mounting Surface: As indicated on Drawings **OR** Wall **OR** Ceiling **OR** Drapery pocket, **as directed**.

c. Installation Fasteners: Sized to support track assembly and drapery, and fabricated from metal compatible with track, brackets, and supporting construction. Provide two fasteners to fasten each bracket to supporting construction.

d. Operation: Baton **OR** Cord **OR** Cord tension pulley, **as directed**.

1) Pulley Mounting Location: Wall **OR** Baseboard **OR** Floor, **as directed**.

2) Draw: One way, stack as indicated on Drawings **OR** One way, stack left **OR** One way, stack right **OR** Two way, center opening, **as directed**.

3) Operating Hardware Location: On stack side **OR** Left **OR** Right **OR** As indicated on Drawings, **as directed**.

e. Carriers: Rollers **OR** Rollers with hooks **OR** Rollers with snaps **OR** Coordinate with drapery headings indicated, **as directed**.

1) Master Carriers: Butt **OR** Overlap, **as directed**.

f. Accessories: <Insert accessories.>

2. Motorized Track:

a. Construction: Extruded aluminum, slotted for mounting at interval of not more than 24 inches (610 mm) o.c., and bendable to radii indicated.

1) Lengths and Configurations: As directed.

2) Support Capability: Weight of drapery indicated **OR** 30 lb (14 kg) **OR** 45 lb (20 kg) **OR** 60 lb (27 kg) **OR** 80 lb (36 kg) **OR** 140 lb (64 kg) **OR** 210 lb (95 kg), **as directed**, mounted on track length indicated.

3) Finish: Manufacturer's standard **OR** White baked enamel **OR** Clear anodic coating, **as directed**.

b. Mounting Brackets: Suitable for fastening track to surface indicated and designed to support weight of track assembly and drapery plus force applied to operate track.

1) Mounting Surface: As indicated on Drawings **OR** Wall **OR** Ceiling **OR** Drapery pocket, **as directed**.

c. Installation Fasteners: Sized to support track assembly and drapery, and fabricated from metal compatible with track, brackets, and supporting construction. Provide two fasteners to fasten each bracket to supporting construction.

d. Motor Operation: Low-voltage motor with built-in low-voltage interface for direct access to control systems, with thermal-overload switch; sized for weight of drapery and track length indicated; and equipped with stops to prevent overdrawing.

1) Control: Wall switch **OR** Remote, infrared **OR** Remote, radio controlled **OR** Digital timer, **as directed**.

2) Draw: One way, stack as indicated on Drawings **OR** One way, stack left **OR** One way, stack right **OR** Two way, center opening, **as directed**.

3) Electrical Requirements: 115 V/60 Hz/120 W/1.10 A **OR** 115 V/60 Hz/140 W/1.20 A **OR** 110 V/60 Hz/150 W/1.0 A **OR** 110 V/60 Hz/550 W/5.0 A, **as directed**.

4) Travel Speed: 6 inches (152 mm) **OR** 8 inches (203 mm) **OR** 12 inches (305 mm), **as directed**, per second.

e. Carriers: Rollers **OR** Rollers with hooks **OR** Rollers with snaps **OR** Coordinate with drapery headings indicated, **as directed**.

1) Master Carriers: Butt **OR** Overlap, **as directed**.

f. Accessories: <**Insert accessories**.>

B. Draperies

1. Drapery:

a. Heading:

1) Pinch (French) Pleats: 100 **OR** 150 **OR** 200, **as directed**, percent fullness.
2) Stack Pleats: 60 **OR** 80 **OR** 100 **OR** 120, **as directed**, percent fullness.
3) Roll Pleats: 60 **OR** 80 **OR** 100 **OR** 120, **as directed**, percent fullness.
4) Accordion Pleats: 40 **OR** 80 **OR** 100 **OR** 120, **as directed**, percent fullness.
5) Pleat Spacing: <**Insert dimension**.>
6) Heading Accessories:
   a) Nonwoven buckram.
   b) Woven snap tape, 7/8 inch (22 mm) wide, with nickel-plated snaps at 4 inches (102 mm) o.c.
   c) Hooks.

b. Drapery Fabric:
1) Manufacturer, Designation, Pattern, Color, and Fiber Content: **As directed**.
2) Orientation: Run right (up the bolt).
3) Width and Pattern Repeat Distance: **As directed**.
4) Textile Treatments: Stain repellent **OR** Flame retardant, polymer type **OR** Stain repellent; and flame retardant, polymer type, **as directed**.

c. Lining Fabric:
1) Lining Type: Blackout; light tight **OR** Water resistant, **as directed**.
2) Manufacturer, Manufacturer's Designation, Color, Fiber Content, and Width: As directed.
3) Textile Treatments: Stain repellent **OR** Flame retardant, polymer type **OR** Stain repellent; and flame retardant, polymer type, **as directed**.

d. Interlining: Acoustical.
1) Manufacturer: **As directed**.

e. Textile Trim and Tiebacks: **As directed.**

f. Hem Weights: 1-inch- (25-mm-) square lead weights **OR** Tape type (string weights), **as directed**.

C. Drapery Fabrication
1. Fabricate draperies in heading styles and fullnesses indicated. Fabricate headings to stand erect. If less than a full width of fabric is required to produce panel of specified fullness, use equal widths of not less than one-half width of fabric located at ends of panel.
   a. One-Way-Stacking Draperies: Add 5 inches (127 mm) to overall width for returns.
   b. Center-Opening Draperies: Add 10 inches (254 mm) to overall width for overlap.
2. Seams: Sew vertical seams with twin-needle sewing machine with selvage trimmed and overlocked. Join widths so that patterns match and vertical seams lay flat and straight without puckering. Horizontal seams are not acceptable.
3. Side Hems: Double-turned, 1-1/2-inch- (38-mm-) wide hems consisting of three layers of fabric, and blindstitched so that stitches are not visible on face of drapery.
4. Bottom Hems: Double-turned, 4-inch- (102-mm-) wide hems consisting of three layers of fabric, and weighted and blindstitched so that weights and stitches are not visible on face of drapery.
   a. Sew in square lead weights at each seam and at panel corners.
5. Interlinings: Extend from top of drapery to within 1/2 inch (13 mm) of lining's bottom hem and to leading edge of side hems to produce full-shadowed appearance.
6. Linings: Equal to widths of drapery fabric and joined to drapery fabric at top by inside invisible seam, and hand stitched at side hems and shadowed with 1-1/2-inch (38-mm) return of face fabric.
   a. Bottom Hem: Hem separately from **OR** Blind stitch to, **as directed,** drapery fabric.

1.3 EXECUTION

A. Drapery Track Installation
1. Install track systems according to manufacturer's written instructions, level and plumb, and at height and location in relation to adjoining openings as indicated on Drawings.

2. Isolate metal parts of tracks and brackets from concrete, masonry, and mortar to prevent galvanic action. Use tape or another method recommended in writing by track manufacturer.

B. Drapery Installation
1. Where draperies abut overhead construction, hang draperies so that clearance between headings and overhead construction is 1/4 inch (6.4 mm).
2. Where draperies extend to floor, install so that bottom hems clear finished floor by not more than 1 inch (25 mm) and not less than 1/2 inch (13 mm).
3. Where draperies extend to windowsill, install so that bottom hems hang above sill line and clear sill line by not more than 1/2 inch (13 mm).

C. Adjusting
1. After hanging draperies, test and adjust each track to produce unencumbered, smooth operation.
2. Steam and dress down draperies as required to produce crease- and wrinkle-free installation.
3. Remove and replace draperies that are stained or soiled.

END OF SECTION 12201

SECTION 12210 - HORIZONTAL LOUVER BLINDS

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for horizontal louver blinds. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. This Section includes the following:
a. Horizontal louver blinds with aluminum, wood and polymer slats.
b. Motorized blind operators.

C. Submittals
1. Product Data: For each type of product indicated.
2. Shop Drawings: Show fabrication and installation details for horizontal louver blinds and motorized blind operators.
a. Wiring Diagrams: Power, system, and control wiring.
3. Samples: For each exposed finish.
4. Product certificates **OR** test reports, **as directed**.
5. Maintenance data.

D. Quality Assurance
1. Fire-Test-Response Characteristics: Provide horizontal louver blinds with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
a. Flame-Resistance Ratings: Passes NFPA 701.
2. 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.
3. Product Standard: Provide horizontal louver blinds complying with WCSC A 100.1.

E. Delivery, Storage, And Handling
1. Deliver horizontal louver blinds in factory packages, marked with manufacturer and product name, fire-test-response characteristics, lead-free designation, and location of installation using same designations indicated on Drawings and in a window treatment schedule.

1.2 PRODUCTS

A. Horizontal Louver Blinds, Aluminum Slats
1. Slats: Aluminum; alloy and temper recommended by producer for type of use and finish indicated; with crowned profile and radiused corners.
a. Width: 2 inches (51 mm) **OR** 1 inch (25 mm) **OR** 1/2 to 5/8 inch (13 to 16 mm), **as directed**.
b. Finish: One color **OR** One color each side **OR** As indicated, **as directed**.
1) Ionized Coating: Antistatic, dust-repellent, baked polyester finish.
2) Reflective Coating: Manufacturer's special coating enhancing the reflection of solar energy on the outside-facing slat surface.
c. Perforated Slats: Openness factor of 6 to 7 percent.

2. Headrail: Formed steel or extruded aluminum; long edges returned or rolled; fully enclosing operating mechanisms on three sides and end plugs.
3. Bottom Rail: Formed-steel or extruded-aluminum tube, with plastic or metal capped ends.
4. Maximum Light-Blocking Blinds: Designed for eliminating all visible light gaps if slats are tilted closed and with minimal-sized rout holes for ladders hidden and placed near back edge for maximum slat overlap; with headrail and bottom rail extended and formed for light-tight joints between rail and adjacent slats or construction.
   a. Finish: Match color, texture, pattern, and gloss of slats **OR** Color, texture, pattern, and gloss differing from slats as indicated by manufacturer's designations **OR** Color, texture, pattern, and gloss differing from slats, matching samples **OR** Color texture, pattern, and gloss differing from slats as selected from manufacturer's full range, **as directed**.
5. Ladders: Evenly spaced to prevent long-term slat sag.
   a. For Blinds with Nominal Slat Width 1 Inch (25 mm) or Less: Braided string.
   b. For Blinds with Nominal Slat Width 1 Inch (25 mm) **OR** 2 Inches (51 mm)\, **as directed**, or More: Braided string **OR** Manufacturer's standard-width reinforced vinyl tapes **OR** Manufacturer's standard-width cloth tapes, **as directed**.
      1) Tape Color, Texture, and Pattern: Color, texture, and pattern as indicated by manufacturer's designations **OR** Color, texture, and pattern matching samples **OR** Color, texture, and pattern as selected from manufacturer's full range, **as directed**.
6. Lift-and-Tilt Control: Motorized operator.
7. Lift Cords: Manufacturer's standard.
8. Tilt Control: Enclosed worm-gear mechanism, slip clutch or detachable wand preventing overrotation, and linkage rod.
9. Lift Operation: Manual.
10. Valance: Two slats **OR** PVC strip **OR** Manufacturer's standard, **as directed**.
11. Mounting: Wall mounting **OR** Ceiling mounting **OR** End mounting **OR** Wall extension brackets **OR** As indicated, **as directed**.
12. Hold-Down Brackets and Hooks or Pins: Manufacturer's standard.
13. Side Channels and Perimeter Light Gap Seals: Manufacturer's standard.
14. Colors, Textures, Patterns, and Gloss: As selected from manufacturer's full range.

B. Horizontal Louver Blinds, Wood Slats
1. Slats: Hardwood, North American **OR** basswood **OR** poplar **OR** ramin, **as directed,** species, flame-retardant treated; with flat profile and radiused corners and beaded edges **OR** and double beaded edges, **as directed**.
   a. Width: 1 inch (25 mm) **OR** 1-3/8 inch (35 mm) **OR** 2 inches (51 mm) **OR** 2-3/8-inch (60-mm), **as directed**.
   b. Finish: Manufacturer's standard colors as indicated, for striped blind with pattern as indicated on Drawings.
2. Headrail: Formed steel or extruded aluminum; long edges returned or rolled; fully enclosing operating mechanisms on three sides and ends.
3. Bottom Rail: Hardwood matching slats.
   a. Finish Color Characteristics: Match color, texture, pattern, and gloss of slats **OR** Match color, texture, pattern, and gloss of valance **OR** Color, texture, pattern, and gloss differing from slats as indicated by manufacturer's designations **OR** Color, texture, pattern, and gloss differing from slats, matching samples **OR** Color texture, pattern, and gloss differing from slats as selected from manufacturer's full range, **as directed**.
4. Maximum Light-Blocking Blinds: Designed for eliminating all visible light gaps if slats are tilted closed and with minimal-sized rout holes for ladders hidden and placed near back edge for maximum slat overlap; with headrail and bottom rail extended and formed for light-tight joints between rail and adjacent slats or construction.
5. Ladders: Braided string **OR** Manufacturer's standard-width cloth tapes, **as directed**. Evenly spaced to prevent long-term louver sag.

a. Tape Color, Texture, and Pattern: Color, texture, and pattern as indicated by manufacturer's designations **OR** Color, texture, and pattern matching samples **OR** Color, texture, and pattern as selected from manufacturer's full range, **as directed**.

6. Tilt Control: Enclosed worm gear mechanism, slip clutch or detachable wand preventing overrotation, and linkage rod.
7. Lift Operation: Manual.
8. Lift Operation: Motorized operator.
9. Valance: Manufacturer's standard.
10. Cornice: as directed by the Owner.
11. Mounting: Wall mounting **OR** Ceiling mounting **OR** End mounting **OR** Wall extension brackets **OR** As indicated, **as directed**.
12. Hold-Down Brackets and Hooks or Pins: Manufacturer's standard, as indicated.
13. Colors, Textures, Patterns, and Gloss: As selected from manufacturer's full range.

C. Horizontal Louver Blinds, Polymer Slats

1. Slats: Lead-free, UV-stabilized, integrally colored, opaque, permanently flexible, extruded PVC **OR** polymer/wood alloy, **as directed,** that will not crack or yellow; antistatic, dust-repellent treated; with crowned **OR** manufacturer's standard, **as directed,** profile.
   a. Width: 2 inches (51 mm) **OR** 2-1/2 inches (64 mm), **as directed**.
      1) Spacing: Manufacturer's standard.
   b. Finish: Wood-tone **OR** Painted, **as directed,** color as indicated.
   c. Finish: Two colors **OR** textures **OR** patterns, **as directed,** as indicated, one per side of slat.
2. Headrail: Formed steel or extruded aluminum; long edges returned or rolled; fully enclosing operating mechanisms on three sides and ends.
3. Bottom Rail: Manufacturers standard **OR** Formed-steel or extruded-aluminum tube, with plastic or metal capped ends **OR** Hardwood matching slats and trapezoid-shaped bottom angled for minimizing light gaps, **as directed**.
4. Ladders: Braided string **OR** Manufacturer's standard-width cloth tapes, **as directed**. Evenly spaced to prevent long-term slat sag.
   a. Tape Color, Texture, and Pattern: Color, texture, and pattern as selected from manufacturer's full range.
5. Tilt Control: Enclosed worm-gear mechanism and linkage rod.
6. Lift Operation: Manual.
7. Lift Operation: Motorized operator.
8. Valance: Manufacturer's standard.
9. Mounting: Wall mounting **OR** Ceiling mounting **OR** End mounting **OR** Wall extension brackets **OR** As indicated, **as directed**.
10. Hold-Down Brackets and Hooks or Pins: Manufacturer's standard, as indicated.
11. Colors, Textures, Patterns, and Gloss: As selected from manufacturer's full range.

D. Horizontal Louver Blind Fabrication

1. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.
   a. Lift-and-Tilt Mechanisms: With permanently lubricated moving parts.
2. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows:
   a. Blind Units Installed between (inside) Jambs: Width equal to 1/4 inch (6 mm) per side or 1/2 inch (13 mm) total, plus or minus 1/8 inch (3.1 mm), less than jamb-to-jamb dimension of opening in which each blind is installed. Length equal to 1/4 inch (6 mm), plus or minus 1/8 inch (3.1 mm), less than head-to-sill dimension of opening in which each blind is installed.
   b. Blind Units Installed outside Jambs: Width and length as indicated, with terminations between blinds of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
3. Installation Brackets: Designed for easy removal and reinstallation of blind, for supporting headrail, valance, and operating hardware, and for hardware position and blind mounting method indicated.

4. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to blind hardware and adjoining construction; type designed for securing to supporting substrate; and supporting blinds and accessories under conditions of normal use.
5. Color-Coated Finish:
   a. Metal: For components exposed to view, apply manufacturer's standard baked finish.
   b. Wood: Apply manufacturer's standard opaque **OR** transparent, **as directed,** factory-applied finish.
6. Component Color: Provide rails, cords, ladders, and exposed-to-view metal, wood, and plastic matching or coordinating with slat color, unless otherwise indicated.

E. Motorized Horizontal Louver Blind Operators
1. General: Provide factory-assembled blind operation systems designed for blind type, size, weight, construction, use, and operation frequency indicated, with lift **OR** tilt **OR** lift-and-tilt, **as directed,** functions. Provide operation systems of size and capacity and with features, characteristics, and accessories suitable for Project conditions and recommended by blind manufacturer, complete with electric motors and factory-prewired motor controls, remote-control stations, remote-control devices, power disconnect switches, enclosures protecting controls and all operating parts, headrail, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
2. Comply with NFPA 70.
3. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6 with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.
4. Electric Motors: UL-approved or -recognized, totally enclosed, insulated motor, complying with NEMA MG 1, with thermal-overload protection and internal limit switches; sized by blind manufacturer to start and operate size and weight of blind considering service factor or Project's service conditions without exceeding nameplate ratings.
   a. Service Factor: According to NEMA MG 1, unless otherwise indicated.
   b. Motor Characteristics: Single phase, 24 **OR** 110 **OR** 220, **as directed,** V, 60 Hz.
   c. Motor Mounting: Within manufacturer's standard headrail enclosure.
5. Remote Controls: Electric controls with NEMA ICS 6, Type 1 enclosure for surface **OR** recessed or flush **OR** within headrail, **as directed,** mounting. Provide the following devices for remote-control activation of blinds:
   a. Control Stations: Keyed, maintained **OR** momentary, **as directed,**-contact, three-position, switch-operated control station with open, close, and off functions. Provide two keys per station.
   b. Control Stations: Maintained **OR** Momentary, **as directed,**-contact, three-position, toggle **OR** rocker, **as directed,**-style, wall-switch-operated control station with open, close, and center off functions.
      1) Color: Ivory **OR** White **OR** As indicated, **as directed**.
6. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop blind at fully raised and fully lowered positions.
7. Operating Features: as directed by the Owner.
8. Accessories:
   a. Solar Power Unit: For use with control system indicated.

1.3 EXECUTION

A. Installation
1. Install horizontal louver blinds level and plumb and aligned with adjacent units according to manufacturer's written instructions, and located so exterior slat edges in any position are not closer than 1 inch (25 mm) **OR** 2 inches (51 mm), **as directed,** to interior face of glass. Install intermediate support as required to prevent deflection in headrail. Allow clearances between adjacent blinds and for operating glazed opening's operation hardware if any.

2. Flush Mounted: Install horizontal louver blinds with slat edges flush with finish face of opening if slats are tilted open.
3. Jamb Mounted: Install headrail flush with face of opening jamb and head.
4. Head Mounted: Install headrail on face of opening head.
5. Recessed: Install headrail concealed within blind pocket.
6. Connections: Connect motorized operators to building electrical system.
7. Adjust horizontal louver blinds to operate smoothly, easily, safely, and free of binding or malfunction throughout entire operational range.
8. Clean horizontal louver blind surfaces after installation, according to manufacturer's written instructions.

END OF SECTION 12210

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SECTION 12210a - VERTICAL LOUVER BLINDS

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for vertical louver blinds. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. This Section includes the following:
a. Vertical louver blinds, aluminum vanes, PVC vanes, PVC vanes with fabric vane insert and fabric vanes.
b. Motorized blind operators.

C. Submittals
1. Product Data: For each type of product indicated.
2. Shop Drawings: Show fabrication and installation details for vertical louver blinds and motorized operators.
a. Wiring Diagrams: Power, system, and control wiring.
3. Samples: For each exposed finish.
4. Product certificates **OR** test reports, **as directed**.
5. Maintenance data.

D. Quality Assurance
1. Fire-Test-Response Characteristics: Provide vertical louver blinds with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
a. Flame-Resistance Ratings: Passes NFPA 701.
2. 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.
3. Product Standard: Provide vertical louver blinds complying with WCSC A 100.1.

E. Delivery, Storage, And Handling
1. Deliver vertical louver blinds in factory packages, marked with manufacturer and product name, fire-test-response characteristics, lead-free designation, and location of installation using same designations indicated on Drawings and in a window treatment schedule.

1.2 PRODUCTS

A. Vertical Louver Blinds, Aluminum Vanes
1. Rail System: Headrail **OR** Dual system with headrail and bottom rail, **as directed**.
a. Rails: Extruded aluminum **OR** Formed steel **OR** Manufacturer's standard, **as directed**; long edges returned or rolled; channel-shaped, enclosing operating mechanisms.
1) Color: Custom color **OR** As selected from manufacturer's standard color range, **as directed**.
2) Anodized aluminum, clear **OR** color, **as directed,** anodized.

2. Vanes: Aluminum, alloy, and temper recommended by producer for type of use and finish indicated; with crowned profile and not less than 3/8-inch (9.5-mm) overlap when vanes are rotated fully closed.
   a. Nominal Vane Width: 3-1/2 inches (89 mm) wide.
   b. Vane Finish: One color as indicated, **OR** Two colors as indicated, one per side of slat, **as directed**.
3. Vane Directional Control: Manual **OR** Motorized operator, **as directed**.
4. Traversing Control: Manual **OR** Motorized operator, **as directed**.
5. Draw and Stack Position: One way, controls and stack left **OR** One way, controls and stack right **OR** One way, controls left and stack opposite **OR** One way, controls right and stack opposite **OR** Center split, controls left **OR** Center split, controls right **OR** Center stack, controls left **OR** Center stack, controls right **OR** Off center, controls left **OR** Off center, controls right **OR** As indicated on Drawings **OR** As indicated in a window treatment schedule, **as directed**.
6. Cord-Tensioner Mounting: Wall **OR** Floor **OR** Sill **OR** Baseboard **OR** As indicated, **as directed**.
7. Valance: One **OR** Two-tiered, **as directed,** vane insert; with dust cover.
   a. Finish Color Characteristics: Match color, texture, pattern, and gloss of vanes **OR** Color, texture, pattern, and gloss differing from vanes as indicated by manufacturer's designations **OR** Color, texture, pattern, and gloss differing from vanes matching samples **OR** Color texture, pattern, and gloss differing from vanes as selected from manufacturer's full range, **as directed**.
8. Louver Bottom: Connecting or spacing chains.
9. Mounting: Wall mounting **OR** Ceiling mounting **OR** End mounting **OR** Wall extension brackets **OR** As indicated, **as directed**.
10. Stack Release: Permitting stacked vanes to be moved away from stacking position for total access to glazed opening.
11. Colors, Textures, Patterns, and Gloss: As selected from manufacturer's full range.

B. Vertical Louver Blinds, PVC Vanes
1. Rail System: Headrail **OR** Dual system with headrail and bottom rail, **as directed**.
   a. Rails: Extruded aluminum **OR** Formed steel **OR** Manufacturer's standard, **as directed**; long edges returned or rolled; channel-shaped, enclosing operating mechanisms.
      1) Color: Custom color **OR** As selected from manufacturer's standard color range, **as directed**.
      2) Anodized aluminum, clear **OR** color, **as directed,** anodized.
2. Vanes: Lead-free, UV-stabilized, integrally colored, opaque, permanently flexible, extruded PVC that will not crack or yellow; with flat **OR** crowned **OR** ribbed, **as directed,** profile and not less than 3/8-inch (9.5-mm) overlap when vanes are rotated fully closed.
   a. Nominal Vane Width: 2 inches (51 mm) **OR** 3-1/2 inches (89 mm) **OR** 4 inches (100 mm) **OR** 5 inches (125 mm), **as directed**.
   b. Perforated Vanes: Openness factor of 3 **OR** 6 **OR** 8 **OR** 10 **OR** 12, **as directed,** percent.
3. Vane Directional Control: Manual, **OR** Motorized operator, **as directed**.
4. Traversing Control: Manual **OR** Motorized operator, **as directed**.
5. Draw and Stack Position: One way, controls and stack left **OR** One way, controls and stack right **OR** One way, controls left and stack opposite **OR** One way, controls right and stack opposite **OR** Center split, controls left **OR** Center split, controls right **OR** Center stack, controls left **OR** Center stack, controls right **OR** Off center, controls left **OR** Off center, controls right **OR** As indicated on Drawings **OR** As indicated, **as directed**.
6. Cord-Tensioner Mounting: Wall **OR** Floor **OR** Sill **OR** Baseboard **OR** As indicated, **as directed**.
7. Valance: One **OR** Two-tiered, **as directed,** vane insert; with dust cover.
   a. Finish Color Characteristics: Match color, texture, pattern, and gloss of vanes **OR** Color, texture, pattern, and gloss differing from vanes as indicated by manufacturer's designations **OR** Color, texture, pattern, and gloss differing from vanes matching samples **OR** Color texture, pattern, and gloss differing from vanes as selected from manufacturer's full range, **as directed**.
8. Louver Bottom: Connecting or spacing chains.

9. Mounting: Wall mounting **OR** Ceiling mounting **OR** End mounting **OR** Wall extension brackets **OR** As indicated, **as directed**.
10. Stack Release: Permitting stacked vanes to be moved away from stacking position for total access to glazed opening.
11. Colors, Textures, Patterns, and Gloss: As selected from manufacturer's full range.

C. Vertical Louver Blinds, PVC Vanes With Fabric Vane Inserts
1. Rail System: Headrail **OR** Dual system with headrail and bottom rail, **as directed**.
   a. Rails: Extruded aluminum **OR** Formed steel **OR** Manufacturer's standard, **as directed**; long edges returned or rolled; channel-shaped, enclosing operating mechanisms.
      1) Color: Custom color **OR** As selected from manufacturer's standard color range, **as directed**.
      2) Anodized aluminum, clear **OR** color, **as directed,** anodized.
2. Vanes: Lead-free, UV-stabilized, permanently flexible, extruded PVC that will not crack or yellow; with not less than 3/8-inch (9.5-mm) overlap when vanes are rotated fully closed. Provide integrally colored, opaque vane with clear grooves for holding fabric insert.
   a. Nominal Vane Width: 3-1/2 inches (89 mm).
   b. Fabric Insert: Manufacturer's standard; stain and fade resistant.
3. Vane Directional Control: Manual **OR** Motorized operator, **as directed**.
4. Traversing Control: Manual **OR** Motorized operator, **as directed**.
5. Draw and Stack Position: One way, controls and stack left **OR** One way, controls and stack right **OR** One way, controls left and stack opposite **OR** One way, controls right and stack opposite **OR** Center split, controls left **OR** Center split, controls right **OR** Center stack, controls left **OR** Center stack, controls right **OR** Off center, controls left **OR** Off center, controls right **OR** As indicated, **as directed**.
6. Cord-Tensioner Mounting: Wall **OR** Floor **OR** Sill **OR** Baseboard **OR** As indicated on Drawings, **as directed**.
7. Valance: One **OR** Two-tiered, **as directed,** vane insert; with dust cover. Fabric vane insert matching vanes.
8. Louver Bottom: Connecting or spacing chains.
9. Mounting: Wall mounting **OR** Ceiling mounting **OR** End mounting **OR** Wall extension brackets **OR** As indicated, **as directed**.
10. Stack Release: Permitting stacked vanes to be moved away from stacking position for total access to glazed opening.
11. Fabric Colors, Textures, and Patterns: As selected from manufacturer's full range.

D. Vertical Louver Blinds, Fabric Vanes
1. Rail System: Headrail **OR** Dual system with headrail and bottom rail, **as directed**.
   a. Rails: Extruded aluminum **OR** Formed steel **OR** Manufacturer's standard, **as directed**; long edges returned or rolled; channel-shaped, enclosing operating mechanisms.
      1) Color: Custom color **OR** As selected from manufacturer's standard color range, **as directed**.
      2) Anodized aluminum, clear **OR** color, **as directed** anodized.
2. Vanes: Manufacturer's standard **OR** PVC-coated fiberglass mesh **OR** PVC-coated polyester mesh, **as directed,** freehanging fabric with hemmed, nonraveling edges; stain and fade resistant; with not less than 3/8-inch (9.5-mm) overlap when vanes are rotated fully closed.
   a. Nominal Vane Width: 2 inches (51 mm) **OR** 3-1/2 inches (89 mm) **OR** 5 inches (125 mm), **as directed**.
3. Vane Directional Control: Manual.
4. Vane Directional Control: Motorized operator.
5. Traversing Control: Manual.
6. Traversing Control: Motorized operator.
7. Draw and Stack Position: One way, controls and stack left **OR** One way, controls and stack right **OR** One way, controls left and stack opposite **OR** One way, controls right and stack opposite **OR** Center split, controls left **OR** Center split, controls right **OR** Center stack, controls left **OR** Center

stack, controls right **OR** Off center, controls left **OR** Off center, controls right **OR** As indicated, **as directed**.

8. Cord-Tensioner Mounting: Wall **OR** Floor **OR** Sill **OR** Baseboard **OR** As indicated, **as directed**.
9. Valance: One **OR** Two-tiered, **as directed,** vane insert; with dust cover. Fabric vane insert matching vanes.
10. Louver Bottom: Connecting or spacing chains **OR** Weights, **as directed**.
11. Mounting: Wall mounting **OR** Ceiling mounting **OR** End mounting **OR** Wall extension brackets **OR** As indicated, **as directed**.
12. Stack Release: Permitting stacked vanes to be moved away from stacking position for total access to glazed opening.
13. Fabric Colors, Textures, and Patterns: As selected from manufacturer's full range.

E. Vertical Louver Blind Fabrication

1. Product Description: Vertical louver blind consisting of equally spaced, synchronized vanes and rail system with self-aligning carrier mechanisms, carriers, traverse and vane directional mechanisms and controls, and installation hardware.
2. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.
   a. Louver Directional and Traversing Control Mechanisms: With permanently lubricated moving parts.
3. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows:
   a. Blind Units Installed between (inside) Jambs: Width equal to 1/4 inch (6 mm) per side or 1/2 inch (13 mm) total less than jamb-to-jamb dimension of opening in which each blind is installed. Length equal to 1/4 inch (6 mm), plus or minus 1/8 inch (3.1 mm), less than head-to-sill dimension of opening in which each blind is installed.
   b. Blind Units Installed outside Jambs: Width and length as indicated, with terminations between blinds of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
4. Installation Brackets: Designed for easy removal and reinstallation of blind, for supporting headrail, valance, and operating hardware, and for hardware position and blind mounting method indicated.
5. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to blind hardware and adjoining construction; type designed for securing to supporting substrate; and supporting blinds and accessories under conditions of normal use.
6. Color-Coated Finish: For metal components exposed to view, unless anodized or plated finish is indicated. Apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.
7. Component Color: Provide cords and exposed-to-view metal and plastic matching or coordinating with vane color, unless otherwise indicated.

F. Motorized Vertical Louver Blind Operators

1. General: Provide factory-assembled blind operation systems designed for blind type, size, weight, construction, use, and operation frequency indicated, with traverse **OR** rotation **OR** traverse and rotation, **as directed** functions. Provide operation systems of size and capacity and with features, characteristics, and accessories suitable for Project conditions and recommended by blind manufacturer, complete with electric motors and factory-prewired motor controls, remote-control stations, remote-control devices, power disconnect switches, enclosures protecting controls and all operating parts, headrail, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with the building electrical system.
2. Comply with NFPA 70.
3. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6 with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.
4. Electric Motors: UL-approved or -recognized, totally enclosed, insulated motor, complying with NEMA MG 1, with thermal-overload protection and internal limit switches; sized by blind

manufacturer to start and operate size and weight of blind considering service factor or Project's service conditions without exceeding nameplate ratings.

a. Service Factor: According to NEMA MG 1, unless otherwise indicated.
b. Motor Characteristics: Single phase, 24 **OR** 110 **OR** 220, **as directed,** V, 60 Hz.
c. Motor Mounting: On top of **OR** Behind, **as directed,** track, left **OR** right, **as directed,** side of headrail.
d. Motor Mounting: As indicated.

5. Remote Controls: Electric controls with NEMA ICS 6, Type 1 enclosure for surface **OR** recessed or flush **OR** within headrail, **as directed,** mounting. Provide the following devices for remote-control activation of blinds:
   a. Control Stations: Keyed, maintained **OR** momentary, **as directed,**-contact, three-position, switch-operated control station with open, close, and off functions. Provide two keys per station.
   b. Control Stations: Maintained **OR** Momentary, **as directed,**-contact, three-position, toggle **OR** rocker, **as directed,**-style, wall-switch-operated control station with open, close, and center off functions.
      1) Color: Ivory **OR** White **OR** As indicated, **as directed**.
6. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop blind at fully traversed, rotated closed and fully retracted, rotated open positions.
7. Operating Features: <**Insert feature.>**
8. Accessories:
   a. Solar Power Unit: For use with control system indicated.

1.3 EXECUTION

A. Installation
1. Install vertical louver blinds level and plumb and aligned with adjacent units according to manufacturer's written instructions, and located so exterior vane edges in any position are not closer than 2 inches (51 mm) to interior face of glass. Install intermediate support as required to prevent deflection in headrail. Allow clearances between adjacent blinds and for operating glazed opening's operation hardware, if any.
2. Flush Mounted: Install vertical louver blinds with vane edges flush with finish face of opening when vanes are tilted open.
3. Jamb Mounted: Install headrail flush with face of opening jamb and head.
4. Head Mounted: Install headrail on face of opening head.
5. Recessed: Install headrail concealed within blind pocket.
6. Connections: Connect motorized operators to building electrical system.
7. Adjust vertical louver blinds to operate smoothly, easily, safely and free of binding or malfunction throughout entire operational range.
8. Clean vertical louver blind surfaces after installation, according to manufacturer's written instructions.

END OF SECTION 12210a

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SECTION 12210b - ROLLER SHADES

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for roller shades. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. This Section includes roller shades and motorized shade operators.

C. Submittals
1. Product Data: For each type of product indicated.
2. Shop Drawings: Include plans, elevations, sections, details, details of installation, operational clearances, wiring diagrams, and relationship to adjoining Work.
   a. Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.
3. Samples: For each exposed finish and for each color and texture required.
4. Window Treatment Schedule: Use same designations indicated on Drawings.
5. Maintenance data.

D. Quality Assurance
1. Fire-Test-Response Characteristics: Provide products passing flame-resistance testing according to NFPA 701 by a testing agency acceptable to authorities having jurisdiction.
2. 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.
3. Comply with WCMA A 100.1.

E. Delivery, Storage, And Handling
1. Deliver shades in factory packages, marked with manufacturer and product name, fire-test-response characteristics, lead-free designation, and location of installation using same designations indicated on Drawings and in a window treatment schedule.

1.2 PRODUCTS

A. Roller Shades
1. Shade Band Material: PVC-coated fiberglass **OR** PVC-coated polyester **OR** PVC-coated fiberglass and polyester blends **OR** Fiberglass and acrylic blend **OR** Metallized film **OR** Mirror film **OR** Tinted film **OR** Owner-furnished material, **as directed**.
   a. Colors: Match samples **OR** As selected from manufacturer's full range **OR** As indicated in a window treatment schedule, **as directed**.
   b. Material Solar-Optical Properties: **As directed.**
   c. Material Openness Factor: **As directed** percent.
   d. Material UV Blockage: **As directed** percent.
2. Rollers: Electrogalvanized or epoxy primed steel or extruded-aluminum tube of diameter and wall thickness required to support and fit internal components of operating system and the weight and width of shade band material without sagging; designed to be easily removable from support brackets. Provide capacity for one **OR** two, **as directed**, roller shade band(s) per roller.

3. Direction of Roll: Regular, from back of roller **OR** Reverse, from front of roller **OR** Regular, from back of roller, and reverse, from front of roller, as indicated on Drawings for double-roller shades, **as directed**.
4. Mounting Brackets: Galvanized or zinc-plated steel **OR** Fascia end caps, fabricated from steel finished to match fascia or headbox, **as directed**.
5. Fascia: L-shaped, formed-steel sheet or extruded aluminum; long edges returned or rolled; continuous panel concealing front and bottom of shade roller, brackets, and operating hardware and operators; removable design for access.
6. Top/Back Cover: L-shaped; material and finish to match fascia; combining with fascia and end caps to form a six-sided headbox enclosure sized to fit shade roller and operating hardware inside.
7. Pocket-Style Headbox: U-shaped, formed-steel sheet or extruded aluminum; long edges returned or rolled; with a bottom cover consisting of slot opening of minimum dimension to allow lowering and raising of shade and a removable or an openable, continuous metal access panel concealing shade roller, brackets, and operating hardware and operators within.
8. Pocket with Ceiling Slot Opening: Six-sided box units for recessed installation; fabricated from formed-steel sheet, extruded aluminum, or wood; with a bottom consisting of slot opening of minimum dimension to allow lowering and raising of shade and a removable or an openable, continuous metal access panel concealing rollers, brackets, and operating hardware and operators within.
   a. Corner Section: Factory formed and welded.
9. Bottom Bar: Steel or extruded aluminum, with plastic or metal capped ends. Provide exposed-to-view, external **OR** concealed, by pocket of shade material, internal, **as directed**,-type.
10. Audiovisual Light-Blocking Shades: Designed for eliminating all visible light gaps when shades are fully closed; fabricated from blackout shade band material with fascia **OR** headbox **OR** pocket, **as directed**, and bottom bar extended and formed for light-tight joints among shade components and between shade components and adjacent construction.
11. Skylight Shades: Manufacturer's complete system for operable skylight shades, including operator, operating hardware, and accessories for smooth operation, designed for installation in horizontal position **OR** inclined position, slope as indicated on Drawings, **as directed**.
12. Valance: As indicated by manufacturer's designation for style and color **OR** Style matching hem; as indicated by manufacturer's designation color **OR** As indicated in a window treatment schedule, **as directed**.
13. Mounting: Inside **OR** Outside **OR** Ceiling **OR** Recessed in ceiling pocket **OR** Wall extension brackets **OR** Bottom-up brackets **OR** As indicated on Drawings, **as directed**.
14. Shade Operation: Manual; with spring roller **OR** continuous-loop bead-chain, clutch, and cord tensioner and bracket **OR** gear and crank **OR** cordless system, **as directed**, lift operator.
15. Hold-Down Brackets and Hooks or Pins and Side Channels: Manufacturer's standard for fixing shade in place, keeping shade band material taut, and reducing light gaps when shades are closed.
16. Shade Operation: Manual; with spring roller **OR** continuous-loop bead-chain, clutch, and cord tensioner and bracket **OR** gear and crank **OR** cordless system, **as directed**, lift operator.

B. Roller Shade Fabrication
1. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):
   a. Shade Units Installed between (Inside) Jambs: Edge of shade not more than 1/4 inch (6 mm) from face of jamb. Length equal to head to sill dimension of opening in which each shade is installed.
   b. Shade Units Installed Outside Jambs: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
2. Installation Brackets: Designed for easy removal and reinstallation of shade, for supporting fascia, headbox, roller, and operating hardware and for hardware position and shade mounting method indicated.

3. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.

C. Motorized Roller Shade Operators
1. General: Provide factory-assembled motorized shade operation systems designed for lifting shades of type, size, weight, construction, use, and operation frequency indicated. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with the building electrical system.
2. Comply with NFPA 70.
3. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6 with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.
4. Electric Motors: UL-approved or -recognized, totally enclosed, insulated motor, complying with NEMA MG 1, with thermal-overload protection, brake, permanently lubricated bearings, and limit switches; sized by shade manufacturer to start and operate size and weight of shade considering service factor or considering Project's service conditions without exceeding nameplate ratings.
   a. Service Factor: According to NEMA MG 1, unless otherwise indicated.
   b. Motor Characteristics: Single phase, 24 **OR** 110 **OR** 220, **as directed**, V, 60 Hz.
   c. Motor Mounting: Within manufacturer's standard roller enclosure.
5. Remote Controls: Electric controls with NEMA ICS 6, Type 1 enclosure surface **OR** recessed or flush, **as directed,** mounting. Keyed switch **OR** Toggle-style, wall switch Rocker-style, wall switch **OR** Rocker-style, group-control wall switch **OR** Rocker-style, individual/group-control wall switch **OR** Sun sensor **OR** Radio **OR** Infrared **OR** Timer **OR** Microprocessor, **as directed**.
6. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop shade at fully raised and fully lowered positions.

1.3 EXECUTION

A. Roller Shade Installation
1. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions, and located so shade band is not closer than 2 inches (50 mm) to interior face of glass. Allow clearances for window operation hardware.
2. Connections: Connect motorized operators to building electrical system.
3. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.
4. Clean roller shade surfaces after installation, according to manufacturer's written instructions.

END OF SECTION 12210b

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SECTION 12210c - PLEATED SHADES

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for pleated shades. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. This Section includes the following types of horizontal-fold shades and accessories:
a. Z-pleated shades.
b. Cellular shades.
c. Motorized shade operators.

C. Definitions
1. Cellular Shades: Pleated shades with more than one horizontally folded fabric layer forming accordion-folded fabric with enclosed air spaces or cells. Cellular shades may consist of two fabric layers forming a continuous accordion fold of enclosed air spaces or cells for a linear row of cells, one cell wide; three fabric layers forming two interconnected accordion folds of enclosed air spaces or cells for two honeycombed rows of cells, nominally two cells wide; or four fabric layers forming three interconnected accordion folds of enclosed air spaces or cells for three honeycombed rows of cells, nominally three cells wide.
2. Pleated Shades: Permanently creased, horizontally folded shades. Alternatively, pleated shades are synonymous with Z-pleated shades according to the industry. Z-pleated shades consist of one fabric layer forming Z-folded pleats.

D. Submittals
1. Product Data: For each type of product indicated.
a. Motorized Shade Operators: Include operating instructions.
b. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.
2. Shop Drawings: Show location and extent of pleated shades. Include elevations, sections, details, and dimensions not shown in Product Data. Show installation details, mountings, attachments to other work, operational clearances, and relationship to adjoining work.
a. Motorized Shade Operators: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
b. Wiring Diagrams: Power, system, and control wiring.
3. Coordination Drawings: Reflected ceiling 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:
a. Suspended ceiling components.
b. Structural members to which equipment **OR** suspension systems, **as directed**, will be attached.
c. Sizes and locations of initial access modules for acoustical tile.
d. Items penetrating finished ceiling, including the following:
1) Lighting fixtures.
2) Air outlets and inlets.
3) Speakers.
4) Sprinklers.
5) Access panels.
e. Perimeter moldings.
4. Samples: For the following products:

a. Shade Fabrics: Not less than 3 inches (76 mm) square, with specified treatments applied. Mark face of material.
b. Valance: Full-size unit, not less than 12 inches (300 mm) long.

5. Maintenance Data.

E. Quality Assurance
1. Fire-Test-Response Characteristics: Provide pleated shades with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency:
   a. Flame-Resistance Ratings: Passes NFPA 701.
2. 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.
3. Product Standard: Provide pleated shades complying with WCMA A 100.1.

F. Delivery, Storage, And Handling
1. Deliver shades in factory packages, marked with manufacturer and product name, fire-test-response characteristics, **OR** lead-free designation, **as directed**, and location of installation using same designations indicated on Drawings and in a window treatment schedule.

1.2 PRODUCTS

A. Z-Pleated Shades
1. Z-Pleated Shade Construction: One-fabric thickness, with uniform pleat spacing maintained at all positions.
   a. Nominal Pleat Width: 1 inch (25 mm) **OR** 2 inches (50 mm) **OR** 3 inches (76 mm) **OR** 4 inches (100 mm), **as directed**.
2. Shade Fabric: Manufacturer's standard **OR** 100 percent nonwoven polyester with antistatic treatment **OR** PVC-coated polyester mesh **OR** 100 percent spun-woven polyester, **as directed**; stain and fade resistant, width as wide as required for seamless shade.
   a. Fabric Width: 36 inches (910 mm) **OR** 48 inches (1220 mm) **OR** 60 inches (1520 mm) **OR** 72 inches (1830 mm) **OR** 84 inches (2130 mm) **OR** 96 inches (2440 mm) **OR** As indicated on Drawings **OR** As indicated in a window treatment schedule, **as directed**.
   b. Pattern: as directed by the Owner.
   c. Style: as directed by the Owner.
   d. Colors: Match samples **OR** As selected from manufacturer's full range **OR** As indicated in a window treatment schedule, **as directed**.
   e. **Material Solar-Optical Properties: as directed by the Owner.**
   f. Material Openness Factor: percent as directed by the Owner..
   g. Material UV Blockage: percent as directed by the Owner..
3. Headrail: Formed steel or extruded aluminum; long edges returned or rolled; fully enclosing operating mechanisms on three sides and ends; capacity for one **OR** two, **as directed**, shade(s) per headrail, unless otherwise indicated on Drawings **OR** in a window treatment schedule, **as directed**.
4. Bottom Rail: Formed-steel or extruded-aluminum tube, sealed with plastic or metal capped ends.
5. Valance: Clear plastic with fabric insert matching fabric shade.
6. R-Value: Not less than 2.22 deg F x h x sq. ft./Btu (0.39 K x sq. m/W) **OR** 4.8 deg F x h x sq. ft./Btu (0.85 K x sq. m/W), **as directed**.
7. Mounting: Wall **OR** Ceiling **OR** End **OR** Wall extension brackets **OR** As indicated on Drawings, **as directed**, mounting permitting easy removal and replacement without damaging shade or adjacent surfaces and finishes; with spacers and shims required for shade placement and alignment indicated.

8. Hold-Down Brackets and Hooks or Pins: Manufacturer's standard, as indicated.
9. Side Channels and Perimeter Seals: Manufacturer's standard for eliminating light gaps when shades are closed.
10. Shade Operation: Manual.
    a. Lift Control: System including lift cord, crash-proof cord lock, and cord joiner ball **OR** System including continuous-cord loop, clutch, and cord tensioner and bracket **OR** Cordless system, **as directed**, designed to hold shade in place unless force is applied to move shade.
    b. Length of Lift Cord **OR** Cord Loop, **as directed**: Manufacturer's standard length **OR** Full length of shade **OR** Length required to make operation convenient from floor level **OR** As indicated on Drawings, **as directed**.
    c. Position of Lift Cord **OR** Cord Loop, **as directed**: As indicated on Drawings **OR** in a window treatment schedule, **as directed**.
    d. Position of Lift Cord **OR** Cord Loop, **as directed**: Left side **OR** Right side **OR** Left end **OR** Right end, **as directed**, of headrail, unless otherwise indicated on Drawings **OR** in a window treatment schedule, **as directed**.
    e. Cord Tensioner Mounting: Wall **OR** Floor **OR** Sill **OR** Baseboard **OR** As indicated on Drawings, **as directed**.
11. Shade Operation: Motorized operator.

B. Cellular Shades
1. Cellular Shade Construction: Two-fabric thicknesses and one row of cells, one cell wide.
    a. Nominal Cell Width: 3/8 to 7/16 inch (10 to 11 mm) **OR** 1/2 inch (13 mm) **OR** 9/16 inch (14.2 mm) **OR** 3/4 inch (19 mm), **as directed**.
2. Cellular Shade Construction: Three-fabric thicknesses and two honeycombed cells, nominally two cells wide.
    a. Nominal Cell Width: 3/8 inch (10 mm).
3. Cellular Shade Construction: Four-fabric thicknesses and three honeycombed cells, nominally three cells wide.
    a. Nominal Cell Width: 3/8 inch (10 mm).
4. Shade Fabric: Manufacturer's standard **OR** 100 percent nonwoven polyester with antistatic treatment **OR** 100 percent spun-woven polyester, **as directed**; stain and fade resistant, width as wide as required for seamless shade.
    a. Fabric Width: 36 inches (910 mm) **OR** 48 inches (1220 mm) **OR** 60 inches (1520 mm) **OR** 72 inches (1830 mm) **OR** 84 inches (2130 mm) **OR** 96 inches (2440 mm) **OR** As indicated on Drawings **OR** As indicated in a window treatment schedule, **as directed**.
    b. Pattern: as directed by the Owner.
    c. Style: as directed by the Owner.
    d. Colors: Match samples **OR** As selected from manufacturer's full range **OR** As indicated in a window treatment schedule, **as directed**.
5. Headrail: Formed steel or extruded aluminum; long edges returned or rolled; fully enclosing operating mechanisms on three sides and ends; capacity for one **OR** two, **as directed**, shade(s) per headrail, unless otherwise indicated on Drawings **OR** in a window treatment schedule, **as directed**.
6. Bottom Rail: Formed-steel or extruded-aluminum tube, sealed with plastic or metal capped ends.
7. Valance: Clear plastic with fabric insert matching fabric shade.
8. R-Value: Not less than 2.22 deg F x h x sq. ft./Btu (0.39 K x sq. m/W) **OR** 4.8 deg F x h x sq. ft./Btu (0.85 K x sq. m/W), **as directed**.
9. Mounting: Wall **OR** Ceiling **OR** End **OR** Wall extension brackets **OR** As indicated on Drawings, **as directed**, mounting permitting easy removal and replacement without damaging shade or adjacent surfaces and finishes; with spacers and shims required for shade placement and alignment indicated.
10. Hold-Down Brackets and Hooks or Pins: Manufacturer's standard, as indicated.
11. Side Channels and Perimeter Seals: Manufacturer's standard for eliminating light gaps when shades are closed.
12. Shade Operation: Manual.

a. Lift Control: System including lift cord, crash-proof cord lock, and cord joiner ball **OR** System including continuous-cord loop, clutch, and cord tensioner and bracket **OR** Cordless system, **as directed**, designed to hold shade in place unless force is applied to move shade.
b. Length of Lift Cord **OR** Cord Loop, **as directed**: Manufacturer's standard length **OR** Full length of shade **OR** Length required to make operation convenient from floor level **OR** As indicated on Drawings, **as directed**.
c. Position of Lift Cord **OR** Cord Loop, **as directed**: As indicated on Drawings **OR** in a window treatment schedule, **as directed**.
d. Position of Lift Cord **OR** Cord Loop, **as directed**: Left side **OR** Right side **OR** Left end **OR** Right end, **as directed**, of headrail, unless otherwise indicated on Drawings **OR** in a window treatment schedule, **as directed**.
e. Cord Tensioner Mounting: Wall **OR** Floor **OR** Sill **OR** Baseboard **OR** As indicated on Drawings, **as directed**.

13. Shade Operation: Motorized operator.

C. Pleated Shade Fabrication
1. Product Description: Pleated shades each consisting of fabric, rails, ladders, lifting mechanism, self-leveling device, and installation hardware.
2. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.
   a. Lifting Mechanism: With permanently lubricated moving parts.
3. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):
   a. Shade Units Installed between (Inside) Jambs: Edge of shade not more than 1/4 inch (6 mm) from face of jamb. Length equal to head-to-sill dimension of opening in which each shade is installed.
   b. Shade Units Installed Outside Jambs: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
4. Installation Brackets: Designed for easy removal and reinstallation of shade, for supporting headrail, valance, **as directed**, and operating hardware and for hardware position and shade mounting method indicated.
5. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.
6. Color-Coated Finish: For metal components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.
7. Component Color: Provide rails and cords, **as directed**, and exposed-to-view ladders, **as directed**, metal and plastic matching or coordinating with fabric color, unless otherwise indicated.

D. Motorized Pleated Shade Operators
1. General: Provide factory-assembled shade operation systems designed for lifting shades of type, size, weight, construction, use, and operation frequency indicated. Provide operation systems of size and capacity and with features, characteristics, and accessories suitable for Project conditions and recommended by shade manufacturer, complete with electric motors and factory-prewired motor controls, remote-control stations, remote-control devices, power disconnect switches, enclosures protecting controls and all operating parts, headrail, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with the building electrical system.
2. Comply with NFPA 70.
3. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6 with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc, **as directed**.

4. Electric Motors: UL-approved or -recognized, totally enclosed, insulated motor, complying with NEMA MG 1, with thermal-overload protection, brake, permanently lubricated bearings, and internal limit switches; sized by shade manufacturer to start and operate size and weight of shade considering service factor or considering Project's service conditions without exceeding nameplate ratings.
   a. Service Factor: According to NEMA MG 1, unless otherwise indicated.
   b. Motor Characteristics: Single phase, 24 **OR** 110 **OR** 220, **as directed**, V, 60 Hz.
   c. Motor Mounting: Within manufacturer's standard headrail enclosure.
5. Remote Controls: Electric controls with NEMA ICS 6, Type 1 enclosure for surface **OR** recessed or flush **OR** within headrail, **as directed**, mounting. Provide the following devices for remote-control activation of shades:
   a. Control Stations: Keyed, maintained **OR** momentary, **as directed**,-contact, three-position, switch-operated control station with open, close, and off functions. Provide two keys per station.
   b. Control Stations: Maintained **OR** Momentary, **as directed**,-contact, three-position, toggle **OR** rocker, **as directed**,-style, wall switch-operated control station with open, close, and center off functions.
      1) Color: Ivory **OR** White **OR** As indicated in a window treatment schedule, **as directed**.
   c. Group Control Stations: Maintained **OR** Momentary, **as directed**,-contact, three-position, rocker-style, wall switch-operated control station with open, close, and center off functions for single-switch group control.
      1) Color: Ivory **OR** White **OR** As indicated in a window treatment schedule, **as directed**.
   d. Individual/Group Control Stations: Maintained **OR** Momentary, **as directed**,-contact, three-position, rocker-style, wall switch-operated control station with open, close, and center-off functions for individual and group control.
      1) Color: Ivory **OR** White **OR** As indicated in a window treatment schedule, **as directed**.
   e. Sun Sensor Controls: Programmable system activated by LEDs detecting daylight intensity and responding by automatically adjusting shades.
   f. Radio Controls: Digital system consisting of code-compatible universal coaxial receiver, one per shade **OR** one per headrail **OR** where indicated on Drawings, **as directed**, and two, **as directed**, portable, multiple-channel transmitters for operating two **OR** four **OR** up to 12, **as directed**, shades individually, each with a single button to open and close shades.
   g. Infrared Controls: System consisting of concealed receiver complete with external eye and connecting modular cable, and two, **as directed**, portable, multiple-channel transmitters with separate buttons to open and close up to 12, **as directed**, individual shades or groups of shades, to open and close all shades simultaneously, and to stop.
   h. Timer Controls: Clock timer, 24-hour **OR** seven-day, **as directed**, programmable for regular events.
   i. Microprocessor Controls: Electronic programmable means for setting, changing, and adjusting control features. Provide unit isolated from voltage spikes and surges.
6. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop shade at fully raised and fully lowered positions.
7. Operating Features: Include the following:
   a. Group switching with integrated switch control; one face plate for multiple switch cut-outs.
   b. Capable of interface with audiovisual **OR** multiroom, **as directed**, control system.
   c. Capable of accepting input from building automation control system.
   d. Override switch.
8. Accessories: Include the following:
   a. Solar Power Unit: For use with control system indicated.
9. Headrail: Manufacturer's standard formed steel or extruded aluminum; long edges returned or rolled; fully enclosing operating mechanisms on three sides and ends; capacity for one **OR** two,

as directed, shade(s) per headrail, unless otherwise indicated on Drawings **OR** in a window treatment schedule, **as directed**.

a. Color: Match shade **OR** As indicated by manufacturer's designations **OR** As selected from manufacturer's full range **OR** As indicated in a window treatment schedule, **as directed**.

1.3 EXECUTION

A. Pleated Shade Installation

1. Install shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions, and located so pleat edges are not closer than 2 inches (50 mm) to interior face of glass. Install intermediate support as required to prevent deflection in headrail. Allow clearances for window operation hardware.
2. Flush Mounted: Install shades with pleat edges flush with finish face of opening if shade is in fully lowered position.
3. Jamb Mounted: Install headrail flush with face of opening jamb and head.
4. Head Mounted: Install headrail on face of opening head.
5. Recessed: Install headrail concealed within shade pocket.
6. Connections: Connect motorized operators to building electrical system.

B. Adjusting

1. Adjust and balance pleated shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

C. Cleaning And Protection

1. Clean pleated shade surfaces after installation, according to manufacturer's written instructions.
2. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that pleated shades are without damage or deterioration at time of Substantial Completion.
3. Replace damaged pleated shades that cannot be repaired, in a manner approved, before time of Substantial Completion.

END OF SECTION 12210c

SECTION 12315 - KITCHEN CASEWORK, STAINLESS STEEL CABINETS

1.1 GENERAL

A. Description of Work
1. This specification covers the furnishing and installation of materials for kitchen casework, stainless steel cabinets. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Quality Assurance
1. Comply with all provisions of specifications for the design, quality testing. Manufacturing and installation of metal kitchen cabinets and specified equipment.
2. All kitchen cabinetry and equipment herein specified and shown on the drawings shall meet the standards, quality of materials, construction, workmanship and finish of Innovative Laboratory Systems Co., 1336 Industrial Rd., Omaha Nebraska, (402) 333-0679. Equal manufacturers acceptable.
3. All metal cabinetry and equipment herein shall be the product of one manufacturer and be the one on which this specification is based or approved of substitutes must be obtained in writing from the Owner ten days prior to the bid due date. All manufacturers other than the specified product shall provide evidence of having a minimum of five years experience in the manufacturing and installation of stainless steel kitchen cabinetry.
4. The manufacturer shall, from one year to date of installation, warrant parts or products manufactured and finished against manufacturing defects in material and any such parts which under normal use prove defective within one year form date of installation, shall be repaired or replaced without charge to the Owner.
5. Wood shall not be used in any portion of the casework construction whether exposed or hidden from view.

C. Submittals
1. Shop Drawings
   a. Identify location of metal cabinetry and related items.
   b. Detail cabinets, shelving, countertops, etc, in related and dimensional position, with sections. Locations for roughing-in of plumbing, including sinks, faucets, strainers, cocks, etc. shall be included
2. Certificates: All bidders shall provide to the Owner independent test results from a nationally recognized testing laboratory on the finishes required for this project with the bid.

1.2 PRODUCTS

A. Material
1. All metal cabinetry shall be fabricated to Type 304 stainless steel free of scales buckles or other defects.
2. Minimum metal gauge: All minimum thickness of metal referred to herein shall be U.S. standard gauge.
   a. 20 Gauge: Inner door panels, inner and outer drawer panels, drawer body, and shelves.
   b. 18 Gauge: Outer door panels, sides, backs, bottoms, and tops.
   c. 16 Gauge: Top rails, cross rails, drawer slides.
   d. 14 Gauge: Leveling and corner gussets.

B. Fabrications
1. Cabinet Grade: Premium and complying with the following.
   a. Align sides, top rails, bottoms and vertical stiles, at intersections, without overlap.

b. Rounded edges.
c. Full welded seams.
d. Grind exposed welds flush and smooth.

2. Cases: The sides of cabinets shall be formed to make a rabbeted stile 1-1/8" wide. Top of case stiles shall be closed by a mitered 45-degree bend from tip of case side. Stiles shall be closed by welded channel, which contains front shelf adjustment louvers. All case members including intermediate cross rails shall be welded for maximum strength. Use of sheet metal screws to hold intermediate cross rails in place is not acceptable. Sides of all cabinets shall be free from any holes to prevent dust and bacteria from entering the cabinet. Pre-punched holes in the side of any cabinet will not be allowed. All drawer cabinets and cupboard cabinets shall have full backs and bottoms welded into place. Any cabinet without any backs or bottoms will be rejected. All interior bottoms of base and tall cabinets shall be turned down to provide a clean, flush interior free from dust catching ledges and preventing bacterial accumulation. Bottoms of all wall units shall be flushed; recessed bottoms are not acceptable.
3. Doors
   a. Doors shall be double panel reinforced construction 5/8" thick and sound deadened with vertical steel battens. Door fronts and liners shall be welded together for added strength. Door fronts and cases shall be slotted to receive hinges. Hinge wings must be concealed when doors open. Wrap around type hinges are not acceptable. All doors shall have soft rubber bumpers for quiet closing. Rubber bumpers must be securely locked in place. Rubber Bumpers attached by adhesives are not acceptable. All corners of doors shall be welded and ground smooth.
   b. Sliding doors shall be double panel reinforced construction 5/8" thick and operate on nylon rollers suspended from stainless steel track at top of unit and center guide at bottom. Sliding doors shall have recessed door pulls.
4. Drawers
   a. Drawers front shall be double panel reinforced construction with 5/8" thick fronts and sound deadened with vertical steel battens. Drawers shall be all welded construction. All drawers shall have soft rubber bumpers for quiet closing. Rubber bumpers must be securely locked in place. Rubber bumpers attached by adhesives are not acceptable. All edges of drawer fronts shall be closed.
   b. Drawer bodies shall be formed from a single sheet of steel including the bottom, two sides, back and inner front. Interior bottoms of drawers shall be fully covered on four sides for ease in cleaning. The top front of the inner drawer shall be offset to interlock with the outer drawer front.
   c. Flanges on the top of drawer body shall be fully formed channel and bent at a 6-degree angle for maximum strength. Flanges shall be formed to leave the inside of the drawer free form sharp edges. Drawer slide shall be welded to drawer body and be part of a "Z" shaped member in a wrap around design to support drawer body. Drawer slides shall have a 15/16" nylon tired ball bearing roller. Drawer slide shall be roller type, positive in action permitting drawer to be fully opened; yet preventing drawer from accidental removal. Case slides shall be a formed piece of galvanized steel with 15/16" nylon tired ball bearing roller at front of slide. All ball bearing rollers for drawer slide and case slide shall be pre-lubricated to guarantee a smooth, quiet operation. All drawers shall rise upward when opened to prevent engaging of drawers and doors below. Drawers shall have self-closing design during the last 5" of travel.
5. Shelves: Shelves shall be formed from a single sheet of stainless steel with 7/8" face turned back and up at a 30-degree angle and edge of flange shall make firm contact with underside of shelf for sound deadening. All shelves in cabinets shall be adjustable on 1-1/2" center and supported by stainless steel clips placed in embossed louvers. All shelves shall be solid.
6. Hardware: Door catch shall be positive type latch located at upper inside edge of door. Stainless steel strike bracket shall be installed inside of door with accessible removable screws. Bolt shall be nylon self-closing type tested for 300,000 opening and closing cycles. Complete bolt housing shall be recessed behind cross rail. Roller catches and/or friction catches are not acceptable.

7. Hinges: Hinges shall be institutional type, 2-1/2" long, with a metal thickness of least 0.090", containing 5-knuckles, and centered 3" above bottom and below top of door. Doors 45" high and over shall have an additional hinge in center. Hinges shall be stainless steel with smooth rounded joints for easy cleaning. When door is closed, only the joint shall be exposed. Both hinge wings shall be encased, one within the door, the other within the case. Hinges shall be attached to the door and the case by screws. Hinges welded to door and/or case are not acceptable.
8. Door and Drawer Pull: Door and drawer pull shall be stainless steel with a brushed satin finish. Shoulder screws shall be used so that when handles are mounted they do not cause the door to buckle or cave. Sliding doors shall have recessed door pulls.
9. Base Cabinet Legs: All base cabinets and sink units shall be furnished with integral stainless steel legs with adjustable levelers. Bottom of base cabinets shall be approximately 6" above the floor.
10. Locking Mechanism: All cabinet doors shall be provided with stainless steel angle hasps, with half-inch diameter holes for pad locking, as shown on the drawings. The left door of each door pair shall have a sliding flush bolt on the inside face, as shown on the drawings, to prevent the pair of doors from swinging open when pad locked.

C. Steel Cabinet Finish
1. Test Procedure: Chemical spot tests shall be made by applying 10 to 15 drops (approximately 0.5 cubic cm) of each reagent listed in Table 1 to the surface to be tested. Each reagent spot shall be open to the atmosphere. Ambient temperature is 68-72 degrees F (20-22 degrees C). After one hour, chemicals shall be flushed away with cold water and the surface, washed with detergent and warm water at 150 degrees F (65 degrees C). Surface shall be examined under 100-foot candles of illumination.

D. Kitchen Cabinets Performance Requirements
1. Base Cabinets.
   a. Cabinets Load Test: A 48" wide standing height combination cupboard and drawer cabinet shall be freestanding with installed counter top. Cabinet shall sit 1" off the floor on all four leveling screws and be capable of supporting a uniform distributed load of 2,000 lbs. Door and drawer operation shall not be affected by the load.
   b. Leveling device for floor mounted cabinets shall be capable of supporting a load of 500 lbs. Without failure and capable of adjustment after load is removed.
   c. Cabinet Door Test: An open door shall withstand a load of 200 lbs. applied directly at the outer edge. Door shall be moved through a 180 degree arc and weight removed. Operation of the door after test shall be normal without distortion that will adversely affect operation for the door catch.
   d. Life Cycle Test.
      1) Door hinge shall operate for 300,000 opening and closing cycles without a failure.
      2) Positive door catch shall operate for 300,000 opening and closing cycles without failure.
      3) Drawer shall be tested and operated with a load of 100 lbs. for a minimum of 150,000 opening and closing cycles. After test, drawers shall operate freely without evidence of dragging or scraping.
2. Wall Cabinets
   a. A 48" wide, 30" high, 12 ¾" deep hinged wall case shall support a load of 1lbs. on cabinet bottom and 100 lbs. on each adjustable shelf for a total of 300 lbs. Cabinet shall not show any significant permanent defection of cabinet, cabinet bottom or shelves. Doors shall operate smoothly when cabinet is fully loaded.
   b. An adjustable shelf shall support a uniformly distributed load of 100 lbs. When load is removed, shelf should show no significant permanent distortion.
   c. Performance of hinge and catch shall be the same as used on base cabinets.

E. Working Surfaces
1. Stainless Steel: Sink and counter tops shall be fabricated of 16 gauge, Type 304, 18-8 solid stainless steel formed down and back making a 1 ½" high face on all exposed edges.

Drainboards and cabinet tops shall be rigidly reinforced the full length of the top. Drainboards shall be two-way pitched to the bowl to provide drainage without channeling or grooving. Drainboards, flanges and splashes shall be integral, being formed from one sheet of metal. Raised edge surrounding unit shall be seamless die formed at front and ends of unit. Sink bowls shall be fabricated of 16 gauge, Type 304, 18-8 solid stainless steel seamless electrically welded to drainboard. All joints shall be electrically welded, ground and polished to a satin finish. Entire units shall be thoroughly sound deadened on under surface with sprayed or trowelled undercoating. Wood shall not be used. All tops shall have stainless steel runners to facilitate fastening to cabinets.

1.3 EXECUTION

A. Insulations

1. Install cabinets, shelves, counter tops and other equipment level and square. Install sink units to provide positive drainage of bottom surface of the sinks.
2. Wall cabinets shall be hung from the metal stud framing system wherever possible. If the wall cabinets must be hung from the wall surfacing at any location, proper anchors shall be used. Install wall cabinets level and aligned.
3. Install base cabinets firmly on ground. Level all the surfaces by adjusting the leg levelers. Attached countertops to inslatted base cabinets with stainless steel screws as required. Caulk with silicone all around counter tops where it interfaces with the existing walls. Install the flat back panels to the wall surfaces by the most appropriate method and caulk as required.
4. All work, including installation of new casework, flooring, ceiling, ductwork, etc., as well as the demolition of the existing casework, flooring, etc. shall be completed within three (3) consecutive days of work start. Hours of work shall be between 7:30 a.m. 9:00 p.m. All work, including work noted on Punch List, shall be completed by 9:00 p.m. of the third work day after work starts.

B. Temporary Work Station

1. During the period of demolition and new casework installation (3 days maximum) the contractor shall provide a temporary cabinet assembly for use by the Owner. The temporary assembly shall have a 6-foot section of cabinets with countertop, sink and faucet. The faucet shall be temporary connected to an apparatus hose bib for providing cold water to the sink. The sink shall be temporarily connected to a sewer line or floor drain if possible for the discharge or to another approved system of temporary discharge by means of a suitable container. For the latter method, the Contractor shall be responsible for periodically disposing of the waste container's contents. The temporary cabinet assembly shall be located reasonably close to the existing kitchens and/or dining areas being remodeled. The Owner shall approve the location of the temporary cabinets.

C. Inspection

1. Inspect installed work of other trades and installation conditions for acceptability. Inform Owner of discrepancies that will jeopardize a complete and proper installation
2. Cleaning: Touching up marred and/or abraded finished surfaces, clean components to post construction accepted levels, remove crating and packing material, broom sweep premises.

END OF SECTION 12315

Task	Specification	Specification Description
12315	01352	No Specification Required

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SECTION 12480 - FLOOR MATS AND FRAMES

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for floor mats and frames. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. This Section includes the following:
a. Roll-up mats in recessed and surface-mounted frames.
b. Entrance mats in recessed and surface-mounted frames.
c. Entrance tiles in recessed and surface-mounted frames.

C. Submittals
1. Product Data: For each type of floor mat and frame.
2. Shop Drawings: Show the following:
a. Items penetrating floor mats and frames, including the following:
1) Door control devices.
b. Divisions between mat sections.
c. Perimeter floor moldings.
d. Custom Graphics: Scale drawing indicating colors.
3. Samples: For each floor mat, tread rail, and frame member.
4. Maintenance Data.

D. Quality Assurance
1. Accessibility Requirements: Provide installed floor mats that comply with Section 4.5 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)" **OR** Sections 302 and 303 in ICC A117.1, **as directed**.

1.2 PRODUCTS

A. Roll-Up Mats
1. Roll-up, Vinyl-Rail Hinged Mats: Vinyl-acrylic tread rails 1-1/2 inches (38 mm) **OR** 2 inches (50 mm), **as directed**, wide by 3/8 inch (9.5 mm) thick, with slotted or perforated vinyl **OR** aluminum, **as directed**, hinges.
a. Tread Inserts: Textured-surface, resilient vinyl **OR** Ribbed-design-surface, resilient vinyl **OR** Mineral abrasive particles bonded to or embedded in vinyl **OR** Aluminum-oxide or silicon-carbide grit in epoxy matrix **OR** 1/4-inch- (6-mm-) high, 28-oz./sq. yd. (950-g/sq. m) weight, level-cut, nylon-pile, fusion-bonded carpet, **as directed**.
b. Colors, Textures, and Patterns of Inserts: As selected from manufacturer's full range.
c. Rail Color: Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Black **OR** As selected from manufacturer's full range, **as directed**.
d. Mat Size: As indicated **OR as directed**.
2. Roll-up, Aluminum-Rail Hinged Mats: Extruded-aluminum tread rails 1-1/2 inches (38 mm) **OR** 2 inches (50 mm), **as directed**, wide by 3/8 inch (9.5 mm) thick, sitting on continuous vinyl cushions.
a. Tread Inserts: Plain serrated aluminum treads **OR** Textured-surface, resilient vinyl **OR** Ribbed-design-surface, resilient vinyl **OR** Mineral abrasive particles bonded to or embedded in vinyl **OR** Aluminum-oxide or silicon-carbide grit in epoxy matrix **OR** 1/4-inch-

(6-mm-) high, 28-oz./sq. yd. (950-g/sq. m) weight, level-cut, nylon-pile, fusion-bonded carpet, **as directed**.

b. Colors, Textures, and Patterns of Inserts: As selected from manufacturer's full range.

c. Rail Color: Mill-finish **OR** Clear **OR** Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Black **OR** As selected from manufacturer's full range, **as directed**.

d. Hinges: Plastic **OR** Aluminum, **as directed**.

e. Mat Size: As indicated **OR as directed**.

3. Surface-Mounted Frames:

a. Tapered Frames: Tapered flexible vinyl edge-frame **OR** aluminum frame, **as directed**, members, not less than 1-1/2 inches (38 mm) wide, attached to mat at all 4 edges, with welded mitered corners.

b. Color: Mill finish **OR** Clear **OR** Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Black **OR** As selected from manufacturer's full range, **as directed**.

4. Recessed Frames:

a. Extruded Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6061-T6 or Alloy 6063-T5, T6, or T52.

b. Color: Mill finish **OR** Clear **OR** Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Black **OR** As selected from manufacturer's full range, **as directed**.

c. Architectural Bronze: ASTM B 455, Alloy UNS No. C38500.

5. Structural Performance (if floor mats must withstand heavy wheeled-cart loads): Provide roll-up mats and frames capable of withstanding the following loads and stresses within limits and under conditions indicated:

a. Uniform floor load of 300 lbf/sq. ft. (14.36 kN/sq. m) **OR as directed**.

b. Wheel load of 350 lb (159 kg) per wheel **OR as directed**.

B. Entrance Mats

1. Resilient Link Mats: 3/8-inch- (9.5-mm-) **OR** 7/16-inch- (11-mm-), **as directed**, thick, reversible vinyl **OR** rubber **OR** rubber-tire, **as directed**, link mats with galvanized spring-steel **OR** stainless-steel, **as directed**, wire link rods, vulcanized edge-nosing trim, steel-reinforced end trim, and links consisting of rectangular units or continuous strips in a heel-proof, solid-weave pattern with no openings between links **OR** heel-proof, close-weave pattern with openings between links not exceeding 1/8 inch (3 mm) wide by 1 inch (25.4 mm) long **OR** open-weave pattern with openings between links about 1/2 inch (13 mm) wide by 1 inch (25.4 mm) long, **as directed**.

a. Color: As selected from manufacturer's full range.

b. Mat Size: As indicated **OR asa directed**.

2. Rubber **OR** Vinyl, **as directed**, Mats: 1/4-inch- (6-mm-) **OR** 3/8-inch- (9.5-mm-) **OR** 7/16-inch- (11-mm-) **OR** 1/2-inch- (13-mm-), **as directed**, thick mats; with square edges for recessed installations **OR** beveled edges for surface applications, **as directed**, and with solid sheet (no perforations) style **OR** perforated style, 1/4-inch (6-mm) diameter on standard spacing **OR** perforated style, 3/16 by 3/4 inch (5 by 19 mm) on standard spacing, **as directed**, standard pyramid design **OR** standard wide-wale corrugated **OR** hi-rib, narrow-wale corrugated, **as directed**, top profile, and low-rib, narrow-wale corrugated **OR** standard knob-base **OR** flat-base, **as directed**, bottom surface.

a. Color: As selected from manufacturer's full range.

b. Mat Size: As indicated, **OR as directed**.

3. Cocoa Mats: Constructed from cocoa fiber yarn permanently bonded to PVC backing for dimensional stability and resistance to shedding; 5/8- to 3/4-inch (16- to 19-mm) overall thickness; 1.5-lb/sq. ft (7.3-kg/sq. m) **OR** 1-inch (25.4-mm) overall thickness; 2.0-lb/sq. ft (10-kg/sq. m) **OR** 1-1/4-inch (32-mm) overall thickness; 2.5-lb/sq. ft (12-kg/sq. m), **as directed**, weight.

a. Color: As selected from manufacturer's full range.

b. Mat Size: As indicated, **as directed**.

4. Rubber-Tire Mats: Units of edge-grain-laminated and chenille-buffed, rubber-tire wall cuts; bonded to sheet rubber or other durable flexible backing sheet to form 3/8- to 7/16-inch- (9.5- to

11-mm-) thick, 12-inch- (300-mm-) square tile **OR** wide, continuous linear strip up to 25 feet (7.6 m) long, **as directed**.
   a. Mat Size: As indicated **OR as directed**.
5. Carpet-Type Mats: Nylon **OR** Polypropylene **OR** Olefin **OR** Polyester, **as directed**, carpet bonded to 1/8- to 1/4-inch- (3- to 6-mm-) thick, flexible vinyl backing to form mats 3/8 or 7/16 inch (9.5 or 11 mm) thick with nonraveling edges.
   a. Colors, Textures, and Patterns: As selected from manufacturer's full range.
   b. Mat Size: As indicated **OR as directed**.
6. Loop Filament Mats: 3M's "Nomad" loop filament vinyl material 3/8 inch (9.5 mm) **OR** 1/2 inch (13 mm), **as directed**, thick, with solid vinyl sheet **OR** foam sheet, **as directed**, backing and with built-in chemical agents to reduce fungus and mildew.
   a. Color: As selected from manufacturer's full range.
   b. Mat Size: As indicated **OR as directed**.
7. Nuway Mats: Nylon-reinforced, 1/2-inch- (13-mm-) wide by 7/16-inch- (11-mm-) **OR** 11/16-inch- (17.4-mm-), **as directed**, thick, vulcanized laminated rubber strips alternating with 9/16-inch- (14-mm-) wide, profile shapes assembled on 0.1055-inch- (2.7-mm-) diameter, galvanized steel wire, 1-1/2 inches (38 mm) o.c. Fibered surface buffed on rubber strips for interior **OR** unbuffed on rubber strips for exterior, **as directed**, installations.
   a. Semiopen construction incorporating a 1/8-inch- (3-mm-) thick, PVC spacer on each wire between each profile shape and rubber strip to allow dirt, grit, and water to drop through.
   b. Profile Shape Finish: Extruded-aluminum, mill finish **OR** Solid architectural-quality brass **OR** High-impact, solid PVC in color selected, **as directed**.
   c. Color: As selected from manufacturer's full range.
   d. Mat Size: As indicated **OR as directed**.
8. Surface-Mounted Frames:
   a. Tapered Frames: Tapered flexible vinyl edge-frame **OR** aluminum frame, **as directed**, members, not less than 2 inches (50 mm) **OR** 1-1/2 inches (38 mm), **as directed**, wide, attached to mat at all 4 edges, **as directed**, with welded mitered corners.
   b. Color: Mill finish **OR** Clear **OR** Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Black **OR** As selected from manufacturer's full range, **as directed**.
9. Recessed Frames:
   a. Extruded Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6061-T6 or Alloy 6063-T5, T6, or T52.
   b. Color: Mill-finish **OR** Clear **OR** Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Black **OR** As selected from manufacturer's full range, **as directed**.
   c. Architectural Bronze: ASTM B 455, Alloy UNS No. C38500.
10. Graphics: Custom inlaid or woven-in graphic design **OR** logo **OR** emblem **OR** characters, **as directed**, as indicated.

C. Entrance Tiles
1. Rubber-Tire Tiles: Units of edge-grain-laminated and chenille-buffed, rubber-tire wall cuts; bonded to sheet rubber or other durable flexible backing sheet to form 3/8- to 7/16-inch- (9.5- to 11-mm-) thick, square tile **OR** continuous linear strip, **as directed**.
   a. Colors, Textures, and Patterns: As selected from manufacturer's full range.
   b. Tile Size: 12 inches (300 mm) **OR** As indicated, **as directed**.
2. Rubber **OR** Vinyl, **as directed**, Tiles: 5/8-inch- (16-mm-) **OR** 7/16-inch- (11-mm-), **as directed**, thick, solid **OR** open-grid, **as directed**, rubber **OR** vinyl, **as directed**, compound molded tiles with concealed interlocking joint tabs **OR** 1/4-inch- (6-mm-) deep, serpentine-grooved top face and knob-base back face on solid tile, **as directed**.
   a. Colors, Textures, and Patterns: As selected from manufacturer's full range.
   b. Tile Size: As indicated **OR as directed**.
3. Carpet-Type Tiles: Nylon **OR** Polypropylene **OR** Olefin **OR** Polyester, **as directed**, carpet bonded to 1/8- to 1/4-inch- (3- to 6-mm-) thick, flexible vinyl backing to form mats 3/8 or 7/16 inch (9.5 or 11 mm) thick with nonraveling edges.
   a. Colors, Textures, and Patterns: As selected from manufacturer's full range.
   b. Tile Size: As indicated **OR as directed**.

4. Surface-Mounted Frames:
   a. Tapered Frames: Tapered flexible vinyl edge-frame **OR** aluminum frame, **as directed**, members, not less than 2 inches (50 mm) **OR** 1-1/2 inches (38 mm), **as directed**, wide, attached to mat at all 4 edges, **as directed**, with welded mitered corners.
   b. Color: Mill finish **OR** Clear **OR** Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Black **OR** As selected from manufacturer's full range, **as directed**.
5. Recessed Frames: Manufacturer's standard extrusion.
   a. Extruded Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6061-T6 or Alloy 6063-T5, T6, or T52.
   b. Color: Mill-finish **OR** Clear **OR** Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Black **OR** As selected from manufacturer's full range, **as directed**.

D. Concrete Fill And Grout Materials
1. Provide concrete grout and fill equivalent in strength to cast-in-place concrete slabs for recessed mats and frames. Use aggregate no larger than one-third fill thickness.

E. Fabrication
1. Floor Mats: Shop fabricate units to greatest extent possible in sizes indicated. Unless otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.
2. Surface-Mounted Frames: As indicated for permanent surface-mounted installation, complete with corner connectors, splice plates or connecting pins, and postinstalled expansion anchors.
3. Recessed Frames: As indicated, for permanent recessed installation, complete with corner pins or reinforcement and anchorage devices.
   a. Fabricate edge-frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins.
4. Coat surfaces of aluminum frames that will contact cementitious material with manufacturer's standard protective coating.

F. Aluminum Finishes
1. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
2. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
3. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.
4. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
5. Class II, Color Anodic Finish: AA-M12C22A32/A34 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, integrally colored or electrolytically deposited color coating 0.010 mm or thicker) complying with AAMA 611.
6. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

G. Copper-Alloy (Bronze) Finishes

1. Finish designations prefixed by CDA comply with the system established by the Copper Development Association for designating copper-alloy finishes, as defined in NAAMM's "Metal Finishes Manual for Architectural and Metal Products."
   a. Remove tool and die marks and stretch lines or blend into finish.
   b. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
2. CDA Mechanical Finish Designation: M11, specular, as fabricated **OR** M32, directionally textured, medium satin, **as directed**.

1.3 EXECUTION

A. Installation
   1. Install recessed mat frames to comply with manufacturer's written instructions. Set mat tops at height recommended by manufacturer for most effective cleaning action; coordinate top of mat surfaces with bottom of doors that swing across mats to provide clearance between door and mat.
      a. For installation in terrazzo flooring areas, provide allowance for grinding and polishing of terrazzo without grinding surface of recessed frames. Coordinate with other trades as required.
      b. Install necessary shims, spacers, and anchorages for proper location and secure attachment of frames.
      c. Install grout and fill around frames and, if required to set mat tops at proper elevations, in recesses under mats. Finish grout and fill smooth and level.
   2. Install surface-type units to comply with manufacturer's written instructions at locations indicated; coordinate with entrance locations and traffic patterns.
      a. Anchor fixed surface-type frame members to floor with devices spaced as recommended by manufacturer.

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

END OF SECTION 12480

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SECTION 12480a - FOOT GRILLES

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for foot grilles. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the Work.

B. Summary
1. This Section includes recessed foot grilles and frames.

C. Performance Requirements
1. Structural Performance: Provide foot grilles and frames capable of withstanding the following loads and stresses:
a. Uniform floor load of 300 lbf/sq. ft. (14.36 kN/sq. m) **OR as directed**.
b. Wheel load of 350 lb (159 kg) **OR as directed,** per wheel.

D. Submittals
1. Product Data: For each type of foot grille and frame.
2. Shop Drawings: Show the following:
a. Items penetrating foot grilles and frames, including the following:
1) Door control devices.
b. Divisions between grille sections.
c. Perimeter floor moldings.
3. Samples: For each type of product involving color selection.
a. Foot Grille: 12-inch- (300-mm-) square assembled sections.
b. Frame Members: 12-inch- (300-mm-) long Sample of each type and color.
4. Maintenance data.

E. Quality Assurance
1. Accessibility Requirements: Provide installed foot grilles that comply with Section 4.5 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)" **OR** Sections 302 and 303 in ICC A117.1., **as directed**

1.2 PRODUCTS

A. Materials
1. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B, with A60 (ZF180) zinc-iron-alloy (galvannealed) coating or with G60 (Z180) mill-phosphatized zinc coating; stretcher-leveled standard of flatness; with minimum thickness indicated representing specified thickness according to ASTM A 924/A 924M.
2. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304.
3. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than strength and durability properties of Alloy 5005-H15.
4. Extruded Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6061-T6 or Alloy 6063-T5, T6, or T52 as standard with manufacturer. Coat surface of frame in contact with cementitious materials with manufacturer's standard protective coating.
5. Extruded Architectural Bronze: ASTM B 455, Alloy No. C38500.
6. Stainless-Steel Angles: ASTM A 276 or ASTM A 479/A 479M, corrosion resistant, Type 304.

B. Foot Grilles
1. General: Provide manufacturer's standard foot-grille assemblies consisting of treads of type and profile indicated, interlocked or joined together by cross members, and with support legs (if any) and other components needed to produce a complete installation.
2. Aluminum **OR** Bronze, **as directed**, Foot Grilles: Provide manufacturer's standard foot grilles with extruded members, top-surfaced tread rails, and as follows:
   a. Tread Rails: Extruded-aluminum **OR** Extruded-bronze, **as directed**, tread rails with extruded-aluminum frame, **as directed**.
   b. Tread Rail Spacing: 1-1/2 inches (38 mm) o.c. with 1/8- to 3/16-inch- (3- to 4.8-mm-) **OR** 2 inches (50 mm) o.c. with 1/4-inch- (6-mm-), **as directed**, wide openings between treads.
   c. Aluminum Finish: Mill **OR** Anodized, **as directed**.
      1) Colors: Clear natural aluminum **OR** Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Black **OR** As selected from manufacturer's full range, **as directed**.
   d. Top Surface: Serrated aluminum **OR** Serrated bronze **OR** Serrated vinyl cap with UV stabilizer and antifungal additive **OR** Textured-surface, resilient vinyl insert **OR** Aluminum-oxide or silicon-carbide grit in epoxy matrix **OR** Abrasive particles bonded to or imbedded in vinyl insert **OR** Fusion-bonded, level-cut-pile nylon carpet insert; 1/4 inch (6 mm) high, 28 oz./sq. yd. (950 g/sq. m), **as directed**.
      1) Colors: As selected from manufacturer's full range, **as directed**.
   e. Grille Size: As indicated **OR as directed**.
3. Stainless-Steel Foot Grille: Type 304.
   a. Surface Treads: 0.071-by-0.177-inch (1.8-by-4.49-mm) wire with 0.125-inch- (3.17-mm-) **OR** 0.090-by-0.172-inch (2.2-by-4.37-mm) wire with 0.145-inch- (3.68-mm-) **OR** 0.093-by-0.156-inch (2.36-by-3.96-mm) wire with 0.125-inch- (3.17-mm-), **as directed**, wide openings between wires.
   b. Support Rods: Spaced 1 inch (25 mm) o.c., welded to each wire.
   c. Mat Grating: 5/8 inch (16 mm) deep.
   d. Pit Grating: 1-1/8 inches (28.5 mm) deep.
   e. Stainless-Steel Finish: Mill **OR** No. 4, **as directed**, finish.
   f. Grille Size: As indicated **OR as directed**.
4. PVC Foot Grille: 1/8-by-1-1/2-by-1-inch (3-by-38-by-25-mm) ribbed top, PVC tread bars joined with 3/8-inch (10-mm) stainless-steel rods with 1-1/16-inch- (27-mm-) long nylon spacers at 12 inches (300 mm) o.c. Provide PVC frame with nylon anchors.
   a. Colors: As selected from manufacturer's full range.
   b. Grille Size: As indicated **OR as directed**.
5. Lockdown: Manufacturer's standard **OR** Hidden **OR** In view, **as directed**.

C. Frames
1. Provide manufacturer's standard frames of size and style for grille type, for permanent recessed installation in subfloor, complete with installation anchorages and accessories. Unless otherwise indicated, fabricate frame of same material and finish as grilles.

D. Support System
1. Level Bed Applications: Provide manufacturer's standard, vinyl cushion support system.
2. Drainage Pit Applications: Provide manufacturer's special deep-pit frame and support extrusion system with intermediate support beams, sized and spaced as recommended by manufacturer for indicated spans and equipped with vinyl support cushions.

E. Drain Pans
1. Provide manufacturer's standard, 0.060-inch- (1.52-mm-) thick, **as directed**, metallic-coated steel **OR** aluminum **OR** stainless-steel, **as directed**, sheet drain pan with NPS 2 (DN 50) drain outlet for each floor grille unit. Coat bottom of pan with protective coating recommended by manufacturer.

F. Fabrication

1. Shop fabricate foot grilles to greatest extent possible in sizes as indicated. Unless otherwise indicated, provide each grille as a single unit; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in grilles are necessary, space symmetrically and away from normal traffic lanes.
2. Fabricate frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins.

G. Finishes, General
1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
2. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

H. Aluminum Finishes
1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Mill Finish: AA-M10 (Mechanical Finish: as fabricated); grind and buff as required to remove scratches, welding, or abrasions produced in fabrication process.
3. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.
4. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
5. Class II, Color Anodic Finish: AA-M12C22A32/A34 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, integrally colored or electrolytically deposited color coating 0.010 mm or thicker).
6. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

I. Stainless-Steel Finishes
1. Mill finish.
2. Directional Satin Finish: No. 4.
   a. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

J. Copper-Alloy (Bronze) Finishes
1. Finish designations for copper alloys comply with the system established for designating copper-alloy finish systems defined in NAAMM's "Metal Finishes Manual for Architectural and Metal Products."
   a. Remove tool and die marks and stretch lines or blend into finish.
   b. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
2. Mechanical Finish Designation: M11, specular, as fabricated **OR** M32, directionally textured, medium satin, **as directed**.

1.3 EXECUTION

A. Installation
1. Install recessed foot grilles and frames and drain pans to comply with manufacturer's written instructions at locations indicated and with top of foot grilles and frames in relationship to one another and to adjoining finished flooring as recommended by manufacturer. Set foot-grille tops

at height for most effective cleaning action. Coordinate top of foot-grille surfaces with doors that swing across grilles to provide clearance under door.

B. Protection

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

END OF SECTION 12480a

SECTION 12610 - FIXED AUDIENCE SEATING

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for fixed audience seating. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section includes fixed audience seating with the following:
   a. Standard, Beam, and Pedestal mounting.
   b. Upholstered chairs, Molded-plastic chairs and Molded-plastic chairs with upholstered inserts.
   c. Self-rising seat mechanism.
   d. Power and data service to individual seats.

C. Submittals
1. Product Data: For each type of product indicated.
2. LEED Submittals:
   a. Certificates for Credit MR 7: Chain-of-custody certificates certifying that wood and wood-based materials comply with forest certification requirements. Include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.
      1) Include statement indicating costs for each certified wood product.
   b. Product Data for Credit EQ 4.4: For each composite wood product, documentation indicating that product contains no urea formaldehyde.
3. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   a. Seating Layout: Show seating layout, aisle widths, row-lettering and chair-numbering scheme, chair widths, and chair spacing in each row.
   b. Accessories: Show accessories, including locations of left- and right-hand tablet arms, electrical devices, accessibility provisions, and attachments to other work.
   c. Wiring Diagrams: For power, signal, and control wiring.
4. Samples: For each seating component and for each color and texture required.
5. Product Certificates: For each type of flame-retardant treatment of fabric, from manufacturer.
6. Maintenance Data.
7. Warranty: Sample of special warranty.

D. Quality Assurance
1. Source Limitations: Obtain fabric of a single dye lot for each color and pattern of fabric required.
2. Forest Certification: Fabricate products with wood components produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
3. Fire-Test-Response Characteristics of Upholstered Chairs:
   a. Fabric: Class 1 according to DOC CS 191 and 16 CFR 1610.61, tested according to California Technical Bulletin 117.
   b. Padding: Comply with California Technical Bulletin 117.
   c. Full-Scale Fire Test: Comply with California Technical Bulletin 133.
4. 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.
5. Preinstallation Conference: Conduct conference at Project site.

E. Warranty

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fixed audience seating that fail in materials or workmanship within specified warranty period.
   a. Failures include, but are not limited to, the following:
      1) Structural failures including standards, beams, and pedestals.
      2) Faulty operation of self-rising seat mechanism.
      3) Faulty operation of electrical components.
      4) Wear and deterioration of fabric and stitching beyond normal use.
      5) Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
   b. Warranty Periods: As follows, from date of Substantial Completion.
      1) Structural: Five years **OR** 10 years **OR** Lifetime, **as directed**.
      2) Operating Mechanisms: Three years **OR** Five years **OR** Lifetime, **as directed**.
      3) Electrical Components: Three **OR** Five, **as directed**, years.
      4) Plastic, Wood, and Paint Components: Two **OR** Three **OR** Five, **as directed**, years.

1.2 PRODUCTS

A. Materials And Finishes
1. Steel: ASTM A 36/A 36M plates, shapes, and bars; ASTM A 513 mechanical tubing; ASTM A 1008/A 1008M cold-rolled sheet; and ASTM A 1011 hot-rolled sheet and strip.
2. Cast Iron: ASTM A 48/A 48M, Class 25 (Class 175), gray iron castings free of blow holes and hot checks with parting lines ground smooth.
3. Cast Aluminum: ASTM B 85 aluminum-alloy die castings.
4. Metal Finish: Finish exposed metal parts with manufacturer's standard polyurethane **OR** baked-on **OR** minimum 1.5-mil- (0.04-mm-) thick, polyester baked-on powder **OR** minimum 1.5-mil- (0.04-mm-) thick, epoxy baked-on powder, **as directed**, coating.
   a. Color: As selected from manufacturer's full range.
5. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
6. Concealed Plywood: HPVA HP-1 hardwood plywood, made with adhesive containing no urea formaldehyde, or DOC PS 1 softwood plywood, as standard with manufacturer.
7. Exposed Plywood: HPVA HP-1, Face Grade A, hardwood veneer core with color-matched hardwood-veneer faces, made with adhesive containing no urea formaldehyde.
8. Hardwood Lumber and Veneer Faces: American black walnut **OR** Red oak **OR** Teak **OR** Birch **OR** Cherry **OR** Maple, **as directed**, selected to be free of visible defects.
   a. Stain and Finish: As selected from manufacturer's full range.
9. Plastic Laminate: NEMA LD 3, Grade VGS for vertical surfaces and Grade HGS for horizontal surfaces.
   a. Color and Pattern: As selected from manufacturer's full range.
10. Fabric: Manufacturer's standard 100 percent nylon **OR** 100 percent polyolefin, **as directed**, with flame-retardant treatment.
    a. Weight: 12 oz./linear yd. (0.37 kg/linear m) **OR** 16 oz./linear yd. (0.50 kg/linear m) **OR** 18 oz./linear yd. (0.56 kg/linear m) **OR** 20 oz./linear yd. (0.62 kg/linear m), **as directed**.
    b. Color and Pattern: As selected from manufacturer's full range.
11. Upholstery Padding: Flexible, cellular, molded or slab polyurethane foam.
12. Molded Plastic: High-density polyethylene or polypropylene, blow or injection molded, with smooth or textured surface that is mar and dent resistant.
    a. Provide with UV inhibitors to retard fading where exposed to sunlight.
    b. Color and Texture: As selected from manufacturer's full range.

B. Fixed Audience Seating
1. Chair Mounting Standards: Floor **OR** Riser, **as directed**, attached of the following material:

a. Steel: One-piece heavy-tube or reinforced sheet with welded mounting plate and welded connections for seat pivots, backs, armrests, and end panels.
b. Cast Iron **OR** Aluminum, **as directed**: One-piece castings with integral mounting points and attachment anchoring points for seat pivots, backs, and armrests.
c. Molded Plastic: One-piece, solid injection-molded plastic with integral reinforcing ribs and attachment anchoring points for seat pivots, backs, and armrests.

2. Chair Mounting Beam: Steel horizontal beam mounted on floor-attached **OR** riser-attached, **as directed**, steel support pedestals spaced at intervals of 2 to 2-1/2 chair widths.
3. Chair Mounting Pedestal: Floor-attached pedestal, manufacturer's standard jury base with swivel **OR** diffuser pedestal, **as directed**.
4. End Panels:
   a. Material: Steel **OR** Cast iron with design **OR** Cast aluminum with design **OR** Plastic laminate **OR** Hardwood-veneer plywood **OR** Solid hardwood **OR** Fabric upholstered **OR** Molded plastic, **as directed**.
      1) Cast-Metal Design: As selected from manufacturer's full range.
   b. Decorative Insert: Plastic laminate **OR** Hardwood-veneer plywood **OR** Solid hardwood **OR** Fabric upholstered **OR** Molded plastic **OR** Customized medallion, **as directed**.
   c. Style: Rectangular **OR** Oval **OR** Teardrop **OR** Tapered **OR** Panel to floor (pew), **as directed**, with square **OR** rounded, **as directed**, corners.
5. Fabric Upholstered Chairs:
   a. Backs:
      1) Padding Thickness: 1-1/4 inches (32 mm) **OR** 2 inches (51 mm) **OR** 3 inches (76 mm), **as directed**.
      2) Rear Panel: Steel **OR** Molded plastic **OR** Fabric upholstered with 1/4-inch (6-mm) padding **OR** Plastic laminate **OR** Hardwood-veneer plywood, **as directed**.
      3) Top Corners: Square **OR** Rounded, **as directed**.
      4) Upholstery Options: Tufting **OR** Decorative stitching, **as directed**.
   b. Seats: Two part **OR** One part with slip-on upholstered padding **OR** One part, fully upholstered, **as directed**, and as follows:
      1) Padding Thickness: Minimum 1-1/2 inches (38 mm) **OR** 3 inches (76 mm) **OR** 4 inches (102 mm), **as directed**, at front and rear edge.
      2) Seat Underside: Steel sheet seat pan **OR** Perforated steel sheet seat pan with acoustical insulation **OR** Hardwood-veneer-faced, formed plywood shell **OR** Molded-plastic shell **OR** Fabric upholstered with padding, **as directed**.
6. Plastic Chairs: One-piece **OR** Two-piece, **as directed**, molded plastic and as follows:
   a. Back: Smooth surface **OR** Textured surface **OR** Formed slats **OR** Smooth surface with upholstered inserts, **as directed**, with square **OR** rounded, **as directed**, top corners.
   b. Seat: Smooth surface **OR** Textured surface **OR** With simulated slats **OR** Smooth surface with upholstered inserts, **as directed**.
   c. Upholstered Inserts: Padding and fabric covering over 1/8-inch (3-mm) plywood or fiberboard backing board, recessed 3/16 inch (5 mm) into seat and back, centered, and attached with hidden, vandal-resistant fasteners.
7. Chair Width: Vary chair widths to accommodate sightlines and row lengths **OR** Single width chair in each row, **as directed**, with minimum chair width of 18 inches (457 mm) **OR** 19 inches (483 mm) **OR** 20 inches (508 mm) **OR** 22 inches (559 mm) **OR** 23 inches (584 mm) **OR** 24 inches (610 mm), **as directed**, from center to center of armrests.
8. Back Height: Standard-style **OR** High-style **OR** Planetarium-style, **as directed**, backs, 31 inches (787 mm) **OR** 32-1/2 inches (826 mm) **OR** 35 inches (889 mm) **OR** 38 inches (965 mm) **OR** 40 inches (1016 mm) **OR** 44 inches (1117 mm), **as directed**, high.
9. Back Pitch: Fixed **OR** Variable, hinged (rocker), **as directed**.
10. Chair Seat Hinges: Self-lubricating, compensating type with noiseless self-rising seat mechanism passing ASTM F 851 and with positive internal stops cushioned with rubber or neoprene.
11. Chair Back Hinges: Self-lubricating type with noiseless mechanism that raises back to vertical position when chair is unoccupied.
12. Self-Rising Seat Mechanism: Spring-actuated, three-quarter fold **OR** Spring-actuated, full fold **OR** Gravity-actuated, full fold, **as directed**.

13. Armrests: Plastic **OR** Hardwood **OR** Upholstered **OR** Plastic laminate on medium-density fiberboard **OR** Integral scrolled cast iron, **as directed**, with rounded edges, concealed mounting, and integral cup holder, **as directed**.
14. Aisle Lighting Fixtures: Manufacturer's standard round **OR** rectangular louvered **OR** concealed in armrest, **as directed**, fixtures.
    a. Bulb: LED **OR** Incandescent, **as directed**.
    b. Power: 24 **OR** 120, **as directed**, V.
    c. For low-voltage lighting, provide manufacturer's voltage-reduction device housed in safety enclosure equipped with fuses, terminal blocks, and safety disconnect.
15. Power and Data Service Package: Manufacturer's standard service **OR** Service, **as directed**, to individual seats including terminal devices and wiring with 18 inches (457 mm) of extra length and as follows.
    a. Power Receptacles: 120 V with wiring and receptacle as specified in Division 15.
    b. Data Ports: Data port terminal with wiring and receptacle jack as specified in Division 15.
    c. Location: Manufacturer's standard location **OR** On raceway beneath the seating **OR** In the armrest **OR** Beneath the armrest on front or side of the standard **OR** In back panel of seat in front, **as directed**.
16. Row-Letter and Chair-Number and Donor Plates: Manufacturer's standard.
    a. Material: Aluminum **OR** Bronze **OR** Stainless steel, **as directed**, with black embossed characters.
    b. Attachment: Manufacturer's standard method **OR** Adhesive **OR** Minimum of two mechanical fasteners, **as directed**.
17. Tablet Arms: Manufacturer's standard-size **OR** Manufacturer's oversize, **as directed**, fixed **OR** foldaway, **as directed**, tablet arm with plastic-laminate writing surface over medium-density fiberboard or plywood core and with rounded, matching PVC edges.
    a. Mounting: Right-hand mounted unless otherwise indicated.
    b. Fold-Away Mechanism: Cast-iron or steel hinge and swivel mechanism that gives positive support in open position and semiautomatic return to stored position below arm block and parallel to chair.
18. Accessible Seating:
    a. Provide removable **OR** rollaway **OR** swing-away, **as directed**, chairs where wheelchair spaces are indicated.
    b. Provide chairs without **OR** with retractable **OR** with foldup, **as directed**, arm on aisle side in locations indicated, but not less than 5 percent of aisle seats. Identify these seats with a sign or marker.

C. Fabrication
1. Floor Attachments: Fabricate to conform to floor slope, if any, so that standards and pedestals are plumb and chairs are maintained at same angular relationship to vertical throughout Project.
2. For beam-mounted chairs in curved patterns, curve the beam to the various radii required for the rows.
3. Upholstery: Fabricate fabric-covered cushions with molded padding beneath fabric and with fabric covering free of welts, creases, stretch lines, and wrinkles. For each upholstered component, install pile and pattern run in a consistent direction.
4. Upholstered Chairs: Fabricate as follows:
    a. Two-Part Upholstered Back: In length required to protect seat in raised position, with padded cushion glued to a curved steel, plywood, or molded-plastic support panel covered with easily replaceable fabric, and with curved rear shell that fully encloses upholstery edges.
    b. Two-Part Seats: Upper part, an upholstered cushion with molded padding over no fewer than five serpentine springs attached to reinforced steel frame, with weight-distributing and abrasion-resistant sheeting separating padding from springs, and removable for reupholstering without removing seat from chair. Lower part, steel pan reinforced at stress points and completely enclosing hinges and self-rising mechanism.
    OR

Two-Part Seats: Upper part, an upholstered cushion with formed padding over a five-ply plywood panel with fabric cover conforming to shape of cushion to conceal inner seat structure and hinge mechanism. Lower part, molded-plastic shell.

c. One-Part Seats: Double-wall plastic shells fitted with a padded upholstered cushion and covered with easily replaceable fabric **OR** padded and fully upholstered, **as directed**.

5. Two-Piece, Molded-Plastic Chairs: Fabricate contoured seat and back separately with double-wall, blow-molded plastic. Fabricate back in length required to protect seat in raised position. Reinforce plastic with steel plates at attachment points.
6. One-Piece, Molded-Plastic Chairs: Provide contoured plastic shell with smoothly rolled edges and reinforcing ribs on underside of shell. Fabricate for attachment of chair to support with self-threading, corrosion-resistant screws.

1.3 EXECUTION

A. Installation
1. Install seating in locations indicated and fastened securely to substrates according to manufacturer's written installation instructions.
   a. Use installation methods and fasteners that produce fixed audience seating assemblies with individual chairs capable of supporting an evenly distributed 600-lb (272-kg) static load without failure or other conditions that might impair the chair's usefulness.
   b. Install standards and pedestals plumb.
2. Install seating with chair end standards aligned from first to last row and with backs and seats varied in width **OR** spacing **OR** width and spacing, **as directed**, to optimize sightlines.
3. Install riser-mounted attachments to maintain uniform chair heights above floor.
4. Install chairs in curved rows at a smooth radius.
5. Install seating so moving components operate smoothly and quietly.
6. Install wiring conductors and cables concealed in components of seating and accessible for servicing.

B. Field Quality Control
1. Perform tests and inspections.
   a. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
   b. Tests for Power Receptacles: As specified in Division 15.
   c. Tests for Data Ports: As specified in Division 15.
2. Prepare test and inspection reports.

C. Adjusting
1. Adjust chair backs so that they are aligned with each other in straight **OR** uniformly curved, **as directed**, rows.
2. Adjust self-rising seat mechanisms so seats in each row are aligned when in upright position.
3. Verify that all components and devices are operating properly.
4. Verify that seating returns to correct at-rest position.
5. Repair minor abrasions and imperfections in finishes with coating that matches factory-applied finish.
6. Replace upholstery fabric damaged during installation.

END OF SECTION 12610

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Task	Specification	Specification Description
12610	01352	No Specification Required

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SECTION 13121 - METAL BUILDING SYSTEMS

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for metal building systems. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section Includes:
a. Structural-steel framing.
b. Metal roof panels.
c. Metal wall panels.
d. Foam-insulation-core metal wall panels.
e. Translucent panels.
f. Metal soffit panels.
g. Thermal insulation.
h. Doors and frames.
i. Windows.
j. Accessories.

C. Definitions
1. Terminology Standard: See MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in referenced standards.

D. Submittals
1. Product Data: For each type of metal building system component. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
a. Structural-steel-framing system.
b. Metal roof panels.
c. Metal wall panels.
d. Metal liner panels.
e. Translucent panels.
f. Insulation and vapor retarder facings.
g. Flashing and trim.
h. Doors.
i. Windows.
j. Accessories.
2. LEED Submittals:
a. Product Test Reports for Credit SS 7.2: For roof panels, documentation indicating that panels comply with Solar Reflectance Index requirement.
b. Product Data for Credit MR 4.1 and Credit MR 4.2, **as directed**: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.
3. Shop Drawings: For the following metal building system components. Include plans, elevations, sections, details, and attachments to other work.
a. Anchor-Bolt Plans: Submit anchor-bolt plans and templates before foundation work begins. Include location, diameter, and projection of anchor bolts required to attach metal building to foundation. Indicate column reactions at each location.

b. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.
   1) Show provisions for attaching roof curbs, service walkways, platforms and pipe racks.

c. Metal Roof and Wall Panel Layout Drawings: Show layouts of metal panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; show locations of exposed fasteners.
   1) Show roof-mounted items including roof hatches, equipment supports, pipe supports and penetrations, lighting fixtures, and items mounted on roof curbs.
   2) Show wall-mounted items including doors, windows, louvers, and lighting fixtures.
   3) Show translucent panels.

4. Samples: For each type of exposed finish required, prepared on Samples of sizes indicated below:
   a. Metal Panels: Nominal 12 inches (300 mm) long by actual panel width. Include fasteners, closures, and other exposed panel accessories.
   b. Translucent Panels: Nominal 12 inches (300 mm) long by actual panel width.
   c. Flashing and Trim: Nominal 12 inches (300 mm) long. Include fasteners and other exposed accessories.
   d. Vapor-Retarder Facings: Nominal 6-inch- (150-mm-) square Samples.
   e. Windows: Full-size, nominal 12-inch- (300-mm-) long frame Samples showing typical profile.
   f. Accessories: Nominal 12-inch- (300-mm-) long Samples for each type of accessory.
5. Door Schedule: For doors and frames. Use same designations indicated on Drawings. Include details of reinforcement.
   a. Door Hardware Schedule: Include details of fabrication and assembly of door hardware. Organize schedule into door hardware sets indicating complete designations of every item required for each door or opening.
   b. Keying Schedule: Detail Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.
6. Delegated-Design Submittal: For metal building systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
7. Qualification Data: For qualified erector, manufacturer, professional engineer, land surveyor and testing agency.
8. Welding certificates.
9. Metal Building System Certificates: For each type of metal building system, from manufacturer.
   a. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:
      1) Name and location of Project.
      2) Order number.
      3) Name of manufacturer.
      4) Name of Contractor.
      5) Building dimensions including width, length, height, and roof slope.
      6) Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
      7) Governing building code and year of edition.
      8) Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads (cranes).
      9) Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
      10) Building-Use Category: Indicate category of building use and its effect on load importance factors.

11) AISC Certification for Category MB: Include statement that metal building system and components were designed and produced in an AISC-Certified Facility by an AISC-Certified Manufacturer.

10. Erector Certificates: For each product, from manufacturer.
11. Manufacturer Certificates: For each product, from manufacturer.
12. Material Test Reports: For each of the following products:
    a. Structural steel including chemical and physical properties.
    b. Bolts, nuts, and washers including mechanical properties and chemical analysis.
    c. Tension-control, high-strength, bolt-nut-washer assemblies.
    d. Shop primers.
    e. Nonshrink grout.
13. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for insulation and vapor-retarder facings. Include reports for thermal resistance, fire-test-response characteristics, water-vapor transmission, and water absorption.
14. Source quality-control reports.
15. Field quality-control reports.
16. Surveys: Show final elevations and locations of major members. Indicate discrepancies between actual installation and the Contract Documents. Have surveyor who performed surveys certify their accuracy.
17. Maintenance Data: For metal panel finishes and door hardware to include in maintenance manuals.
18. Warranties: Sample of special warranties.

E. Quality Assurance
1. Manufacturer Qualifications: A qualified manufacturer and member of MBMA.
    a. AISC Certification for Category MB: An AISC-Certified Manufacturer that designs and produces metal building systems and components in an AISC-Certified Facility.
    b. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
2. Land Surveyor Qualifications: A professional land surveyor who practices in jurisdiction where Project is located and who is experienced in providing surveying services of the kind indicated.
3. Erector Qualifications: An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.
4. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
5. Source Limitations: Obtain metal building system components, including primary and secondary framing and metal panel assemblies, from single source from single manufacturer.
6. Welding Qualifications: Qualify procedures and personnel according to the following:
    a. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
    b. AWS D1.3, "Structural Welding Code - Sheet Steel."
7. Structural Steel: Comply with AISC 360, "Specification for Structural Steel Buildings," for design requirements and allowable stresses.
8. Cold-Formed Steel: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses.
9. Fire-Resistance Ratings: Where indicated, provide metal panel assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    a. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
    b. Combustion Characteristics: ASTM E 136.
10. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

a. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

11. Preinstallation Conference: Conduct conference at Project site.

F. Delivery, Storage, And Handling

1. Deliver components, sheets, panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
2. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
3. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
4. Protect foam-plastic insulation as follows:
   a. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
   b. Protect against ignition at all times. Do not deliver foam-plastic insulation materials to Project site before installation time.
   c. Complete installation and concealment of foam-plastic materials as rapidly as possible in each area of construction.

G. Project Conditions

1. Weather Limitations: Proceed with installation only when weather conditions permit metal panels to be installed according to manufacturers' written instructions and warranty requirements.
2. Field Measurements:
   a. Established Dimensions for Foundations: Comply with established dimensions on approved anchor-bolt plans, establishing foundation dimensions and proceeding with fabricating structural framing without field measurements. Coordinate anchor-bolt installation to ensure that actual anchorage dimensions correspond to established dimensions.
   b. Established Dimensions for Metal Panels: Where field measurements cannot be made without delaying the Work, either establish framing and opening dimensions and proceed with fabricating metal panels without field measurements, or allow for field trimming metal panels. Coordinate construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

H. Coordination

1. Coordinate sizes and locations of concrete foundations and casting of anchor-bolt inserts into foundation walls and footings. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-place Concrete".
2. Coordinate installation of roof curbs, equipment supports and roof penetrations, which are specified in Division 07 Section "Roof Accessories".
3. Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

I. Warranty

1. Special Warranty on Metal Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
   a. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
      1) Color fading more than 5 Hunter units when tested according to ASTM D 2244.
      2) Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
      3) Cracking, checking, peeling, or failure of paint to adhere to bare metal.

b. Finish Warranty Period: 20 **OR** 10, **as directed**, years from date of Substantial Completion.

2. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that leak or otherwise fail to remain weathertight within specified warranty period.
   a. Warranty Period: 20 years from date of Substantial Completion.

1.2 PRODUCTS

A. Metal Building Systems
1. Description: Provide a complete, integrated set of metal building system manufacturer's standard mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior.
   a. Provide metal building system of size and with bay spacings, roof slopes, and spans indicated.
2. Primary-Frame Type:
   a. Rigid Clear Span: Solid-member, structural-framing system without interior columns.
   b. Rigid Modular: Solid-member, structural-framing system with interior columns.
   c. Truss-Frame Clear Span: Truss-member, structural-framing system without interior columns.
   d. Truss-Frame Modular: Truss-member, structural-framing system with interior columns.
   e. Lean to: Solid- or truss-member, structural-framing system without interior columns, designed to be partially supported by another structure.
3. End-Wall Framing: Manufacturer's standard, for buildings not required to be expandable, consisting of primary frame, capable of supporting one-half of a bay design load, and end-wall columns **OR** load-bearing end-wall and corner columns and rafters, **as directed**.
   OR
   End-Wall Framing: Engineer end walls to be expandable. Provide primary frame, capable of supporting full-bay design loads, and end-wall columns.
4. Secondary-Frame Type: Manufacturer's standard purlins and joists and flush-framed **OR** partially inset-framed **OR** exterior-framed (bypass), **as directed**, girts.
5. Eave Height: 16 feet (4.9 m) **OR** 20 feet (6.1 m) **OR** 24 feet (7.3 m) **OR** 28 feet (8.5 m) **OR** Manufacturer's standard height, as indicated by nominal height on Drawings, **as directed**.
6. Bay Spacing: 20 feet (6.1 m) **OR** 25 feet (7.6 m) **OR** 30 feet (9.1 m) **OR** As determined by manufacturer, **as directed**.
7. Roof Slope: 1/4 inch per 12 inches (1:48) **OR** 1/2 inch per 12 inches (1:24) **OR** 1 inch per 12 inches (1:12) **OR** 4 inches per 12 inches (1:3) **OR** Manufacturer's standard for frame type required, **as directed**.
8. Roof System: Manufacturer's standard vertical-rib, standing-seam **OR** trapezoidal-rib, standing-seam **OR** lap-seam, **as directed**, metal roof panels with field-installed insulation, **as directed**.
9. Exterior Wall System: Manufacturer's standard tapered-rib, exposed-fastener **OR** reverse-rib, exposed-fastener **OR** concealed-fastener, **as directed**, metal wall panels with field-installed insulation, **as directed**.
   OR
   Exterior Wall System: Manufacturer's standard foam-insulation-core metal wall panels.

B. Metal Building System Performance
1. Delegated Design: Design metal building system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
2. Structural Performance: Metal building systems shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to procedures in MBMA's "Metal Building Systems Manual."
   a. Design Loads: As indicated on Drawings.

OR
Design Loads: As required by MBMA's "Metal Building Systems Manual" **OR** ASCE/SEI 7, **as directed**.

b. Deflection Limits: Design metal building system assemblies to withstand design loads with deflections no greater than the following:
   1) Purlins and Rafters: Vertical deflection of 1/180 **OR** 1/240, **as directed**, of the span.
   2) Girts: Horizontal deflection of 1/180 **OR** 1/240, **as directed**, of the span.
   3) Metal Roof Panels: Vertical deflection of 1/180 **OR** 1/240, **as directed**, of the span.
   4) Metal Wall Panels: Horizontal deflection of 1/180 **OR** 1/240, **as directed**, of the span.
   5) Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.

c. Drift Limits: Engineer building structure to withstand design loads with drift limits no greater than the following:
   1) Lateral Drift: Maximum of 1/200 **OR** 1/400, **as directed**, of the building height.

d. Metal panel assemblies shall withstand the effects of gravity loads and loads and stresses within limits and under conditions indicated according to ASTM E 1592.

3. Seismic Performance: Metal building systems shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
4. Thermal Movements: Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   a. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
5. Air Infiltration for Metal Roof Panels: Air leakage through assembly of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) of roof area when tested according to ASTM E 1680 at negative test-pressure difference of 1.57 lbf/sq. ft. (75 Pa).
6. Air Infiltration for Metal Wall Panels: Air leakage through assembly of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) of wall area when tested according to ASTM E 283 at static-air-pressure difference of 1.57 lbf/sq. ft. (75 Pa).
7. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E 1646 at test-pressure difference of 2.86 lbf/sq. ft. (137 Pa).
8. Water Penetration for Metal Wall Panels: No water penetration when tested according to ASTM E 331 at a wind-load design pressure of not less than 2.86 lbf/sq. ft. (137 Pa).
9. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for Class 30 **OR** Class 60 **OR** Class 90, **as directed**.
10. Thermal Performance: Provide insulated metal panel assemblies with the following maximum U-factors and minimum R-values for opaque elements when tested according to ASTM C 1363 or ASTM C 518:
    a. Metal Roof Panel Assemblies:
       1) U-Factor: as directed by the Owner.
       2) R-Value: as directed by the Owner.
    b. Metal Wall Panel Assemblies:
       1) U-Factor: as directed by the Owner.
       2) R-Value: as directed by the Owner.
11. Energy Performance (for LEED-NC Credit SS 7.2): Provide roof panels with Solar Reflectance Index not less than 78 **OR** 29, **as directed**, when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency.
12. Energy Performance (for ENERGY STAR requirements): Provide roof panels that are listed on the DOE's ENERGY STAR Roof Products Qualified Product List for low **OR** steep, **as directed**,-slope roof products.

13. Energy Performance (for roofs that must comply with CEC-Title 24): Provide roof panels with initial solar reflectance not less than 0.70 and emissivity not less than 0.75 when tested according to CRRC.

C. Structural-Steel Framing
1. Primary Framing: Manufacturer's standard primary-framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafter, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.
   a. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.
      1) Slight variations in span and spacing may be acceptable if necessary to comply with manufacturer's standard, as approved by the Owner.
   b. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted.
   c. Rigid Modular Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide interior columns fabricated from round steel pipes or tubes, or shop-welded, built-up steel plates.
   d. Truss-Frame, Clear-Span Frames: Rafter frames fabricated from joist girders, and I-shaped column sections fabricated from shop-welded, built-up steel plates or structural-steel shapes.
   e. Truss-Frame Modular Frames: Rafter frames fabricated from joist girders, and I-shaped column sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide interior columns fabricated from round steel pipes or tubes, or shop-welded, built-up steel plates.
   f. Long-Bay Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide interior columns fabricated from round steel pipes or tubes, or shop-welded, built-up steel plates.
   g. Frame Configuration: Single gable **OR** One-directional sloped **OR** Lean to, with high side connected to and supported by another structure **OR** Multiple gable **OR** Load-bearing-wall type **OR** Multistory, **as directed**.
   h. Exterior Column Type: Uniform depth **OR** Tapered, **as directed**.
   i. Rafter Type: Uniform depth **OR** Tapered, **as directed**.
2. End-Wall Framing: Manufacturer's standard primary end-wall framing fabricated for field-bolted assembly to comply with the following:
   a. End-Wall and Corner Columns: I-shaped sections fabricated from structural-steel shapes; shop-welded, built-up steel plates; or C-shaped, cold-formed, structural-steel sheet.
   b. End-Wall Rafters: C-shaped, cold-formed, structural-steel sheet; or I-shaped sections fabricated from shop-welded, built-up steel plates or structural-steel shapes.
3. Secondary Framing: Manufacturer's standard secondary framing, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Unless otherwise indicated, fabricate framing from either cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet, prepainted with coil coating, to comply with the following:
   a. Purlins: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; minimum 2-1/2-inch- (64-mm-) wide flanges.
      1) Depth: As indicated **OR** As needed to comply with system performance requirements, **as directed**.

      OR

      Purlins: Steel joists of depths indicated.
   b. Girts: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees from flange, with minimum 2-1/2-inch- (64-mm-) wide flanges.
      1) Depth: As indicated **OR** As required to comply with system performance requirements, **as directed**.

c. Eave Struts: Unequal-flange, C-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; to provide adequate backup for metal panels.
d. Flange Bracing: Minimum 2-by-2-by-1/8-inch (51-by-51-by-3-mm) structural-steel angles or 1-inch (- (25-mm-) diameter, cold-formed structural tubing to stiffen primary-frame flanges.
e. Sag Bracing: Minimum 1-by-1-by-1/8-inch (25-by-25-by-3-mm) structural-steel angles.
f. Base or Sill Angles: Minimum 3-by-2-inch (76-by-51-mm) zinc-coated (galvanized) steel sheet.
g. Purlin and Girt Clips: Manufacturer's standard clips fabricated from steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
h. Secondary End-Wall Framing: Manufacturer's standard sections fabricated from zinc-coated (galvanized) steel sheet **OR** structural-steel sheet, **as directed**.
i. Framing for Openings: Channel shapes; fabricated from cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings and head, jamb, and sill of other openings.
j. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.

4. Canopy Framing: Manufacturer's standard structural-framing system, designed to withstand required loads; fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide frames with attachment plates and splice members, factory drilled for field-bolted assembly.
   a. Type: Straight-beam, eave type **OR** Purlin-extension type **OR** Tapered-beam, below-eave type **OR** As indicated, **as directed**.
5. Bracing: Provide adjustable wind bracing as follows:
   a. Rods: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 (345); or ASTM A 529/A 529M, Grade 50 (345); minimum 1/2-inch- (13-mm-) diameter steel; threaded full length or threaded a minimum of 6 inches (152 mm) at each end.
   b. Cable: ASTM A 475, 1/4-inch- (6-mm-) diameter, extra-high-strength grade, Class B, zinc-coated, seven-strand steel; with threaded end anchors.
   c. Angles: Fabricated from structural-steel shapes to match primary framing, of size required to withstand design loads.
   d. Rigid Portal Frames: Fabricated from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
   e. Fixed-Base Columns: Fabricated from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
   f. Diaphragm Action of Metal Panels: Design metal building to resist wind forces through diaphragm action of metal panels.
   g. Bracing: Provide wind bracing using any method specified above, at manufacturer's option.
6. Bolts: Provide plain-finish bolts for structural-framing components that are primed or finish painted. Provide zinc-plated or hot-dip galvanized bolts for structural-framing components that are galvanized.
7. Materials:
   a. W-Shapes: ASTM A 992/A 992M; ASTM A 572/A 572M, Grade 50 or 55 (345 or 380); or ASTM A 529/A 529M, Grade 50 or 55 (345 or 380).
   b. Channels, Angles, M-Shapes, and S-Shapes: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 or 55 (345 or 380); or ASTM A 529/A 529M, Grade 50 or 55 (345 or 380).
   c. Plate and Bar: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 or 55 (345 or 380); or ASTM A 529/A 529M, Grade 50 or 55 (345 or 380).
   d. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
   e. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B or C, structural tubing.
   f. Structural-Steel Sheet: Hot-rolled, ASTM A 1011/A 1011M, Structural Steel (SS), Grades 30 through 55 (205 through 380), or High-Strength Low-Alloy Steel (HSLAS), Grades 45 through 70 (310 through 480); or cold-rolled, ASTM A 1008/A 1008M, Structural Steel

(SS), Grades 25 through 80 (170 through 550), or High-Strength Low-Alloy Steel (HSLAS), Grades 45 through 70 (310 through 480).

g. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grades 33 through 80 (230 through 550), or High-Strength Low-Alloy Steel (HSLAS), Grades 50 through 80 (340 through 550); with G60 (Z180) coating designation; mill phosphatized.

h. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
   1) Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grades 33 through 80 (230 through 550), or High-Strength Low-Alloy Steel (HSLAS), Grades 50 through 80 (340 through 550); with G90 (Z275) coating designation.
   2) Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Structural Steel (SS), Grade 50 or 80 (340 or 550); with Class AZ50 (AZM150) coating.

i. Joist Girders: Manufactured according to "Standard Specifications for Joist Girders," in SJI's "Standard Specifications and Load Tables for Steel Joists and Joist Girders"; with steel-angle, top- and bottom-chord members, and end- and top-chord arrangements as indicated and required for primary framing.

j. Steel Joists: Manufactured according to "Standard Specifications for Open Web Steel Joists, K-Series," in SJI's "Standard Specifications and Load Tables for Steel Joists and Joist Girders"; with steel-angle, top- and bottom-chord members, and end- and top-chord arrangements as indicated and required for secondary framing.

k. Non-High-Strength Bolts, Nuts, and Washers: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), carbon-steel, hex-head bolts; ASTM A 563 (ASTM A 563M) carbon-steel hex nuts; and ASTM F 844 plain (flat) steel washers.
   1) Finish: Plain **OR** Hot-dip zinc coating, ASTM A 153/A 153M, Class C **OR** Mechanically deposited zinc coating, ASTM B 695, Class 50, **as directed**.

l. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563 (ASTM A 563M) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M) hardened carbon-steel washers.
   1) Finish: Plain **OR** Hot-dip zinc coating, ASTM A 153/A 153M, Class C **OR** Mechanically deposited zinc coating, ASTM B 695, Class 50, **as directed**.

m. High-Strength Bolts, Nuts, and Washers: ASTM A 490 (ASTM A 490M), Type 1, heavy-hex steel structural bolts or tension-control, bolt-nut-washer assemblies with spline ends; ASTM A 563 (ASTM A 563M) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M) hardened carbon-steel washers, plain.

n. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex-head steel structural bolts with spline ends.
   1) Finish: Plain **OR** Mechanically deposited zinc coating, ASTM B 695, Class 50 **OR** Mechanically deposited zinc coating, ASTM B 695, Class 50, baked-epoxy coated, **as directed**.

o. Unheaded Anchor Rods: ASTM F 1554, Grade 36 **OR** ASTM A 572/A 572M, Grade 50 (345) **OR** ASTM A 36/A 36M **OR** ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), **as directed**.
   1) Configuration: Straight.
   2) Nuts: ASTM A 563 (ASTM A 563M) hex **OR** heavy-hex, **as directed**, carbon steel.
   3) Plate Washers: ASTM A 36/A 36M carbon steel.
   4) Washers: ASTM F 436 (ASTM F 436M) hardened carbon steel.
   5) Finish: Plain **OR** Hot-dip zinc coating, ASTM A 153/A 153M, Class C **OR** Mechanically deposited zinc coating, ASTM B 695, Class 50, **as directed**.

p. Headed Anchor Rods: ASTM F 1554, Grade 36 **OR** ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), **as directed**.
   1) Configuration: Straight.
   2) Nuts: ASTM A 563 (ASTM A 563M) hex **OR** heavy-hex, **as directed**, carbon steel.
   3) Plate Washers: ASTM A 36/A 36M carbon steel.
   4) Washers: ASTM F 436 (ASTM F 436M) hardened carbon steel.

5) Finish: Plain **OR** Hot-dip zinc coating, ASTM A 153/A 153M, Class C **OR** Mechanically deposited zinc coating, ASTM B 695, Class 50, **as directed**.

q. Threaded Rods: ASTM A 193/A 193M **OR** ASTM A 572/A 572M, Grade 50 (345) **OR** ASTM A 36/A 36M **OR** ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), **as directed**.

1) Nuts: ASTM A 563 (ASTM A 563M) hex **OR** heavy-hex, **as directed**, carbon steel.

2) Washers: ASTM F 436 (ASTM F 436M) hardened **OR** ASTM A 36/A 36M, **as directed**, carbon steel.

3) Finish: Plain **OR** Hot-dip zinc coating, ASTM A 153/A 153M, Class C **OR** Mechanically deposited zinc coating, ASTM B 695, Class 50, **as directed**.

r. Recycled Content of Steel Products: Provide steel products with an average recycled content so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

8. Finish: Factory primed. Apply specified primer immediately after cleaning and pretreating.

a. Apply primer to primary and secondary framing to a minimum dry film thickness of 1 mil (0.025 mm).

1) Prime secondary framing formed from uncoated steel sheet to a minimum dry film thickness of 0.5 mil (0.013 mm) on each side.

b. Prime galvanized members with specified primer after phosphoric acid pretreatment.

c. Primer: SSPC-Paint 15, Type I, red oxide.

D. Metal Roof Panels

1. Vertical-Rib, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced **OR** flat pan, **as directed**, between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels.

a. Material: Zinc-coated (galvanized) **OR** Aluminum-zinc alloy-coated, **as directed**, steel sheet, 0.022-inch (0.56-mm) **OR** 0.028-inch (0.71-mm) **OR** 0.034-inch (0.86-mm), **as directed**, nominal thickness.

1) Exterior Finish: Fluoropolymer **OR** Siliconized polyester, **as directed**.

2) Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.

b. Clips: Manufacturer's standard, fixed type **OR** floating type to accommodate thermal movement, **as directed**; fabricated from zinc-coated (galvanized) steel **OR** aluminum-zinc alloy-coated steel **OR** stainless-steel, **as directed**, sheet.

c. Joint Type: Panels snapped together.

OR

Joint Type: Mechanically seamed, single folded **OR** double folded **OR** folded according to manufacturer's standard, **as directed**.

d. Panel Coverage: 16 inches (406 mm).

e. Panel Height: 2 inches (51 mm).

f. Uplift Rating: UL 30 **OR** UL 60 **OR** UL 90, **as directed**.

2. Trapezoidal-Rib, Standing-Seam Metal Roof Panels: Formed with raised trapezoidal ribs at panel edges and intermediate stiffening ribs symmetrically spaced **OR** flat pan, **as directed**, between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels.

a. Material: Zinc-coated (galvanized) **OR** Aluminum-zinc alloy-coated, **as directed**, steel sheet, 0.022-inch (0.56-mm) **OR** 0.028-inch (0.71-mm) **OR** 0.034-inch (0.86-mm), **as directed**, nominal thickness.

1) Exterior Finish: Fluoropolymer **OR** Siliconized polyester, **as directed**.

2) Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.

b. Clips: Manufacturer's standard, fixed type **OR** floating type to accommodate thermal movement, **as directed**; fabricated from zinc-coated (galvanized) steel **OR** aluminum-zinc alloy-coated steel **OR** stainless-steel, **as directed**, sheet.

c. Joint Type: Panels snapped together.
OR
Joint Type: Mechanically seamed, single folded **OR** double folded **OR** folded according to manufacturer's standard, **as directed**.
d. Panel Coverage: 24 inches (610 mm).
e. Panel Height: 3 inches (76 mm).
f. Uplift Rating: UL 30 **OR** UL 60 **OR** UL 90, **as directed**.

3. Tapered-Rib-Profile, Lap-Seam Metal Roof Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced **OR** flat pan, **as directed**, between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
   a. Material: Zinc-coated (galvanized) **OR** Aluminum-zinc alloy-coated, **as directed**, steel sheet, 0.022-inch (0.56-mm) **OR** 0.028-inch (0.71-mm) **OR** 0.034-inch (0.86-mm), **as directed**, nominal thickness.
      1) Exterior Finish: Fluoropolymer **OR** Siliconized polyester, **as directed**.
      2) Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
   b. Major-Rib Spacing: 6 inches (152 mm) **OR** 12 inches (305 mm), **as directed**, o.c.
   c. Panel Coverage: 36 inches (914 mm).
   d. Panel Height: 0.75 inch (19 mm) **OR** 1.125 inches (29 mm) **OR** 1.188 inches (30 mm) **OR** 1.25 inches (32 mm) **OR** 1.5 inches (38 mm), **as directed**.
4. Tapered-Rib-Profile, Metal Liner Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced **OR** flat pan, **as directed**, between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
   a. Material: Zinc-coated (galvanized) **OR** Aluminum-zinc alloy-coated, **as directed**, steel sheet, 0.022-inch (0.56-mm) **OR** 0.028-inch (0.71-mm) **OR** 0.034-inch (0.86-mm), **as directed**, nominal thickness.
      1) Exterior Finish: Fluoropolymer **OR** Siliconized polyester, **as directed**.
      2) Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
   b. Major-Rib Spacing: 6 inches (152 mm) **OR** 12 inches (305 mm), **as directed**, o.c.
   c. Panel Coverage: 36 inches (914 mm).
   d. Panel Height: 1.25 inches (32 mm) **OR** 1.5 inches (38 mm), **as directed**.
5. Materials:
   a. Metallic-Coated Steel Sheet: Restricted-flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
      1) Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality.
      2) Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40 (Class AZM150 coating designation, Grade 275); structural quality.
      3) Surface: Smooth, flat **OR** Embossed, **as directed**, finish.
6. Finishes:
   a. Exposed Coil-Coated Finish:
      1) Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
      2) Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
      3) Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.

b. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

E. Metal Wall Panels

1. Tapered-Rib-Profile, Exposed-Fastener Metal Wall Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced **OR** flat pan, **as directed**, between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
   a. Material: Zinc-coated (galvanized) **OR** Aluminum-zinc alloy-coated, **as directed**, steel sheet, 0.022-inch (0.56-mm) **OR** 0.028-inch (0.71-mm) **OR** 0.034-inch (0.86-mm), **as directed**, nominal thickness.
      1) Exterior Finish: Fluoropolymer **OR** Siliconized polyester, **as directed**.
      2) Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
   b. Major-Rib Spacing: 6 inches (152 mm) **OR** 12 inches (305 mm), **as directed**, o.c.
   c. Panel Coverage: 36 inches (914 mm).
   d. Panel Height: 0.75 inch (19 mm) **OR** 1.125 inches (29 mm) **OR** 1.188 inches (30 mm) **OR** 1.25 inches (32 mm) **OR** 1.5 inches (38 mm), **as directed**.
2. Reverse-Rib-Profile, Exposed-Fastener Metal Wall Panels: Formed with recessed, trapezoidal major valleys and intermediate stiffening valleys symmetrically spaced **OR** flat pan, **as directed**, between major valleys; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
   a. Material: Zinc-coated (galvanized) **OR** Aluminum-zinc alloy-coated, **as directed**, steel sheet, 0.022-inch (0.56-mm) **OR** 0.028-inch (0.71-mm) **OR** 0.034-inch (0.86-mm), **as directed**, nominal thickness.
      1) Exterior Finish: Fluoropolymer **OR** Siliconized polyester, **as directed**.
      2) Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
   b. Major-Rib Spacing: 12 inches (305 mm) o.c.
   c. Panel Coverage: 36 inches (914 mm).
   d. Panel Height: 1.125 inches (29 mm) **OR** 1.188 inches (30 mm) **OR** 1.25 inches (32 mm) **OR** 1.5 inches (38 mm), **as directed**.
3. Concealed-Fastener Metal Wall Panels: Formed with vertical panel edges and a single wide recess, centered between panel edges **OR** flush surface, **as directed**; with flush joint between panels; with 1-inch- (25-mm-) wide flange for attaching interior finish; designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant, **as directed**, in side laps.
   a. Material: Zinc-coated (galvanized) **OR** Aluminum-zinc alloy-coated, **as directed**, steel sheet, 0.028-inch (0.71-mm) **OR** 0.034-inch (0.86-mm), **as directed**, nominal thickness.
      1) Exterior Finish: Fluoropolymer **OR** Siliconized polyester, **as directed**.
      2) Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
   b. Panel Coverage: 16 inches (406 mm).
   c. Panel Height: 3 inches (76 mm).
4. Tapered-Rib-Profile, Metal Liner Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced **OR** flat pan, **as directed**, between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
   a. Material: Zinc-coated (galvanized) **OR** Aluminum-zinc alloy-coated, **as directed**, steel sheet, 0.022-inch (0.56-mm) **OR** 0.028-inch (0.71-mm) **OR** 0.034-inch (0.86-mm), **as directed**, nominal thickness.
      1) Exterior Finish: Siliconized polyester **OR** Acrylic enamel, **as directed**.

2) Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.

b. Major-Rib Spacing: 6 inches (152 mm) **OR** 12 inches (305 mm), **as directed** o.c.

c. Panel Coverage: 36 inches (914 mm).

d. Panel Height: 1.25 inches (32 mm) **OR** 1.5 inches (38 mm), **as directed**.

5. Flush-Profile, Metal Liner Panels: Solid **OR** Perforated, **as directed**, panels formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced **OR** flat pan, **as directed**, between panel edges; with flush joint between panels; designed for interior side of metal wall panel assemblies and installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant, **as directed**, in side laps.

a. Material: Zinc-coated (galvanized) **OR** Aluminum-zinc alloy-coated, **as directed**, steel sheet, 0.028-inch (0.71-mm) **OR** 0.034-inch (0.86-mm), **as directed**, nominal thickness.

1) Exterior Finish: Siliconized polyester **OR** Polyester **OR** Acrylic enamel, **as directed**.

2) Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.

b. Sound Absorption: NRC not less than 0.65 **OR** 0.85 **OR** 1.00, **as directed** when tested according to ASTM C 423.

c. Panel Coverage: 12 inches (305 mm).

d. Panel Height: 1.5 inches (38 mm).

6. Materials:

a. Metallic-Coated Steel Sheet: Restricted-flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

1) Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality.

2) Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40 (Class AZM150 coating designation, Grade 275); structural quality.

3) Surface: Smooth, flat **OR** Embossed, **as directed**, finish.

7. Finishes:

a. Exposed Coil-Coated Finish:

1) Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2) Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

3) Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.

b. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

F. Foam-Insulation-Core Metal Wall Panels

1. Description: Provide factory-formed and -assembled, metal wall panels fabricated from two metal facing sheets and an insulation core foamed in place during fabrication, with joints between panels designed to form weathertight seals. Include accessories required for weathertight installation.

a. Concealed-Fastener, Foam-Insulation-Core Metal Wall Panels: Formed with tongue-and-groove panel edges; designed for sequential installation by interlocking panel edges and mechanically attaching panels to supports using concealed clips or fasteners.

1) Facings: Fabricate panel with exterior and interior facings of same material and thickness.

2) Exterior Surface: Smooth, flat **OR** Striated **OR** Shallow ribs **OR** Shallow V grooves, **as directed**.
3) Panel Coverage: 36 inches (914 mm) **OR** 42 inches (1067 mm), **as directed**, nominal.
4) Panel Thickness: 2 inches (51 mm) **OR** 2.5 inches (64 mm) **OR** 3 inches (76 mm) **OR** 4 inches (102 mm) **OR** 5 inches (127 mm) **OR** 6 inches (152 mm), **as directed**.
5) Thermal-Resistance Value (R-Value): as directed by the Owner.

2. Panel Performance:
   a. Flatwise Tensile Strength: 30 psi (200 kPa) when tested according to ASTM C 297/C 297M.
   b. Humid Aging: Volume increase not greater than 6.0 percent and no delamination or metal corrosion when tested for seven days at 140 deg F (60 deg C) and 100 percent relative humidity according to ASTM D 2126.
   c. Heat Aging: Volume increase not greater than 2.0 percent and no delamination, surface blistering, or permanent bowing when tested for seven days at 200 deg F (93 deg C) according to ASTM D 2126.
   d. Cold Aging: Volume decrease not more than 1.0 percent and no delamination, surface blistering, or permanent bowing when tested for seven days at minus 20 deg F (29 deg C) according to ASTM D 2126.
   e. Fatigue: No evidence of delamination, core cracking, or permanent bowing when tested to a 20-lbf/sq. ft. (958-kPa) positive and negative wind load and with deflection of L/180 for two million cycles.
   f. Autoclave: No delamination when exposed to 2-psi (13.8-kPa) pressure at a temperature of 212 deg F (100 deg C) for 2-1/2 hours.
   g. Fire-Test-Response Characteristics: Class A according to ASTM E 108.
3. Polyisocyanurate Insulation-Core Performance:
   a. Density: 2.0 to 2.6 lb/cu. ft. (32 to 42 kg/cu. m) when tested according to ASTM D 1622.
   b. Compressive Strength: Minimum 20 psi (140 kPa) when tested according to ASTM D 1621.
   c. Shear Strength: 26 psi (179 kPa) when tested according to ASTM C 273/C 273M.
4. Materials:
   a. Polyisocyanurate Insulation: Modified polyisocyanurate foam using a non-CFC blowing agent, foamed-in-place or board type as indicated, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively.
      1) Closed-Cell Content: 90 percent when tested according to ASTM D 6226.
   b. Metallic-Coated Steel Sheet: Restricted-flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
      1) Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality.
      2) Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40 (Class AZM150 coating designation, Grade 275); structural quality.
      3) Surface: Smooth, flat **OR** Embossed, **as directed**, finish.
5. Finishes:
   a. Exposed Coil-Coated Finish:
      1) Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
      2) Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

3) Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.

b. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

G. Translucent Panels

1. Uninsulated Translucent Panels: Glass-fiber-reinforced polyester, translucent plastic; complying with ASTM D 3841, Type CC2 (general purpose) **OR** Type CC1 (limited flammability), **as directed**, Grade 1 (weather resistant); smooth finish on both sides. Match profile of adjacent metal panels.
   a. Roof Panel Weight: Not less than 8 oz./sq. ft. (2441 g/sq. m).
   b. Wall Panel Weight: Not less than 6 oz./sq. ft. (1831 g/sq. m).
   c. Light Transmittance: Not less than 55 percent according to ASTM D 1494.
   d. Metal Edge: Fabricate full length of each side of panel with metal edge for seaming into standing-seam roof panel joint.
   e. Color: White.
2. Insulated Translucent Panels: Fabricate insulating units of two sheets of glass-fiber-reinforced polyester, translucent plastic separated by an air space; complying with ASTM D 3841, Type CC1 (limited flammability), Grade 1 (weather resistant); smooth finish on both sides. Match profile of adjacent metal panels.
   a. Exterior Panel Weight: Not less than 8 oz./sq. ft. (2441 g/sq. m) **OR** 6 oz./sq. ft. (1831 g/sq. m), **as directed**.
   b. Interior Panel Weight: Not less than 8 oz./sq. ft. (2441 g/sq. m) **OR** 6 oz./sq. ft. (1831 g/sq. m) **OR** 4 oz./sq. ft. (1221 g/sq. m), **as directed**.
   c. Light Transmittance: Not less than 42 percent according to ASTM D 1494.
   d. Metal Edge: Fabricate full length of each side of panel with metal edge for seaming into standing-seam roof panel joint.
   e. Color: White.
3. Mastic for Translucent Panels: Nonstaining, saturated vinyl polymer as recommended by translucent panel manufacturer for sealing laps.
4. Performance:
   a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      1) Flame-Spread Index: 25 or less.
      2) Smoke-Developed Index: 450 or less.

H. Metal Soffit Panels

1. General: Provide factory-formed metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant, **as directed**, in side laps. Include accessories required for weathertight installation.
2. Metal Soffit Panels: Match profile and material of metal roof **OR** wall, **as directed**, panels.
   a. Finish: Match finish and color of metal roof panels **OR** Match finish and color of metal wall panels **OR** As indicated on Drawings, **as directed**.
3. Tapered-Rib-Profile, Exposed-Fastener Metal Soffit Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced **OR** flat pan, **as directed**, between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
   a. Material: Zinc-coated (galvanized) **OR** Aluminum-zinc alloy-coated, **as directed**, steel sheet, 0.022-inch (0.56-mm) **OR** 0.028-inch (0.71-mm) **OR** 0.034-inch (0.86-mm), **as directed**, nominal thickness.
      1) Exterior Finish: Fluoropolymer **OR** Siliconized polyester, **as directed**.

2) Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.

b. Major-Rib Spacing: 6 inches (152 mm) **OR** 12 inches (305 mm), **as directed**, o.c.

c. Panel Coverage: 36 inches (914 mm).

d. Panel Height: 0.75 inch (19 mm) **OR** 1.125 inches (29 mm) **OR** 1.188 inches (30 mm) **OR** 1.25 inches (32 mm) **OR** 1.5 inches (38 mm), **as directed**.

4. Concealed-Fastener Metal Soffit Panels: Formed with vertical panel edges and a single wide recess, centered between panel edges **OR** flush surface, **as directed**; with flush joint between panels; with 1-inch- (25-mm-) wide flange for attaching interior finish; designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant, **as directed**, in side laps.

a. Material: Zinc-coated (galvanized) **OR** Aluminum-zinc alloy-coated, **as directed**, steel sheet, 0.028-inch (0.71-mm) **OR** 0.034-inch (0.86-mm), **as directed**, nominal thickness.

1) Exterior Finish: Fluoropolymer **OR** Siliconized polyester, **as directed**.

2) Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.

b. Panel Coverage: 12 inches (305 mm) **OR** 16 inches (406 mm), **as directed**.

c. Panel Height: 1 inch (25 mm) **OR** 1.5 inches (38 mm), **as directed**.

I. Thermal Insulation

1. Faced Metal Building Insulation: ASTM C 991, Type II, glass-fiber-blanket insulation; 0.5-lb/cu. ft. (8-kg/cu. m) density; 2-inch- (51-mm-) wide, continuous, vapor-tight edge tabs; with a flame-spread index of 25 or less.

2. Unfaced Metal Building Insulation: ASTM C 991, Type I, or NAIMA 202, glass-fiber-blanket insulation; 0.5-lb/cu. ft. (8-kg/cu. m) density; 2-inch- (51-mm-) wide, continuous, vapor-tight edge tabs; with a flame-spread index of 25 or less.

a. Vapor-Retarder Facing: ASTM C 1136, with permeance not greater than 0.02 perm (1.15 ng/Pa x s x sq. m) when tested according to ASTM E 96/E 96M, Desiccant Method.

1) Composition: White metallized-polypropylene film facing, fiberglass scrim reinforcement, and kraft-paper backing.

OR

Composition: Aluminum foil facing, elastomeric barrier coating, fiberglass scrim reinforcement, and kraft-paper backing.

OR

Composition: White polypropylene **OR** vinyl, **as directed**, film facing, fiberglass scrim reinforcement, and metallized-polyester film backing.

OR

Composition: White polypropylene film facing and fiberglass-polyester-blend fabric backing.

3. Mineral-Fiber-Blanket Insulation: ASTM C 665, type indicated below; consisting of fibers manufactured from glass, slag wool, or rock wool.

a. Nonreflective Faced: Type II (blankets with nonreflective membrane covering), Category 1 (membrane is a vapor retarder), Class A (membrane-faced surface with a flame-spread index of 25 or less).

b. Reflective Faced: Type III (blankets with reflective membrane covering), Category 1 (membrane is a vapor retarder), Class A (membrane-faced surface with a flame-spread index of 25 or less).

c. Unfaced: Type I (blankets without membrane covering), passing ASTM E 136 for combustion characteristics.

d. Vapor-Retarder Facing: ASTM C 1136, with permeance not greater than 0.02 perm (1.15 ng/Pa x s x sq. m) when tested according to ASTM E 96/E 96M, Desiccant Method.

1) Composition: White metallized-polypropylene film facing, fiberglass scrim reinforcement, and kraft-paper backing.

2) Composition: Aluminum foil facing, elastomeric barrier coating, fiberglass scrim reinforcement, and kraft-paper backing.
3) Composition: White polypropylene **OR** vinyl, **as directed**, film facing, fiberglass scrim reinforcement, and metallized-polyester film backing.
4) Composition: White polypropylene film facing and fiberglass-polyester blend fabric backing.

4. Faced, Polyisocyanurate Board Insulation: ASTM C 1289, Type I (foil facing), Class 2, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, based on tests performed on unfaced core. Provide units tested for interior exposure without an approved thermal barrier.
5. Retainer Strips: 0.025-inch (0.64-mm) nominal-thickness, formed, metallic-coated steel or PVC retainer clips colored to match insulation facing.
6. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

J. Doors And Frames
1. Swinging Personnel Doors and Frames: As specified in Division 08 Section "Steel Doors And Frames".
OR
Swinging Personnel Doors and Frames: Metal building system manufacturer's standard doors and frames; prepared and reinforced at strike and at hinges to receive factory- and field-applied hardware according to BHMA A156 Series.
a. Steel Doors: 1-3/4 inches (44 mm) thick; fabricated from 0.040-inch (1.02-mm) nominal-thickness, metallic-coated steel face sheets; of seamed **OR** seamless, **as directed**, hollow-metal construction; with 0.064-inch (1.63-mm) nominal-thickness, inverted metallic-coated steel channels welded to face sheets at top and bottom of door.
1) Design: Flush panel **OR** As indicated, **as directed**.
2) Core: Kraft honeycomb with U-factor rating of at least 0.47 Btu/sq. ft. x h x deg F (2.67 W/sq. m x K).
OR
Core: Polystyrene foam with U-factor rating of at least 0.16 Btu/sq. ft. x h x deg F (0.91 W/sq. m x K).
OR
Core: Polyurethane foam with U-factor rating of at least 0.07 Btu/sq. ft. x h x deg F (0.40 W/sq. m x K).
3) Glazing Frames: Steel frames to receive field-installed glass.
4) Glazing: As specified in Division 08 Section "Glazing".
b. Steel Frames: Fabricate 2-inch- (51-mm-) wide face frames from 0.064-inch (1.63-mm) nominal-thickness, metallic-coated steel sheet.
1) Type: Knocked down for field assembly **OR** Factory welded, **as directed**.
c. Fabricate concealed stiffeners, reinforcement, edge channels, and moldings from either cold- or hot-rolled steel sheet.
d. Hardware:
1) Provide hardware for each door leaf, as follows:
a) Hinges: BHMA A156.1. Three plain **OR** antifriction, **as directed**,-bearing, standard-weight, full-mortise, stainless-steel or bronze, template-type hinges; 4-1/2 by 4-1/2 inches (114 by 114 mm), with nonremovable pin.
b) Lockset: BHMA A156.2. Key-in-lever cylindrical **OR** Mortise, with lever handle, **as directed**, type.
c) Exit Device: BHMA A156.3. Touch- or push-bar type.
d) Threshold: BHMA A156.21. Extruded aluminum.
e) Silencers: Pneumatic rubber; three silencers on strike jambs of single door frames and two silencers on heads of double door frames.
f) Closer: BHMA A156.4. Surface-applied, standard-duty hydraulic type.
g) Weather Stripping: Vinyl applied to head and jambs, with vinyl sweep at sill.

2) Provide each pair of double doors with the following hardware in addition to that specified for each leaf:
   a) Astragal: Removable type.
   b) Surface Bolts: Top and bottom of inactive door.

e. Anchors and Accessories: Manufacturer's standard units, galvanized according to ASTM A 123/A 123M.

f. Fabrication: Fabricate doors and frames to be rigid; neat in appearance; and free from defects, warp, or buckle. Provide continuous welds on exposed joints; grind, dress, and make welds smooth, flush, and invisible.

2. Horizontal-Sliding Doors: Manufacturer's standard horizontal-sliding door assembly including structural frame, door panels, brackets, guides, tracks, hardware, and installation accessories.

a. Door Frames: Channels and zees; fabricated from minimum 0.064-inch (1.63-mm) nominal-thickness, metallic-coated steel sheet or structural-steel shapes.

b. Door Panels: Same material and finish as metal wall panels.

c. Hardware: Manufacturer's standard metallic-coated steel track, bottom guides, lock angles for side closure, and brackets. Support each door leaf by two four-wheel trolleys. Provide metallic-coated steel handle for each leaf, and slide bolt or padlock hasp. Flash top of track with metallic-coated steel sheet hood.

3. Materials:

a. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.

b. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

c. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with G60 (Z180) zinc (galvanized) or A60 (ZF180) zinc-iron-alloy (galvannealed) coating designation.

4. Finishes for Personnel Doors and Frames:

a. Prime Finish: Factory-apply manufacturer's standard primer immediately after cleaning and pretreating.

1) Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

b. Factory-Applied Paint Finish: Manufacturer's standard, complying with SDI A250.3 for performance and acceptance criteria.

1) Color and Gloss: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.

K. Windows

1. Aluminum Windows: As specified in Division 08 Section "Aluminum Windows".

OR

Aluminum Windows: Metal building system manufacturer's standard, with self-flashing mounting fins, and as follows:

a. Type, Performance Class, and Performance Grade: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 and as follows:

1) Horizontal-Sliding Units: HS-LC25 **OR** HS-C30, **as directed**.

2) Single-Hung Units: H-LC25 **OR** H-C30, **as directed**.

3) Fixed Units: F-LC25 **OR** F-C30, **as directed**.

b. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than 0.064-inch (1.63-mm) thickness at any location for main frame and sash members.

1) Thermally Improved Construction: Fabricate window units with an integral, concealed, low-conductance thermal barrier; located between exterior materials and

window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact.

c. Mullions: Between adjacent windows, fabricated of extruded aluminum matching finish of window units.

d. Fasteners, Anchors, and Clips: Nonmagnetic stainless steel, aluminum, or other noncorrosive material, compatible with aluminum window members, trim, hardware, anchors, and other components of window units. Fasteners shall not be exposed, except for attaching hardware.

1) Reinforcement: Where fasteners screw-anchor into aluminum less than 0.128 inch (3.26 mm) thick, reinforce interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard, noncorrosive, pressed-in, spline grommet nuts.

e. Hardware: Manufacturer's standard; of aluminum, stainless steel, die-cast steel, malleable iron, or bronze; including the following:

1) Cam-action sweep sash lock and keeper at meeting rails.
2) Spring-loaded, snap-type lock at jambs.
3) Pole-operated, cam-action locking device on meeting rail where rail is more than 72 inches (1830 mm) above floor.
4) Lift handles for single-hung units.
5) Nylon sash rollers for horizontal-sliding units.
6) Steel or bronze operating arms.

f. Sliding-Type Weather Stripping: Woven-pile weather stripping of wool, polypropylene, or nylon pile and resin-impregnated backing fabric; complying with AAMA 701/702.

g. Insect Screens: Provide removable insect screen on each operable exterior sash, with screen frame finished to match window unit, and as follows:

1) Aluminum Wire Fabric: 18-by-18 (1.1-by-1.1-mm), 18-by-16 (1.1-by-1.3-mm), or 18-by-14 (1.1-by-1.5-mm) mesh of 0.013-inch- (0.3-mm-) diameter, coated aluminum wire; complying with FS RR-W-365, Type VII.

OR

Glass-Fiber Mesh Fabric: 18-by-16 (1.1-by-1.3-mm) or 18-by-14 (1.1-by-1.5-mm) mesh of PVC-coated, glass-fiber threads, woven and fused to form a fabric mesh; complying with ASTM D 3656.

OR

Fabric: Manufacturer's standard aluminum wire fabric or glass-fiber mesh fabric.

2. Glazing: Comply with requirements specified in Division 08 Section "Glazing".

OR

Glazing:

a. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear), 3 mm thick.

b. Heat-Treated Float Glass: ASTM C 1048, Type I, Quality-Q3, Class I (clear), Condition A, 3 mm thick.

c. Tinted Float Glass: ASTM C 1036, Type I, Quality-Q3, Class 2, 3 mm thick.

1) Tint Color: Blue **OR** Blue-green **OR** Bronze **OR** Green **OR** Gray **OR** Manufacturer's standard color, **as directed**.

d. Patterned Glass: ASTM C 1036, Type II, Quality-Q6, Class 1 (clear), Form 3, Pattern P3 (random), 3 mm thick.

e. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of 2.5-mm-thick clear float glass separated by a dehydrated interspace, qualified according to ASTM E 2190.

f. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201.

1) Provide safety glazing labeling.

g. Glazing Stops: Screw-applied or snap-on glazing stops coordinated with Division 08 Section "Glazing" and with glazing system indicated. Match material and finish of window frames.

h. Factory-Glazed Fabrication: Glaze window units in the factory to greatest extent possible and practical for applications indicated. Comply with requirements in Division 08 Section "Glazing".

3. Finish:
   a. Mill finish.
   b. Baked-Enamel Finish: Organic Coating: Thermosetting, modified-acrylic enamel primer/topcoat system complying with AAMA 2603 except with a minimum dry film thickness of 0.7 mil (0.02 mm), medium gloss.
      1) Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.

L. Accessories
1. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.
   a. Form exposed sheet metal accessories that are without excessive oil-canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.
   a. Closures: Provide closures at eaves and ridges, fabricated of same material as metal roof panels.
   b. Clips: Manufacturer's standard, formed from steel **OR** stainless-steel, **as directed**, sheet, designed to withstand negative-load requirements.
   c. Cleats: Manufacturer's standard, mechanically seamed cleats formed from steel **OR** stainless-steel sheet or nylon-coated aluminum, **as directed**, sheet.
   d. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
   e. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
   f. Thermal Spacer Blocks: Where metal panels attach directly to purlins, provide thermal spacer blocks of thickness required to provide 1-inch (25-mm) standoff; fabricated from extruded polystyrene.
3. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including copings, fasciae, mullions, sills, corner units, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels unless otherwise indicated.
   a. Closures: Provide closures at eaves and rakes, fabricated of same material as metal wall panels.
   b. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
   c. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
4. Flashing and Trim: Formed from 0.022-inch (0.56-mm) nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match adjacent metal panels.
   a. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.
   b. Opening Trim: Formed from 0.022-inch (0.56-mm) **OR** 0.034-inch (0.86-mm), **as directed**, nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet

prepainted with coil coating. Trim head and jamb of door openings, and head, jamb, and sill of other openings.

5. Gutters: Formed from 0.022-inch (0.56-mm) nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match roof fascia and rake trim. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- (2438-mm-) long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."
   a. Gutter Supports: Fabricated from same material and finish as gutters.
   b. Strainers: Bronze, copper, or aluminum wire ball type at outlets.
6. Downspouts: Formed from 0.022-inch (0.56-mm) nominal-thickness, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match metal wall panels. Fabricate in minimum 10-foot- (3-m-) long sections, complete with formed elbows and offsets.
   a. Mounting Straps: Fabricated from same material and finish as gutters.
7. Roof Ventilators: Gravity type, complete with hardware, flashing, closures, and fittings.
   a. Circular-Revolving Type: Minimum 20-inch- (508-mm-) diameter throat opening; fabricated from 0.028-inch (0.71-mm) nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match metal roof panels; with matching base and rain cap.
      1) Type: Directional **OR** Stationary, **as directed**, revolving.
      2) Bird Screening: Galvanized steel, 1/2-inch- (13-mm-) square mesh, 0.041-inch (1.04-mm) wire; or aluminum, 1/2-inch- (13-mm-) square mesh, 0.063-inch (1.6-mm) wire.
      3) Dampers: Spring-loaded, butterfly type; pull-chain operation; with pull chain of length required to reach within 36 inches (914 mm) of floor.
      4) Reinforce and brace units, with joints properly formed and edges beaded to be watertight under normal positive-pressure conditions.
      5) Mount ventilators on square-to-round bases for ridge or on-slope mounting, designed to match roof pitch and roll formed to match metal roof panel profile.
   b. Continuous or Sectional-Ridge Type: Factory-engineered and -fabricated, continuous unit; fabricated from 0.022-inch (0.56-mm) nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match metal roof panels. Fabricated in minimum 10-foot- (3-m-) long sections. Provide throat size and total length indicated, complete with side baffles, ventilator assembly, end caps, splice plates, and reinforcing diaphragms.
      1) Bird Screening: Galvanized steel, 1/2-inch- (13-mm-) square mesh, 0.041-inch (1.04-mm) wire; or aluminum, 1/2-inch- (13-mm-) square mesh, 0.063-inch (1.6-mm) wire.
      2) Dampers: Manually operated, spring-loaded, vertically rising type; chain and worm gear operator; with pull chain of length required to reach within 36 inches (914 mm) of floor.
      3) Throat Size: 9 inches (229 mm) **OR** 12 inches (305 mm), **as directed**.
8. Louvers: Size and design indicated; self-framing and self-flashing. Fabricate welded frames from minimum 0.052-inch (1.32-mm) nominal-thickness, metallic-coated steel sheet; finished to match metal wall panels. Form blades from 0.040-inch (1.02-mm) nominal-thickness, metallic-coated steel sheet; folded or beaded at edges, set at an angle that excludes driving rains, and secured to frames by riveting or welding. Fabricate louvers with equal blade spacing to produce uniform appearance.
   a. Blades: Fixed.
      OR
      Blades: Adjustable type, with weather-stripped edges, and manually operated by hand crank or pull chain.
   b. Free Area: Not less than 7.0 sq. ft. (0.65 sq. m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.

c. Bird Screening: Galvanized steel, 1/2-inch- (13-mm-) square mesh, 0.041-inch (1.04-mm) wire; with rewirable frames, removable and secured with clips; fabricated of same kind and form of metal and with same finish as louvers.
   1) Mounting: Interior **OR** Exterior, **as directed**, face of louvers.

d. Vertical Mullions: Provide mullions at spacings recommended by manufacturer, or 72 inches (1830 mm) o.c., whichever is less.

9. Roof Curbs: Fabricated from minimum 0.052-inch (1.32-mm) nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match metal roof panels; with welded top box and bottom skirt, and integral full-length cricket; capable of withstanding loads of size and height indicated.
   a. Curb Subframing: Fabricated from 0.064-inch (1.63-mm) nominal-thickness, angle-, C-, or Z-shaped metallic-coated steel sheet.
   b. Insulation: 1-inch- (25-mm-) thick, rigid type.

10. Service Walkways: Fabricated from 0.052-inch (1.32-mm) nominal-thickness, metallic-coated steel plank grating; with slip-resistant pattern; 18-inch (457-mm) **OR** 24-inch (610-mm) **OR** 36-inch (914-mm), **as directed**, overall width. Support walkways on framing system anchored to metal roof panels without penetrating panels; with predrilled holes and clamps or hooks for anchoring.

11. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.

12. Materials:
   a. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.
      1) Fasteners for Metal Roof Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with a stainless-steel cap or zinc-aluminum-alloy head and EPDM sealing washer.
         OR
         Fasteners for Metal Roof Panels: Self-drilling, Type 410 stainless-steel or self-tapping, Type 304 stainless-steel or zinc-alloy-steel hex washer head, with EPDM washer under heads of fasteners bearing on weather side of metal panels.
      2) Fasteners for Metal Wall Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with EPDM sealing washers bearing on weather side of metal panels, **as directed**.
         OR
         Fasteners for Metal Wall Panels: Self-drilling, Type 410 stainless-steel or self-tapping, Type 304 stainless-steel or zinc-alloy-steel hex washer head, with EPDM sealing washers bearing on weather side of metal panels, **as directed**.
      3) Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
      4) Blind Fasteners: High-strength aluminum or stainless-steel rivets.
   b. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
   c. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
   d. Metal Panel Sealants:
      1) Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene-compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape of manufacturer's standard size.
      2) Joint Sealant: ASTM C 920; one-part elastomeric polyurethane or polysulfide; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended by metal building system manufacturer.

M. Source Quality Control
1. Testing Agency (if required): Engage a qualified testing agency to evaluate product.
2. Special Inspector (if required by local code): Owner will engage a qualified special inspector to perform the following tests and inspections and to submit reports. Special inspector will verify that manufacturer maintains detailed fabrication and quality-control procedures and will review the completeness and adequacy of those procedures to perform the Work.
   a. Special inspections will not be required if fabrication is performed by manufacturer registered and approved by authorities having jurisdiction to perform such Work without special inspection.
      1) After fabrication, submit copy of certificate of compliance to authorities having jurisdiction, certifying that Work was performed according to Contract requirements.
3. Testing: Test and inspect shop connections for metal buildings according to the following:
   a. Bolted Connections: Shop-bolted connections shall be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
   b. Welded Connections: In addition to visual inspection, shop-welded connections shall be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at inspector's option:
      1) Liquid Penetrant Inspection: ASTM E 165.
      2) Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
      3) Ultrasonic Inspection: ASTM E 164.
      4) Radiographic Inspection: ASTM E 94.
4. Product will be considered defective if it does not pass tests and inspections.
5. Prepare test and inspection reports.

N. Fabrication
1. General: Design components and field connections required for erection to permit easy assembly.
   a. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
   b. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members shall be free of cracks, tears, and ruptures.
2. Tolerances: Comply with MBMA's "Metal Building Systems Manual" for fabrication and erection tolerances.
3. Primary Framing: Shop fabricate framing components to indicated size and section, with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.
   a. Make shop connections by welding or by using high-strength bolts.
   b. Join flanges to webs of built-up members by a continuous, submerged arc-welding process.
   c. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin web or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
   d. Weld clips to frames for attaching secondary framing.
   e. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary framing with specified primer after fabrication.
4. Secondary Framing: Shop fabricate framing components to indicated size and section by roll-forming or break-forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.
   a. Make shop connections by welding or by using non-high-strength bolts.
   b. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop prime uncoated secondary framing with specified primer after fabrication.
5. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.

a. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

1.3 EXECUTION

A. Examination
1. Examine substrates, areas, and conditions, with erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
2. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with erector present, for compliance with requirements and metal building system manufacturer's tolerances.
   a. Engage land surveyor to perform surveying.
3. Proceed with erection only after unsatisfactory conditions have been corrected.

B. Preparation
1. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.
2. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place unless otherwise indicated.

C. Erection Of Structural Framing
1. Erect metal building system according to manufacturer's written erection instructions and erection drawings.
2. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.
3. Set structural framing accurately in locations and to elevations indicated, according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.
4. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
   a. Set plates for structural members on wedges, shims, or setting nuts as required.
   b. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
   c. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
5. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
   a. Level and plumb individual members of structure.
   b. Make allowances for difference between temperature at time of erection and mean temperature when structure will be completed and in service.
6. Primary Framing and End Walls: Erect framing level, plumb, rigid, secure, and true to line. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist-cure grout for not less than seven days after placement.
   a. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for bolt type and joint type specified.
      1) Joint Type: Snug tightened or pretensioned.

7. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.
   a. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
   b. Locate and space wall girts to suit openings such as doors and windows.
   c. Locate canopy framing as indicated.
   d. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.
8. Steel Joists and Joist Girders: Install joists, girders, and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Standard Specifications and Load Tables for Steel Joists and Joist Girders," joist manufacturer's written instructions, and requirements in this Section.
   a. Before installation, splice joists delivered to Project site in more than one piece.
   b. Space, adjust, and align joists accurately in location before permanently fastening.
   c. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
   d. Bolt joists to supporting steel framework using carbon-steel bolts unless otherwise indicated.
      OR
      Bolt joists to supporting steel framework using high-strength structural bolts unless otherwise indicated. Comply with RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for high-strength structural bolt installation and tightening requirements.
   e. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.
9. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.
   a. Tighten rod and cable bracing to avoid sag.
   b. Locate interior end-bay bracing only where indicated.
10. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.
11. Erection Tolerances: Maintain erection tolerances of structural framing within AISC 303.

D. Metal Panel Installation, General
1. Examination: Examine primary and secondary framing to verify that structural-panel support members and anchorages have been installed within alignment tolerances required by manufacturer.
   a. Examine roughing-in for components and systems penetrating metal panels, to verify actual locations of penetrations relative to seams before metal panel installation.
2. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
   a. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes.
      1) Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.
   b. Install metal panels perpendicular to structural supports unless otherwise indicated.
   c. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
   d. Locate and space fastenings in uniform vertical and horizontal alignment.
   e. Locate metal panel splices over, but not attached to, structural supports with end laps in alignment.
   f. Lap metal flashing over metal panels to allow moisture to run over and off the material.
3. Lap-Seam Metal Panels: Install screw fasteners using power tools with controlled torque adjusted to compress EPDM washers tightly without damage to washers, screw threads, or metal panels. Install screws in predrilled holes.

a. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply metal panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.

4. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.

5. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated; or, if not indicated, provide types recommended by metal panel manufacturer.
   a. Seal metal panel end laps with double beads of tape or sealant the full width of panel. Seal side joints where recommended by metal panel manufacturer.
   b. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants".

E. Metal Roof Panel Installation

1. General: Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.
   a. Install ridge and hip caps as metal roof panel work proceeds.
   b. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.

2. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint, at location and spacing and with fasteners recommended by manufacturer.
   a. Install clips to supports with self-drilling or self-tapping fasteners.
   b. Install pressure plates at locations indicated in manufacturer's written installation instructions.
   c. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
      OR
      Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so that clip, metal roof panel, and factory-applied sealant are completely engaged.
   d. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Predrill panels for fasteners.
   e. Provide metal closures at peaks, rake edges, rake walls and each side of ridge and hip caps.

3. Lap-Seam Metal Roof Panels: Fasten metal roof panels to supports with exposed fasteners at each lapped joint, at location and spacing recommended by manufacturer.
   a. Provide metal-backed sealing washers under heads of exposed fasteners bearing on weather side of metal roof panels.
   b. Provide sealant tape at lapped joints of metal roof panels and between panels and protruding equipment, vents, and accessories.
   c. Apply a continuous ribbon of sealant tape to weather-side surface of fastenings on end laps and on side laps of nesting-type metal panels, on side laps of ribbed or fluted metal panels, and elsewhere as needed to make metal panels weatherproof to driving rains.
   d. At metal panel splices, nest panels with minimum 6-inch (152-mm) end lap, sealed with butyl-rubber sealant and fastened together by interlocking clamping plates.

4. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

5. Metal Roof Panel Installation Tolerances: Shim and align metal roof panels within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

F. Metal Wall Panel Installation

1. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts, extending full height of building, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
    a. Unless otherwise indicated, begin metal panel installation at corners with center of rib lined up with line of framing.
    b. Shim or otherwise plumb substrates receiving metal wall panels.
    c. When two rows of metal panels are required, lap panels 4 inches (102 mm) minimum.
    d. When building height requires two rows of metal panels at gable ends, align lap of gable panels over metal wall panels at eave height.
    e. Rigidly fasten base end of metal wall panels and allow eave end free movement due to thermal expansion and contraction. Predrill panels.
    f. Flash and seal metal wall panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
    g. Install screw fasteners in predrilled holes.
    h. Install flashing and trim as metal wall panel work proceeds.
    i. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated; or, if not indicated, as necessary for waterproofing.
    j. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws.
    k. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.
2. Metal Wall Panels: Install metal wall panels on exterior side of girts. Attach metal wall panels to supports with fasteners as recommended by manufacturer.
3. Insulated Metal Wall Panels: Install insulated metal wall panels on exterior side of girts. Attach panels to supports at each panel joint using concealed clip and fasteners at maximum 42 inches (1067 mm) o.c., spaced not more than manufacturer's recommendation. Fully engage tongue and groove of adjacent insulated metal wall panels.
    a. Install clips to supports with self-tapping fasteners.
    b. Apply continuous ribbon of sealant to panel joint on concealed side of insulated metal wall panels as vapor seal; apply sealant to panel joint on exposed side of panels as weather seal.
4. Installation Tolerances (for highly finished metal wall panel assemblies): Shim and align metal wall panels within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m), nonaccumulative, on level, plumb, and on location lines as indicated, and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

G. Translucent Panel Installation
1. Translucent Panels: Attach translucent panels to structural framing with fasteners according to manufacturer's written instructions. Install panels perpendicular to supports unless otherwise indicated. Anchor translucent panels securely in place, with provisions for thermal and structural movement.
    a. Provide end laps of not less than 6 inches (152 mm) and side laps of not less than 1-1/2-inch (38-mm) corrugations for metal roof panels.
    b. Provide end laps of not less than 4 inches (102 mm) and side laps of not less than 1-1/2-inch (38-mm) corrugations for metal wall panels.
    c. Align horizontal laps with adjacent metal panels.
    d. Seal intermediate end laps and side laps of translucent panels with translucent mastic.

H. Metal Soffit Panel Installation
1. Provide metal soffit panels the full width of soffits. Install panels perpendicular to support framing.
2. Flash and seal metal soffit panels with weather closures where panels meet walls and at perimeter of all openings.

I. Thermal Insulation Installation
1. General: Install insulation concurrently with metal panel installation, in thickness indicated to cover entire surface, according to manufacturer's written instructions.

a. Set vapor-retarder-faced units with vapor retarder toward warm side of construction unless otherwise indicated. Do not obstruct ventilation spaces except for firestopping.
b. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to the surrounding construction to ensure airtight installation.
c. Install factory-laminated, vapor-retarder-faced blankets straight and true in one-piece lengths, with both sets of facing tabs sealed, to provide a complete vapor retarder.
OR
Install blankets straight and true in one-piece lengths. Install vapor retarder over insulation, with both sets of facing tabs sealed, to provide a complete vapor retarder.

2. Blanket Roof Insulation: Comply with the following installation method:
a. Over-Framing Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Hold in place by metal roof panels fastened to secondary framing.
b. Between-Purlin Installation: Extend insulation and vapor retarder between purlins. Carry vapor-retarder-facing tabs up and over purlin, overlapping adjoining facing of next insulation course and maintaining continuity of retarder. Hold in place with bands and crossbands below insulation.
c. Over-Purlin-with-Spacer-Block Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Install layer of filler insulation over first layer to fill space formed by metal roof panel standoffs. Hold in place by panels fastened to standoffs.
1) Thermal Spacer Blocks: Where metal roof panels attach directly to purlins, install thermal spacer blocks.
d. Two-Layers-between-Purlin-with-Spacer-Block Installation: Extend insulation and vapor retarder between purlins. Carry vapor-retarder-facing tabs up and over purlin, overlapping adjoining facing of next insulation course and maintaining continuity of retarder. Install layer of filler insulation over first layer to fill space between purlins formed by thermal spacer blocks. Hold in place with bands and crossbands below insulation.
1) Thermal Spacer Blocks: Where metal roof panels attach directly to purlins, install thermal spacer blocks.
e. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.

3. Blanket Wall Insulation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Hold in place by metal wall panels fastened to secondary framing.
a. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
b. Sound-Absorption Insulation: Where sound-absorption requirement is indicated for metal liner panels, cover insulation with polyethylene film and provide inserts of wire mesh to form acoustical spacer grid.

4. Board Wall Insulation: Extend board insulation in thickness indicated to cover entire wall. Hold in place by metal wall panels fastened to secondary framing. Comply with manufacturers' written instructions.
a. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.

J. Door And Frame Installation
1. General: Install doors and frames plumb, rigid, properly aligned, and securely fastened in place according to manufacturers' written instructions. Coordinate installation with wall flashings and other components. Seal perimeter of each door frame with elastomeric sealant used for metal wall panels.
2. Personnel Doors and Frames: Install doors and frames according to SDI A250.8. Fit non-fire-rated doors accurately in their respective frames, with the following clearances:
a. Between Doors and Frames at Jambs and Head: 1/8 inch (3 mm).
b. Between Edges of Pairs of Doors: 1/8 inch (3 mm).
c. At Door Sills with Threshold: 3/8 inch (9.5 mm).

d. At Door Sills without Threshold: 3/4 inch (19.1 mm).
e. At fire-rated openings, install frames according to, and doors with clearances specified in, NFPA 80.

3. Sliding Service Doors: Bolt support angles to opening head members through factory-punched holes. Bolt door tracks to support angles at maximum 24 inches (610 mm) o.c. Set doors and operating equipment with necessary hardware, jamb and head mold stops, continuous hood flashing, anchors, inserts, hangers, and equipment supports.
4. Field Glazing: Comply with installation requirements in Division 8 Section "Glazing."
5. Door Hardware: Mount units at heights indicated in DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
   a. Install surface-mounted items after finishes have been completed on substrates involved.
   b. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
   c. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
   d. Set thresholds for exterior doors in full bed of butyl-rubber sealant complying with requirements specified in Division 07 Section "Joint Sealants".

K. Window Installation
1. General: Install windows plumb, rigid, properly aligned, without warp or rack of frames or sash, and securely fasten in place according to manufacturer's written instructions. Coordinate installation with wall flashings and other components. Seal perimeter of each window frame with elastomeric sealant used for metal wall panels.
   a. Separate dissimilar materials from sources of corrosion or electrolytic action at points of contact with other materials by complying with requirements specified in AAMA/WDMA/CSA 101/I.S.2/A440.
2. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.
3. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
4. Mount screens directly to frames with tapped screw clips.
5. Field Glazing: Comply with installation requirements in Division 08 Section "Glazing".

L. Accessory Installation
1. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
   a. Install components required for a complete metal roof panel assembly, including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
   b. Install components for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
   c. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.
2. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
   a. Install exposed flashing and trim that is without excessive oil-canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
   b. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion

joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

3. Gutters: Join sections with riveted-and-soldered or lapped-and-sealed joints. Attach gutters to eave with gutter hangers spaced as required for gutter size, but not more than 36 inches (914 mm) o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
4. Downspouts: Join sections with 1-1/2-inch (38-mm) telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1524 mm) o.c. in between.
   a. Provide elbows at base of downspouts to direct water away from building.
      OR
      Tie downspouts to underground drainage system indicated.
5. Circular Roof Ventilators: Set ventilators complete with necessary hardware, anchors, dampers, weather guards, rain caps, and equipment supports. Mount ventilators on flat level base. Install preformed filler strips at base to seal ventilator to metal roof panels.
6. Continuous Roof Ventilators: Set ventilators complete with necessary hardware, anchors, dampers, weather guards, rain caps, and equipment supports. Join sections with splice plates and end-cap skirt assemblies where required to achieve indicated length. Install preformed filler strips at base to seal ventilator to metal roof panels.
7. Louvers: Locate and place louver units level, plumb, and at indicated alignment with adjacent work.
   a. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
   b. Provide perimeter reveals and openings of uniform width for sealants and joint fillers.
   c. Protect galvanized- and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of corrosion-resistant paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
   d. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 07 Section "Joint Sealants" for sealants applied during louver installation.
8. Roof Curbs: Install curbs at locations indicated on Drawings. Install flashing around bases where they meet metal roof panels.
9. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

M. Field Quality Control
1. Special Inspections: Engage, **as directed**, a qualified special inspector to perform the following special inspections:
   a. Inspection of fabricators.
   b. Steel construction.
2. Testing Agency: Engage, **as directed**, a qualified testing agency to perform tests and inspections.
3. Tests and Inspections:
   a. High-Strength, Field-Bolted Connections: Connections shall be tested and inspected during installation according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
   b. Welded Connections: In addition to visual inspection, field-welded connections shall be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at inspector's option:
      1) Liquid Penetrant Inspection: ASTM E 165.
      2) Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
      3) Ultrasonic Inspection: ASTM E 164.
      4) Radiographic Inspection: ASTM E 94.
4. Product will be considered defective if it does not pass tests and inspections.

5. Prepare test and inspection reports.

N. Adjusting
1. Doors: After completing installation, test and adjust doors to operate easily, free of warp, twist, or distortion.
2. Door Hardware: Adjust and check each operating item of door hardware and each door to ensure proper operation and function of every unit. Replace units that cannot be adjusted to operate as intended.
3. Windows: Adjust operating sashes and ventilators, screens, hardware, and accessories for a tight fit at contact points and at weather stripping to ensure smooth operation and weathertight closure. Lubricate hardware and moving parts.
4. Roof Ventilators and Adjustable Louvers: After completing installation, including work by other trades, lubricate, test, and adjust units to operate easily and be free of warp, twist, or distortion as needed to provide fully functioning units.
   a. Adjust louver blades to be weathertight when in closed position.

O. Cleaning And Protection
1. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
2. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
3. Touchup Painting: After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing, bearing plates, and accessories.
   a. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or by SSPC-SP 3, "Power Tool Cleaning."
   b. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

   OR

   Touchup Painting: Cleaning and touchup painting are specified in Division 9 painting Sections.
4. Metal Panels: Remove temporary protective coverings and strippable films, if any, as metal panels are installed. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
   a. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
5. Doors and Frames: Immediately after installation, sand rusted or damaged areas of prime coat until smooth and apply touchup of compatible air-drying primer.
   a. Immediately before final inspection, remove protective wrappings from doors and frames.
6. Windows: Clean metal surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances. Clean factory-glazed glass immediately after installing windows.
7. Louvers: Clean exposed surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.
   a. Restore louvers damaged during installation and construction period so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by the Owner, remove damaged units and replace with new units.
      1) Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 13121

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SECTION 13281 - REMOVAL OF FRIABLE ASBESTOS-CONTAINING MATERIALS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for removal of friable asbestos-containing materials. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Description

1. Furnish all labor, materials, facilities, equipment, services, employee training and testing, permits and agreements necessary to perform the work required for asbestos removal, encapsulation, repair, clean-up, decontamination, re-insulation and all other work in accordance with these specifications, in accordance with the latest regulations from the U.S. Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), the recommendations of National Institute of Occupational Safety and Health (NIOSH), and any other applicable federal, state and local government regulations. Whenever there is a conflict or overlap of the above references, the most stringent provision is applicable.
2. The work specified herein shall be performed by competent persons trained, knowledgeable and qualified in the state-of-the-art techniques of asbestos abatement, handling and subsequent cleaning of contaminated areas.

C. Scope

1. The quantities of materials and limits of abatement work area(s) shall be verified by the asbestos contractor.

D. Asbestos Hazard

1. Asbestos-containing material when damaged or disturbed is subject to fiber releases. Wet methods are a primary means of controlling fiber release.
2. Strict compliance with each of the provisions outlined in these specifications for the encapsulation, repair and handling of asbestos-containing material is of great importance, because:
   a. The inhalation of airborne asbestos fibers can cause a very serious and often fatal disease.
   b. Workers may not be aware they are inhaling asbestos fibers.
   c. Symptoms of the disease do not appear for many years.
   d. Only the Contractor and his employees can prevent the inhalation of asbestos fibers, which can lead to the development of asbestos-related disease.
   e. No insurance is available to provide for asbestos-related disease.

E. Other Hazardous Material

1. Contractor shall comply with OSHA 29 CFR 1926.62 - Lead in Construction when demolishing any equipment or architectural component identified as lead-containing or lead-based paint. The work of this project is considered a demolition activity.
2. The Owner anticipates that a substantial amount of the Project will involve lead paint.

F. Qualifications

1. The Owner and the Owner's Representative will verify and approve the experience of the Asbestos Abatement Contractor based upon submission at the time of bidding by Contractor evidence of the following:
   a. Experience: Provide the names and locations of at least three asbestos abatement projects of comparable size and complexity comparable with this work. Provide the names and telephone numbers of contact person at previous projects. Provide the final air monitoring decontamination fiber levels achieved.

b. Personnel: Provide the name(s) of "Competent Person" as defined by OSHA 29 CFR 1926.32(f) - Asbestos. Demonstrate the education and specialized training with successful completion of examination of an EPA approved course. Provide evidence of participation in five projects of complexity comparable with this project.

c. Licensing and Certification: The Contractor must hold a current, valid asbestos license issued by the State in which the work is to be performed.

G. Notices And Record Keeping

1. Contractor shall maintain for at least 30 years, a record for each asbestos project in which the Contractor engages. Each record shall include the following information: name, address, and social security number of all personnel involved with the project, the name address and social security number of the OSHA "Competent Person" who will supervise the work, the amount of asbestos material that was removed, repaired, encapsulated or disturbed, the commencement and completion date of the work, copies of Hazardous Waste Manifest(s), personal air monitoring results and any other appropriate information.
2. The Contractor shall send written notification as required by USEPA National Emission Standards for Hazardous Air Pollutants (NESHAPS) Asbestos Regulations (40 CFR 61, Subpart M) to the Owner, at least 10 working days prior to beginning any work on asbestos-containing materials.
3. Include the following information:
   a. Name and address of Owner or operator.
   b. Description of the facility being demolished or renovated, including the size, age, and prior use of the facility.
   c. Estimate of the approximate amount of asbestos material present in the facility in terms of linear feet of pipe, and surface area on other facility components. For facilities in which the amount of asbestos materials is less than 80 linear meters (260 linear feet) on pipes and less than 15 square meters (160 square feet) on other facility components, explain techniques of estimation.
   d. Location of the facility being demolished or renovated.
   e. Scheduled starting and completion dates of demolition or renovation.
   f. Nature of planned demolition or renovation and method(s) to be used.
   g. Procedures to be used to comply with the requirements of USEPA National Emission Standards for Hazardous Air Pollutants (NESHAPS) Asbestos Regulations (40 CFR 61 Subpart M).
   h. Name and location of the waste disposal site where the asbestos waste material will be deposited.
4. Prior to commencement of work, the Contractor shall submit the following documents to the Owner's Representative. No work will be allowed to start until these documents have been approved:
   a. The schedule of the work, including manpower, length and number of work shifts. Schedule shall be coordinated with the Owner's full occupancy of all areas of the building.
   b. Satisfactory proof that written notification has been provided to the EPA regional office and the Owner.
   c. Proof that all required permits, disposal site locations, and arrangements for transportation and disposal of asbestos-contaminated materials, supplies and the like have been obtained.
   d. Complete a worker certificate indicating that all employees have had instruction and training on the hazards of asbestos exposure, the use and fitting of respirators, protective dress, wet and dry decontamination procedures, entry and exit from work areas, and all aspects of work procedures and protective measures.
   e. Documentation indicating that all employees have received appropriate medical examinations and have successfully passed fit testing for the respirator to be worn. As a minimum, medical exams must be consistent with OSHA 29 CFR 1926.1101(K)(9)(viii)(G)-Asbestos Regulation.

f. Samples of signs to be used in and around the work area to comply with 0SHA 29 CFR 1926.1101(K)(9)(viii)(I)- Asbestos regulations and as required by federal, state and municipal regulations.
g. Material Safety Data Sheets (OSHA form 174 or equivalent) for all chemicals used during work performed under this section.
h. Encapsulation data and encapsulation procedures.
i. Design of pressure differential system including calculation used to arrive at the number of machines necessary to achieve one air change per every 10 minutes.
j. Location of personnel and material decontamination units for each work area.

5. Contractor shall provide written notification to the Owner's Representative of his intent to start work at least five days in advance. In no case will the Contractor start work until authorization to proceed is given.
6. During the work, Contractor shall maintain a daily log which will be kept at the job site. Items to be included in the daily log shall include but are not limited to the following:
   a. Meetings, purpose, attendees, discussions, items of resolution.
   b. Visitations, authorized and unauthorized.
   c. Sign-in sheets of all personnel entering and leaving the work area.
   d. Special or unusual events (i.e., barrier breeching equipment failures).
   e. Personal air monitoring results.
   f. Two copies of the daily log are required for Project Closeout.

H. Terminology (Definitions)

1. Abatement - Procedures to control fiber release from asbestos-containing materials. Includes removal, enclosure or encapsulation.
2. Air Lock - A system for permitting ingress or egress without permitting air movement between any two adjacent areas consisting of two curtained doorways. The air lock must be maintained in an uncontaminated condition at all times.
3. Air Monitoring; - The process of measuring the asbestos fiber content of a specific volume of air in a stated period of time using methods approved or recommended by OSHA, EPA, NIOSH or other method approved by the Owner or the Owner's Representative.
4. Amended water - Water to which a surfactant has been added.
5. Asbestos - A generic name given to a number of naturally occurring hydrated mineral silicates that possess a unique crystalline structure, are incombustible in air, and are separable into fibers. Asbestos includes the asbestiform varieties of Chrysotile (serpentine), Crocidolite (Riebeckite), Amosite (Cummingtonite-Grunente), Anthophyllite, Actinolite, and Tremolite.
6. Asbestos-containing. material (ACM) - Any material that contains more than 1 percent asbestos by weight as determined by Polarized Light Microscopy (PLM).
7. Authorized Visitor - The Owner or his designated representative, or a representative of any regulatory or other agency having jurisdiction over the project.
8. Class I - Asbestos work means activities involving the removal of thermal systems insulation (TSI) and surfacing ACM and PACM.
9. Class II - Asbestos work means activities involving the removal of ACM which is not TSI or surfacing material. This includes, but is not limited to, the removal of asbestos-containing wallboard, floor tile and sheeting, roofing and siding shingles, and construction mastics.
10. Class III - Asbestos work means repair and maintenance operations where "ACM" including TSI and surfacing ACM and PACM is likely to be disturbed.
11. Class IV - Asbestos work means maintenance and custodial activities during which employees contact but do not disturb ACM or PACM and activities to clean-up dust, waste and debris resulting from Class I, II and III activities.
12. Critical Barrier - A unit of temporary construction which provides the only separation between an asbestos work area and an adjacent, potentially occupied, space. The critical barrier is composed of at least one intact sheet of polyethylene sheeting.
13. Decontamination Enclosure System - A series of connected rooms with curtained doorways between any two adjacent rooms, for the decontamination of workers or of materials and equipment. A decontamination system contains at least two air locks.

14. Disposal - All procedures necessary to transport and deposit the asbestos-contaminated material stripped and removed from the building in a waste disposal site in compliance with applicable federal, state, and local regulations.
15. Disposal Site - A site approved by the EPA for the disposal of asbestos-containing wastes.
16. Encapsulant - A liquid which can be applied to asbestos-containing materials and which controls the possible release of fibers from the materials.
17. Encapsulation - The use of an agent to seal the surface (bridging encapsulant) or penetrate the bulk (penetrating encapsulant) of the asbestos-containing material.
18. HEPA -High Efficiency Particulate Air - A type of filter which is 99.97% efficient at filtering particles of 0.3 micrometers in diameter.
19. HEPA Vacuum Equipment - Vacuuming equipment equipped with a HEPA filter in the exhaust outlet, and so designed and maintained that 99.97% of all particles of 0.3 micrometer in diameter in the inlet air are collected and retained.
20. Negative Pressure Respirators - Respirators which function by the wearer breathing in air through a filter.
21. NIOSH - National Institute of Occupational Safety and Heath.
22. Owner's Representative - Authorized Consultants
23. Permissible Exposure Level (PEL) - A level of airborne fibers specified by OSHA as an occupational exposure standard for asbestos. It is 0.1 f/cc of air, eight-hour TWA, as measured by Phase Contrast Microscopy.
24. Repair - The restoration of damaged or deteriorated asbestos-containing material to intact condition.
25. Respirator Protection Program - A set of procedures and equipment required by OSHA if employees wear negative pressure respirators or if fiber levels are above the PEL.
26. Surfactant - Chemical wetting agent added to water to improve penetration, thus reducing the amount of water required for a given operation or area, and enhancing the effect of the water in reducing fiber release.
27. Thermal Systems Insulation - Material applied to pipes, fittings, boilers, breeching, tanks, ducts or other interior structural components to prevent heat loss or gain, or water condensation, or for other purposes.
28. Wet Cleaning - The process of eliminating asbestos contamination from building surfaces and objects by using cloths and mops or other cleaning tools that have been dampened with clean water and afterwards disposing of these cleaning tools as asbestos-contaminated waste.

I. Permits And Licenses:
1. The Contractor must maintain current licenses as required by applicable state or local jurisdictions for the removal, transporting, disposal or other regulated activity relative to the work of this contract.

J. Regulations
1. This section sets forth governmental regulations and industry standards which are included and incorporated herein by reference and made a part of the specifications. This section also sets forth those notices and permits which are known to the Owner and which either must be applied for and received, or which must be given to governmental agencies before start of work.
2. Except to the extent that more explicit or more stringent requirements are written directly into the contract documents, all applicable codes, regulations, and standards have the same force and effect (and are made a part of the contract documents by reference) as if copied directly into the contract documents, or as if published copies are bound herewith.
3. The Contractor shall assume full responsibility and liability for the compliance with all applicable federal, state, and local regulations pertaining to work practices, hauling, disposal, and protection of workers, visitors to the site, and persons occupying areas adjacent to the site. The Contractor is responsible for providing medical examinations and maintaining medical records of personnel as required by the applicable federal, state, and local regulations. The Contractor shall hold the Owner and the Owner's Representative harmless for failure to comply with any applicable work,

hauling, disposal, safety, health or other regulation on the part of himself, his employees, or his Sub-Contractors.

4. Federal requirements which govern asbestos abatement work or hauling and disposal of asbestos waste materials include but are not limited to the following regulations:
   a. U.S. Department of Labor, Occupational Safety and Health Administration, (OSHA), including but not limited to:
      1) U.S. Department of Labor, OSHA, including, but not limited to:
         a) Occupational Exposure to Asbestos, Tremolite, Anthophyllite and Actinolite; Final Rules
            Title 29, Part 1910, Section 1001
            Part 1926, Section 1101 of the Code of Federal Regulations
         b) Respiratory Protection
            Title 29, Part 1910, Section 134 of the Code of Federal Regulations
         c) Construction Industry
            Title 29, Part 1926.1011, of the Code of Federal Regulation
         d) Access to Employee Exposure and Medical Records
            Title 29, Part 1910, Section 2 of the Code of Federal Regulations
         e) Hazard Communication
            Title 29, Part 1910, Section 1200 of the Code of Federal Regulations
         f) Specifications for Accident Prevention Signs and Tags
            Title 29, Part 1910, Section 145 of the Code of Federal Regulations
      2) U.S. Environmental Protection Agency (EPA) including, but not limited to:
         a) Asbestos Abatement Projects Rule
            40 CFR Part 762
            CPTS 62044, FRL 2843-9
            Federal Register, Vol. 50 No. 134, July 12,1985
            P28530-28540
         b) Regulation for Asbestos
            Title 40, Part 61, Subpart A of the Code of Federal Regulations
         c) National Emission Standard for Asbestos
            Title 40, Part 61, Subpart M (Revised Subpart B) of the Code of Federal Regulations
      3) State requirements which govern asbestos abatement work and/or hauling and disposal of asbestos waste materials.
      4) Contractor shall abide by all local requirements which govern asbestos abatement work or hauling and disposal of asbestos waste materials including the following:
         a) American National Standards Institute (ANSI)
            1430 Broadway
            New York, NY 10018
            (212) 354-3300
         b) Fundamentals Governing the Design and Operation of Local Exhaust Systems Publication Z9.2-79
         c) Practices for Respiratory Protection Publication Z288.2-80
         d) American Society for Testing and Materials (ASTM)
            1916 Race Street
            Philadelphia, PA 19103
            (215) 299-5400
         e) Specification for Encapsulants for Friable Asbestos-Containing Building Materials
         f) Safety and Health Requirements Relating to Occupational Exposure to Asbestos

K. Owner's Representative
   1. The Owner's Representative is authorized by the Owner to perform the following:
      a. Have free access to all asbestos work areas.

b. To assist in interpretation of procedures.
c. To advise on all provisions of the contract documents pertaining to the control of asbestos.
d. To stop work if, in the course of performing their monitoring duties, an instance of substantial nonconformance with the contract documents is observed.
e. To stop work if a situation presenting a health hazard to workers or the Owner's employees or occupants of the building is observed.
f. To act as the Owner's liaison in technical matters involving the asbestos-related work.
g. To perform air sampling inside and outside the asbestos work area during the project. The Contractor shall cooperate fully with Owner's Representative, its agents and employees, and ensure cooperation of his/her workers during collection of air samples and work area inspections.
h. The Owner's Representative role in advising the Owner on environmental health matters does not relieve the Contractor's obligation to comply with all applicable health and safety regulations. Air monitoring results generated by Owner's Representative shall not be used by the Contractor to represent compliance with regulatory agency requirements for monitoring of worker's exposure to airborne asbestos, nor shall any other activity on the part of Owner's Representative represent the Contractor's compliance with applicable health and safety regulations.

L. Pre-Construction Conference
1. An initial progress meeting recognized as "Pre-Construction Conference" shall be held prior to start of any work. Contractor shall meet at project site, with General Superintendent, the Owner, the Owner's Representative, and other entities concerned with asbestos abatement work. Record discussions and agreements and furnish copy to each participant. Provide at least 72 hours advance notice to all participants prior to convening Pre-Construction Conference.
2. This is an organizational meeting, to review responsibilities and personnel assignments, to locate the containment and decontamination areas; and temporary facilities including power, light, water, etc.
3. Submit waivers on forms, and executed in a manner acceptable to the Owner. Administrative requirements that must proceed or coincide with Contractor's submittal for final payment shall consist of the following:
a. Completion of project closeout requirements.
b. Completion of items specified for completion beyond time of substantial completion (regardless of whether special payment application was previously made).
c. Assurance, satisfactory to the Owner, that unsettled claims will be settled and that work not actually completed and accepted will be completed without undue delay.
d. Transmittal of required project construction records to the Owner.
e. Landfill receipts for all asbestos-containing material.
f. Proof, satisfactory to the Owner, that taxes, fees and similar obligations of Contractor have been paid.
g. Removal of temporary facilities, services, surplus materials, rubbish and similar elements.
h. Consent of surety for final payment.

M. Project Closeout
1. Project closeout is the term used to describe certain collective project requirements that indicate completion of the work to be fulfilled near the end of the contract time. Also, in preparation for final acceptance of the work by the Owner, as well as, final payment to the Contractor and the normal termination of the Contract.
2. Include supporting documentation for completion as indicated in these contract documents.
3. Submit a statement on accounting of changes to the Contract Sum.
4. Advise the Owner of pending insurance change-over requirements.
5. Submit specific warranties, workmanship and maintenance bonds, maintenance agreements, final certifications and similar documents.

6. Obtain and submit releases enabling the Owner's full, unrestricted use of the work area and access to services and utilities. Where required, include occupancy permits, operating certificates and similar releases.
7. Results of the completed inspection will form the initial "punch-list" for final acceptance.
8. A complete record, certified by the testing laboratory, of all personal air monitoring results.
9. Complete the following cleaning operations as outlined in Paragraph “Decontamination Procedures” before requesting the Owner's Representative inspection for certification of substantial completion.
    a. Remove exposed labels in finished spaces which are not required as permanent labels on materials supplied as part of the work, except for "Asbestos", "Asbestos Free", or Thermal Insulation Labels specified elsewhere.
    b. Clean transparent materials, affected by the work including mirrors and window/door glass, to a polished condition, removing substances which are noticeably vision-obscuring materials. Replace broken glass and damaged transparent materials.
    c. Clean exposed hard-surfaced finishes affected by the work, to a dirt-free condition, free of dust, stains, films and similar distracting substances. Except as otherwise indicated, avoid disturbance of natural weathering of exterior surfaces. Restore reflective surfaces to original reflective condition.
    d. Clean plumbing fixtures affected by the work to a sanitary condition, free of stains including those resulting from water exposure.
    e. Replace all HVAC filters using materials supplied by the Owner or clean non-replaceable filters after minimum of two days of operation of HVAC equipment.
    f. Clean light fixtures and lamps, which have been affected by the work so as to function with full efficiency. Replace lamps where inoperable.
    g. Repair any damage to wall, ceiling and floor surfaces caused by installation and removal of the polyethylene sheeting.

N. Personnel Protection
1. Prior to commencement of work, the workers shall be instructed and be knowledgeable in the areas described in Paragraph "Submittals and Notices" having to do with employees.
2. Worker Protection - shall comply with 29 CFR 1910.134 (Respiratory Protection).
    a. Because there is no known safe level of exposure to asbestos, it is prudent to reduce worker's exposures to as low a level as possible. Proper respiratory protection is critical in minimizing exposure.
    b. Workers shall be provided, as a minimum, with personally issued and marked respirators equipped with high efficiency particulate filters approved by NIOSH to be worn in the designated work area and/or whenever a potential exposure to asbestos exists. Sufficient filters shall be provided for replacement as required by the workers or applicable regulations. Disposable respirators shall not be used.
    c. No worker shall be exposed to levels greater than 0.01 f/cc as determined by the protection factor of the respirator worn and the work area fiber levels.
    d. Whenever powered purifying respirator protection is used, a sufficient supply of replacement batteries and HEPA filter cartridges shall be provided to the workers.
    e. Air monitoring required by OSHA is work of the Contractor and not covered in this specification. Contractor shall post, on a daily basis, results of the air monitoring results from the previous shift. A complete record, certified by the testing laboratory, of all personal air monitoring tests and results will be furnished to the Owner and the Owner's Representative prior to Contractor's Request for Final Payment.
    f. During encapsulation operations or usage of other organic base aerosols (e.g., spray glue, expanding foam), workers shall be provided with combination cartridges consisting of organic vapor and HEPA sections.
    g. Workers shall be provided with sufficient sets of protective full-body clothing to be worn in the designated work area and/or whenever potential exposure to asbestos exists. Such clothing shall include, but not be limited to, full-body coveralls, headgear and gloves. Workers shall assure that hoods covering their hair are worn in the designated work areas

at all times. Eye protection and hard hats shall be provided as required by applicable safety regulations. Eye protection shall be worn during encapsulation operations. Non-disposable type protective clothing and footwear shall be left in the work area until the end of the asbestos abatement work, at which time such items will be disposed of as asbestos waste.

h. Non-skid footwear shall be provided to all abatement workers. Disposable clothing shall be adequately sealed to the footwear to prevent body contamination.

i. Protective clothing shall not be worn in lieu of street clothing outside the work area.

j. Visitor Clothing: The Contractor shall provide authorized visitors with suitable respirator, protective clothing, headgear, eye protection, and footwear as described herein, whenever they enter the work area.

3. Decontamination and Work Procedures: The decontamination and work procedures to be followed by workers shall be posted as described in these specifications.

4. Worker and Authorized Visitor Protection Procedures:

a. Each worker and authorized visitor shall, upon entering the job site, remove street clothes in a designated clean change area and put on a respirator with new filters and clean protective clothing before entering the work area.

b. The Contractor's employees shall perform a positive/negative respirator fit test each time he enters the work area. If leakage occurs, the respirator must be re-adjusted or replaced.

c. Workers shall maintain their respirators in a safe operating condition. The condition of respirators shall be checked daily.

d. Workers and visitors shall complete the decontamination procedures as outlined in the specification upon exiting the work area.

e. Workers shall not eat, drink, smoke, or chew gum or tobacco in or near the asbestos work areas.

f. Workers shall be fully protected with respirators and protective clothing immediately prior to the first disturbance of asbestos-containing or contaminated materials and until final cleanup is completed.

O. Air Monitoring

1. The airborne fiber counts outside the work area will be monitored to detect faults in the work area isolation such as contamination of the building outside of the work areas with airborne asbestos fibers, failure of filtration or rupture in the negative pressure system.

   Should any of the above occur, the Contractor shall immediately cease asbestos abatement activities until the fault is corrected. Work shall not recommence until authorized by Owner's Representative. In the case of mini-enclosures the Owner's Representative will monitor air in a remote location of the residence to determine the baseline of asbestos.

2. The airborne fiber counts in the work area will be monitored. The purpose of this air monitoring will be to detect airborne fiber counts which may significantly challenge the ability of the work area isolation procedures to protect the balance of the building or outside of the building from contamination by airborne fibers. In the case of mini-enclosures the Owner's representative may monitor air outside of several enclosures if they are in close proximity.

3. Contractor shall maintain an average airborne count inside the work area of less than 0.5 f/cc. If the fiber counts rise above this figure for any sample taken, revise work procedures to lower fiber counts. If the TWA fiber count for any work shift or eight-hour period exceeds 0.5 f/cc, stop all work, leave pressure differential system in operation and notify Owner's Representative. Do not recommence work until authorized in writing by Owner's Representative.

4. If airborne fiber counts exceed 1.0 f/cc for any period of time cease all work until fiber counts fall below 0.5 f/cc and notify Owner's Representative. Do not recommence work until authorized in writing by the Owner's Representative.

5. If any air sample taken outside of the work area exceeds the 0.01 f/cc of air, Contractor shall immediately and automatically stop all work. If this air sample was taken inside the building and outside of critical barriers around the work area, immediately erect new critical barriers to isolate the affected area from the balance of the building. Erect Critical Barriers at the next existing structural isolation of the involved space (e.g., wall, ceiling, and floor). Leave Critical Barriers in

place until completion of work and insure that the operation of the negative pressure system in the work area results in a flow of air from the balance of the building into the affected area.

6. If the exit from the clean room of the personnel decontamination unit enters the affected area, establish a temporary decontamination facility consisting of a shower room and changing room. After cleaning and decontamination of the affected area remove the shower room and leave the changing room in place as an air lock.
7. After certification of visual inspection in the work area, remove critical barriers separating the work area from the affected area. Final air samples will be taken within the entire area.
8. The following procedure will be used to resolve any disputes regarding fiber types when a project has been stopped due to excessive airborne fiber counts. "Airborne Fibers" referred to above include all fibers regardless of composition as counted in the Phase Contrast Microscopy (PCM) NIOSH 7400 Method procedures. If work has stopped due to high airborne fiber counts, air samples will be secured in the same area by the Owner's Representative for analysis by electron microscopy. "Airborne fibers" counted in samples analyzed by Scanning or Transmission Electron Microscopy (TEM) shall be only asbestos fibers, but of any diameter and length. Subsequent to analysis by Electron Microscopy the number of airborne fibers shall be determined by multiplying the number of fibers, regardless of composition, counted by the PCM NIOSH 7400 Method procedure by a number equal to asbestos fibers counted divided by all fibers counted in the electron microscopy analysis.
9. If electron microscopy is used to arrive at the basis for determining airborne fiber counts in accordance with the above paragraph, and if the average of airborne asbestos fibers in all samples taken exceeds 0.1 f/cc, or if any one sample exceeds 0.2 f/cc, then the cost of such analysis will be born by the Contractor, at no additional cost to the Owner.
10. The Owner's Representative will secure at least the following air samples to establish a base line before start of work involving large enclosures:

Location Sampled	**Number of Samples**	**Analysis Method**	**Detection Limit f/cc**	**Minimum Volume Liters**	**Rate LPM**
Each Work Area	1	PCM	0.01	1,900	2-16
Outside Each Work Area	1-3	PCM	0.01	1,900	2-16

11. Base Line is an action level expressed in f/cc, which is ten percent greater than the largest of the following:
    a. Average of the samples collected on cellulose ester filters outside each work area.
    b. Average of the samples collected on cellulose ester filters outside the building.
    c. 0.01 fibers per cubic centimeter.
12. Daily: From start of work of Paragraph "Temporary Enclosure" through the work of Paragraph "Project Decontamination," the Owner may be taking the following samples on a daily basis. The location of each air sample will be determined by the Owner's Representative.
    a. Baseline
    b. Work Area
13. For larger enclosures samples will be collected on 25 mm cassettes with the following filter medial:
    PCM: 0.8 micrometer mixed cellulose ester.

Location Sampled	Number of Samples	Analysis Method	Detection Limit f/cc	Minimum Volume Liters	Rate LPM
Each Work Area	2	PCM	0.01	1,900 as required by conditions	2-16
Outside Each Work Area Critical Barrier	1	PCM	0.01	1,900	2-16
Clean Room	1	PCM	0.01	1,900	2-16
Equip Decon	1	PCM	0.01	1,900	2-16

14. Additional samples may be taken at the Owner or the Owner's Representative discretion. If airborne fiber counts exceed allowed limits, additional samples will be taken as necessary to monitor fiber levels.
15. The services of a testing laboratory will be employed by the Owner to perform laboratory analysis of the air samples. Samples will be sent daily so that verbal reports on air samples can be obtained in a timely manner. A complete record, certified by the testing laboratory, of all air monitoring tests and results will be furnished to the Owner's Representative, the Owner and the Contractor.
16. Air samples may be analyzed on site by the Owner's Representative, if they are to be analyzed by the NIOSH 7400 Method.
17. Cellulose ester filters will be analyzed using the PCM NIOSH 7400 Method. Thus analysis will be carried out at a laboratory located off the job site.
18. At the completion of the work in occupied areas and prior to the dismantling of the isolation system, final air clearance will be conducted by Owner's Representative.
19. Decontamination of the work area will be considered complete when all samples indicate fiber levels are less than 0.0l f/cc of air as analyzed by PCM NIOSH 7400 Method or an average of less than 70 structures per square millimeter of filter area as analyzed by TEM; Level II AHERA Method.
20. The Contractor may conduct his own air monitoring and laboratory testing. If he elects to do this the cost of such air monitoring and laboratory testing shall be included in the Contract Sum.

P. Equipment Removal Procedures
1. Clean all external surfaces of contaminated waste containers and equipment thoroughly by wet sponging or HEPA vacuuming before moving such items into the equipment decontamination enclosure system washroom for final cleaning and removal to uncontaminated areas. Ensure that personnel do not leave the work areas through the equipment decontamination enclosure system.

Q. Disposal Activities
1. It is the responsibility of the Contractor to comply with current federal, state and local regulations concerning the waste handling, transportation, and disposal of asbestos-containing material (ACM) and accompanying solvents or residues.
2. The Contractor will document actual disposal of the waste at the designated landfill by completing Disposal Certificate or submitting proof of landfill receipt.

1.2 PRODUCTS

A. Materials
1. All Contractor's equipment delivered to the site shall be free of asbestos contamination.
2. Store all materials subject to damage off the ground, away from wet or damp surfaces, and under cover sufficient to prevent damage or contamination.
3. Damaged or deteriorating materials shall not be used and shall be removed from the premises. Materials that become contaminated shall be disposed of in accordance with applicable regulations.
4. Polyethylene flame retardant sheet of 6-mil thickness shall be used unless otherwise specified. Polyethylene sheeting shall be sized to minimize the frequency of joints. Polyethylene sheeting must satisfy the National Fire Prevention Association Standard 701, "Small Scale Fire Test for Flame Resistant Textile and Film."
5. Adhesive tape shall be capable of sealing joints of adjacent sheets of polyethylene and for use in attachment of polyethylene sheet to finished or unfinished surfaces of similar materials and shall be capable of adhering under dry and wet conditions, including use of amended water. Contractor shall use adhesive tape compatible with finished surfaces.

6. Protective devices such as, but not limited to, disposable clothing, respirators, gloves, hard hats, etc. shall be used.
7. Wetting agent shall be a mixture of 50/50 polyoxyethylene ether and polyglycol ester or equivalent commercial product.
8. Encapsulant materials shall be the bridging and penetrating type and conform with the following characteristics:
   a. Encapsulants shall not be solvent-based or utilize a hydrocarbon in the liquid in which the solid parts of the encapsulant are suspended.
   b. Encapsulant shall not be flammable.
9. A non-hardening lagging sealer for enclosing and sealing raw exposed edges and surfaces of asbestos-containing materials.
10. Pre-mixed or job mixed insulating plaster manufactured for use on plumbing equipment shall be used when repairing damaged thermal insulation material.
11. Non-woven fibrous glass mat and open weave glass fiber mat cloth for repair of thermal systems insulation.
12. Fire retardant sealant shall prevent fire, smoke, water and toxic fumes from penetrating through sealants. Sealant shall have a flame spread, smoke and fuel contribution of zero, and shall be ASTM and Underwriter's Laboratory (UL) rated for three hours for standard method of fire test for fire stop systems.

B. Tools And Equipment
1. Provide suitable tools for repair and encapsulation of asbestos-containing materials and for removal of asbestos-containing materials that are beyond repair. Wire brushes shall not be used as a means of removing or cleaning asbestos-containing materials from surfaces, if they are used as the surface is being sprayed with water or amended water.
2. Provide sufficient number of HEPA-filtered vacuum cleaners equipped with pick-up adapters, steel floor wands, crevice tools, and carpet tools.
3. Airless sprayers capable of spraying amended water shall be provided in sufficient number to allow continuous uninterrupted work.
4. Asbestos filtration devices shall utilize high efficiency particulate air (HEPA) filtration systems.
5. Transportation equipment, as required, shall be suitable for loading, temporary storage, and unloading of contaminated waste without exposure to persons or property, and shall be quiet in motion if used within the building.

1.3 EXECUTION

A. Safety Procedures For Power And Lighting
1. The use of wet methods for removal, repair, encapsulation or cleaning procedures increases the potential for electrical shock when working around electrical panels, conduit, light fixtures, alarm systems, junction boxes, transformers, etc. In coordination with the Owner, de-energize as much electrical equipment as possible to prevent electrical shock to employees performing the work. The Contractor shall use the following precautions:
   a. Use non-conductive tools and vacuum attachments.
   b. Utilize "hot line" covers over energized cables and power lines when possible.
   c. Ensure all electrical equipment in use is properly grounded before the job starts. Check outlets, wiring, extension cords and power pickups.
   d. Avoid stringing wiring across floors. Elevate wiring if possible.
   e. Ensure electrical outlets are tightly sealed and taped to avoid water spray.
   f. Determine operating voltages of equipment and lines before working on or near energized parts.
   g. Energized parts must be insulated or guarded from employee contact and other conductive objects. Extension cords must be three-wire type and connected to a Ground Fault Interrupter (GFI) circuit.
   h. Lock or secure de-energized circuits at panel and post warning signs.

i. Seal heating vents with two layers of polyethylene sheeting prior to the start of work. The Contractor shall repair any damage caused by Contractor's operations to duct work, grilles, dampers, louvers or HVAC equipment at the completion of the work at Contractor's expense. Coordinate all lock out and or de-energizing with Owner.

B. Temporary Facilities

1. Use qualified tradesmen for installation of temporary services and facilities. Locate temporary services and facilities where they will serve the entire project adequately and result in minimum interference with the performance of the work and operations of the building. Coordinate all installations and shut downs with building owner.
2. Relocate, modify and extend services and facilities as required during the course of work so as to accommodate the entire work of the project.
3. Provide new or used materials and equipment that are undamaged and in serviceable condition. Provide only materials and equipment that are recognized as being suitable for the intended use, by compliance with appropriate standards.
4. During the erection and/or moving of scaffolding, care must be exercised so that the polyethylene floor covering is not damaged.
5. Clean, as necessary, debris from non-slip surfaces.
6. At the completion of abatement work, clean all construction aids within the work area, wrap in one layer of 6-mil polyethylene sheet and seal before removal from the work area.
7. Temporary water service connections to the Owner's water system shall include back flow protection. Valves shall be temperature and pressure rated for operation of the temperatures and pressures encountered.
8. Employ heavy-duty abrasion-resistant hoses with a pressure rating 50 percent greater than the maximum pressure of the water distribution system to provide water into each work area and to each Decontamination Unit. Provide fittings as required to allow for connection to existing wall hydrants or spouts, as well as temporary water heating equipment, branch piping, showers, shut-off nozzles and equipment.
9. Electrical Services shall comply with applicable NEMA, NECA and UL standards and governing regulations for materials and layout of temporary electric service.
10. Provide a weatherproof, grounded temporary electric power service and distribution system of sufficient size, capacity, and power characteristics to accommodate performance of work during the construction period. Install temporary lighting adequate to provide sufficient illumination for safe work and traffic conditions in every area of work.
11. Provide receptacle outlets equipped with ground fault circuit interrupters, reset button and pilot light, for plug-in connection of power tools and equipment.
12. Use only grounded extension cords; use "hard-service" cords where exposed to abrasion and traffic. Use single lengths or use waterproof connectors to connect separate lengths of electric cords, if single lengths will not reach areas of work. All cords shall be elevated off the floor inside the containment area.
13. Temporary wiring in the work area shall be type UL non-metallic sheathed cable located overhead and exposed for surveillance. Do not wire temporary lighting with plain, exposed (insulated) electrical conductors. Provide liquid tight enclosures or boxes for wiring devices.
14. Provide Type "A" fire extinguishers for temporary offices and similar spaces where there is minimal danger of electrical or grease-oil-flammable liquid fires. In other locations provide type "ABC" dry chemical extinguishers, or a combination of several extinguishers of NFPA recommended types for the exposures in each case.
15. Use of the Owner's existing toilet facilities, as indicated, will be permitted, so long as these facilities are properly cleaned and maintained in a condition acceptable to the Owner. At substantial completion, restore these facilities to the condition prevalent at the time of initial use. All provisions of these specifications regarding leaving the work area must be met.
16. When mini-enclosures area being used all of the requirements above will be enforced by the Owner's Representative. The construction and set-up of the mini-enclosures may be done by the Abatement Contractor.

C. Pressure Differential System

1. Before start of work Contractor shall submit design of pressure differential system to the Owner's Representative for review. Do not begin work until system has been approved by Owner's Representative. Include in the submittal the following:
   a. Number of pressure differential machines required and the calculations necessary to determine the number of machines.
   b. Description of projected air-flow within work area and methods required to provide adequate air flow in all portions of the work area.
2. If the enclosure is not a mini-enclosure, the Contractor must supply the required number of asbestos air filtration units to the site in accordance with these specifications. Each unit shall include the following:
   a. Cabinet constructed of steel or other durable materials able to withstand damage from rough handling and transportation. The width of the cabinet should be less than 30 inches to fit through standard-size doorways. Cabinet shall be factory sealed to prevent asbestos-containing dust from being released during use, transport, or maintenance. Access to and replacement of all air filters shall be from intake end. Unit shall be mounted on casters or wheels.
   b. Rate capacity of fan according to useable air-moving capacity under actual operating conditions. Use centrifugal-type fan.
   c. The final filter shall be the HEPA type. The filter media (folded into closely pleated panels) must be completely sealed on all edges with a structurally rigid frame.
   d. A continuous rubber gasket shall be located between the filter and the filter housing to form a tight seal.
   e. Provide HEPA Units that are individually tested and certified on site by an independent testing agency to have an efficiency of not less than 99.97 percent when challenged with 0.3 m dioctylphthlaate (DOP) particles when tested in accordance with Military Standard Number 2182 and Army Instruction Manual 136-300-175A. Provide filters that bear a UL586 label to indicate ability to perform under specified conditions.
   f. Pre-filters, which protect the final filter by removing the larger particles, are required to prolong the operating life of the HEPA filter. Two stages of pre-filtration are required. The first-stage pre-filter shall be a low-efficiency type (e.g., for particles 10 microns and larger). The second-stage (or intermediate) filter shall have a medium efficiency (e.g., effective for particles down to 5 microns). Pre-filters and intermediate filters shall be installed either on or in the intake grid of the unit and held in place with special housings or clamps.
   g. Each unit shall be equipped with a Magnahelic gauge or manometer to measure the pressure drop across filters and indicate when filters have become loaded and need to be changed. A table indicating the useable air-handling capacity for various static pressure readings on the Magnahelic gauge shall be affixed near the gauge for reference, or the Magnahelic reading indicating at what point the filters should be changed, noting Cubic Feet per Minute (CFM) air delivery at that point. Provide units equipped with an elapsed time meter to show the total accumulated hours of operation.
   h. The unit shall have an electrical (or mechanical) lockout to prevent fan from operating without a HEPA filter. Units shall be equipped with automatic shutdown system to stop fan in the event of a major rupture in the HEPA filter or blocked air discharge. Warning lights are required to indicate normal operation, too high a pressure drop across the filters (i.e., filter overloading), and too low of a pressure drop (i.e., major rupture in HEPA filter or obstructed discharge).
   i. Electrical components shall be approved by the National Electrical Manufacturers Association (NEMA) and Underwriters' Laboratories (UL). Each unit shall be equipped with overload protection sized for the equipment. The motor, fan, fan housing, and cabinet shall be grounded.
   j. If a mini-enclosure is used the air filtration unit may be a HEPA filtered vacuum with a flow rate of at least 100 cubic feet per minute (CFM).
3. Provide a fully operational pressure differential system within the work area maintaining continuously a pressure differential across work area enclosures of 0.02 inches of water for glove

bag operations and mini-containments**.** Demonstrate to the Owner's Representative the pressure differential by use of pressure differential meter or a manometer, before disturbance of any asbestos-containing materials. In the case of a mini-enclosure visual evidence of pressure differential through the use of a smoke generation tube shall be sufficient as in paragraph C.13 of this section.

4. Continuously monitor and record the pressure differential between the work area and the building outside of the work area.
5. Provide fully operational negative pressure systems supplying a minimum of one air change every ten minutes (six changes per hour), less in the instance of a mini-enclosure. Determine the volume in cubic feet of the work area by multiplying floor area by ceiling height. Determine total ventilation requirement in cubic feet per minute (cfm) for the work area by dividing this volume by the air change rate.
6. Ventilation Required (CFM) = Volume of work area (cu. ft.)/10 min.
7. Determine number of units needed to achieve ten-minute change rate by dividing the ventilation requirement (CFM) above capacity of exhaust unit(s) used. Capacity of a unit for purposes of this section is the capacity in cubic feet per minute with fully loaded filters (pressure differential which causes loaded filter warning light to come on) in the machines labeled operating characteristics.
8. Add one additional unit as a backup in case of equipment failure or machine shutdown for filter changing.
9. Locate exhaust unit(s) so that makeup air enters work area primarily through decontamination facilities and traverses work area as much as possible. This may be accomplished by positioning the unit(s) at a maximum distance from the worker access opening or other makeup air sources.
10. Vent to outside of building, unless authorized in writing by the Owner's Representative.
11. Each unit shall be serviced by a dedicated minimum 115v-20A circuit with overload device tied into an existing building electrical panel which has sufficient spare capacity to accommodate the load of all pressure differential units connected. Dedication of an existing circuit may be accomplished by shutting down existing loads on the circuit.
12. Test pressure differential system before any asbestos-containing material is wetted or removed. After the work area has been prepared, the decontamination facility set up, and the exhaust unit(s) installed, start the unit(s) (one at a time). Demonstrate operation and testing of pressure differential system to the Owner's Representative.
13. Demonstrate of operations of the pressure differential system to the Owner's Representative will include, but not be limited to, the following:
    a. Plastic barriers and sheeting move lightly in toward work area.
    b. Curtain of decontamination units move lightly in toward work area.
    c. There is a noticeable movement of air through the decontamination unit. Use stroke tube to demonstrate air movement from clean room, and from equipment room to work area.
    d. Use smoke tubes to demonstrate a positive motion of air across all area in which work is to be performed.
    e. Use a differential pressure meter or manometer to demonstrate a pressure difference of at least 0.02 inches (as allowed) of water across <u>every</u> barrier separating the work area from the balance of the building or outside. This is not required in the case of a mini enclosure.
14. Start exhaust units before beginning work (before any asbestos-containing material is disturbed). After abatement work has begun, run units continuously to maintain a constant negative pressure until decontamination of the work area is complete. Do not turn off units at the end of the work shift or when abatement operations temporarily stop.
15. Do not shut down pressure differential system during encapsulating procedures, unless authorized by the Owner's Representative in writing. Start abatement work at a location farthest from the exhaust units and proceed toward them. If an electric power failure occurs, immediately stop all abatement work and do not resume until power is restored and exhaust units are operating again.
16. At completion of abatement work, allow exhaust units to run as specified to remove airborne fibers that may have been generated during abatement work and cleanup and to purge the work area with clean makeup air. The units may be required to run for a longer time after decontamination, if

dry or only partially wetted asbestos material was encountered during any abatement work. In the case of a mini-enclosure the vacuum may be removed and the entrance sealed following encapsulation until the clearance sample is collected.

17. Prior to final air test, remove pre-filter and wipe out inside lip of negative air machine.
18. When a final inspection and the results of final air tests indicate that the area has been decontaminated, exhaust units may be removed from the work area. Before removal from the work area, remove and properly dispose of pre-filter, and seal Intake to the machine with 6-mil polyethylene to prevent environmental contamination from the filters.

D. Work Area Preparation

1. The work area is the location where asbestos-abatement work occurs. It is a variable of the extent of work of the contract. It may be a portion of a room, a single room, or a complex of rooms. A "work area" is considered contaminated during the work, and must be isolated from the balance of the building, and decontaminated at the completion of the asbestos-control work.
2. Pre-clean fixed objects, walls and floor surfaces within the proposed work areas using HEPA filtered vacuum equipment and wet cleaning methods as appropriate.
3. Seal all openings, supply and exhaust vents, and convectors within ten feet of the work area with 6-mil polyethylene sheeting secured and completely sealed with plastic adhesion tape.
4. Contact fire control agencies to review procedures prior to start of work.
5. Provide flame resistant polyethylene sheeting that conforms to requirements set forth by the National Fire Protection Association Standard 701, Small Scale Fire Test for Flame-resistant Textiles and Films. Provide largest size possible to minimize seams, four- or six- mils thick, frosted or black.
6. Provide spray adhesive in aerosol cans which is specifically formulated to stick tenaciously to sheet polyethylene and supporting surface.
7. Completely isolate the work area from other parts of the building so as to prevent asbestos-containing dust or debris from passing beyond the isolated area. Should the area beyond the work area(s) become contaminated with asbestos-containing dust or debris as a consequence of the work, clean those areas in accordance with the procedures indicated in Paragraph "Decontamination Procedures." All such required cleaning or decontamination shall be performed at no additional cost to the Owner.
8. Place all tools (i.e., scaffolding, staging) necessary for the work in the area to be isolated prior to erection of plastic sheeting temporary enclosure.
9. Disable ventilation systems or any other system bringing air into or out of the work area. Disable system by disconnecting wires, removing circuit breakers, by lockable switch or other positive means that will prevent accidental premature restarting of equipment.
10. Remove and dispose of all electrical and mechanical items, such as lighting fixtures, clocks, diffusers, registers, escutcheon plates, etc., which cover any part of the surface on which work is to be performed.
11. All general construction items such as cabinets, casework, doors and window trim, moldings, ceilings, trim, etc., which cover the surface of the work as required to prevent interference with the work. To be performed by the Owner: clean, decontaminate and reinstall all such materials, upon completion of all removal work with materials, finishes, and workmanship to match existing installations before start of work.
12. Permit Access to the work area only through the Decontamination Unit. All other means of access shall be closed off and sealed and warning signs displayed on the clean side of the sealed access.
13. Provide Warning Signs at each visual and physical barriers reading as follows in both English and Spanish:

Legend	Notation
KEEP OUT	3" Sans Serif Gothic or Block
BEYOND THIS POINT	1" Sans Serif Gothic or Block
ASBESTOS ABATEMENT WORK	1" Sans Serif Gothic or Block

IN PROGRESS BREATHING ASBESTOS DUST MAY BE HAZARDOUS TO YOUR HEALTH	1" Sans Serif Gothic or Block 14 Point Gothic

14. Alternate methods of containing the work area may be submitted to the Owner's Representative for approval. Do not proceed with any such method(s) without prior written approval of the Owner's Representative.
15. Individually seal all ventilation openings (supply and exhaust), lighting fixtures, clocks, doorways, windows, convectors and speakers, and other openings into the work area with plastic adhesion tape alone or with polyethylene sheeting at least 4-mil in thickness, taped securely in place with plastic adhesion tape. Maintain seal until all work including Project Decontamination is completed. Take care in sealing off lighting fixtures to avoid melting or burning of sheeting.
16. Provide sheet plastic barriers at least 6-mil in thickness as required to completely seal openings from the work area into adjacent areas. Seal the perimeter of all sheet plastic barriers with plastic adhesion tape or spray cement.
17. Where applicable, construct framing of the containment out of fire treated wood or aluminum studs. Mini-enclosure frames may be constructed of Polyvinyl Chloride (PVC) tubing.
18. Cover all walls in work area extending to the underside of the ceiling grid system with one layer of polyethylene sheeting, at least 6-mil in thickness, mechanically supported and sealed with plastic adhesion tape or spray-glue in the same manner as "Critical Barrier" sheet plastic barriers. Tape all joints with plastic adhesion tape. Contractor shall be responsible for repair of damaged wall finishes.
19. Cover floor with two layers of 6-mil polyethylene sheeting (exclude for floor tile and adhesive).
20. Provide Pressure Differential System per Paragraph “Pressure Differential System.”
21. If the enclosure barrier is breached in any manner that could allow the passage of asbestos debris or airborne fibers, then add the affected area to the work area, enclose it as required by this section of the specification and decontaminate it as described in Paragraph “Decontamination Procedures.”
22. Establishing a Mini-Containment area:
    a. Establish work area so that unauthorized entry is prevented; Construct a two-compartment fire treated wood frame around work area; install one layer 6-mil polyethylene sheeting to structural members and two layers 6 mil polyethylene sheeting to the floor. Exception: no floor required if mini-containment is being constructed to perform a floor tile activity. Seal all edges to wall, ceiling, and floor surfaces with duct tape. Install viewing inspection windows, where feasible.
    b. Seal all penetrations with duct tape such as pipes, electrical conduit, or ducts contained within the mini-containment.
    c. Install triple 6-mil polyethylene flaps at both doorways. Place portable sprayer with clean water, disposable towels, and pre-labeled disposal bag in air lock.
    d. Install appropriate signs on outside of mini-containment area.
    e. Install HEPA vacuum; extend hose into mini-containment area for general vacuuming, negative air, and cleaning of disposal suit.
    f. Accumulate all loose materials for disposal. Place in approved container. Apply appropriate labels. Adequately wet clean all wall, floor, tool and equipment surfaces.
    g. Abatement worker must wear two disposable suits. Remove outer suit in work area and place in a plastic bag. Enter air lock.
    h. In air lock, wet wipe respirator and wash hands with clean water. Remove respirator and place in a clean plastic bag. Proceed to remote shower unit where inner suit may be removed.

E. Worker Protection
1. This section describes the equipment and procedures required for protecting workers against asbestos contamination and other work place hazards except for respiratory protection.
2. Respiratory Protection is specified in Paragraph “Respiratory Protection.”

3. Train in accordance with EPA's Model Accreditation Plan, 40 CFR 763 - Asbestos, all workers in the dangers inherent in handling asbestos and breathing asbestos dust and in proper work procedures and personal and area protective measures. Include but do not limit the topics covered in the course to the following:
   a. Methods of recognizing asbestos.
   b. Health effects associated with asbestos.
   c. Relationship between smoking and asbestos in producing lung cancer.
   d. Nature of operations that could result in exposure to asbestos.
4. Importance of and instruction in the use of necessary protective controls, practices and procedures to minimize exposure including:

   Engineering controls
   Work practices
   Respirators
   Housekeeping procedures
   Hygiene facilities
   Protective clothing
   Decontamination procedures
   Emergency procedures
   Waste disposal procedures
   Appropriate work practices for the work
   Requirements of medical surveillance program
   Review of OSHA 29 CFR 1926.1101(k)(9)(viii)(G) - Asbestos
   Pressure differential systems
   Work practices including hands on or on job training
   Personal decontamination procedures
   Air monitoring, personal and area

5. Provide medical examinations for all workers who may encounter an airborne fiber level of 0.1 f/cc or greater for an 8 hour time weighted average. In the absence of specific airborne fiber data, provide medical examination for all workers who will enter the work area for any reason. Examination shall, at minimum, meet OSHA requirements as set forth in 29 CFR 1926.1101(k)(9)(viii)(G) - Asbestos. In addition, provide an evaluation of the individual's ability to work in environments capable of producing heat stress in the worker.
6. Before start of work Contractor shall submit the following to the Owner's Representative for review. Do not start work until receipt of Owner's Representative.
   a. An original signed copy of the Certificate of Worker's Acknowledgement found at the end of this specification, for each worker who is to be at the job site or enter the work area.
   b. Courses outline or name of institution providing the worker training course.
   c. Report from medical examination conducted within last 12 months as part of compliance with OSHA medical surveillance requirements for each worker who is to enter the work area.
7. Provide disposable full-body coveralls and disposable head covers, and require that they be worn by all workers in the work area. Provide a sufficient number for all required changes, for all workers in the work area.
8. Provide work boots with non-skid soles, and where required by OSHA, foot protectives, for all workers. Provide boots at no cost to workers. Paint uppers of all boots red with water proof enamel. Do not allow boots to be removed from the work area for any reason, after being contaminated with asbestos-containing material. Dispose of boots as asbestos contaminated waste at the end of the work.
9. Provide head protectives (hard hats) as required by OSHA for all workers, and provide four spares for use by Owner's Representative, and Owner. Label hats with same warning labels as used on disposal bags. Require hard hats to be worn at all times that work is in progress that may potentially cause head injury. Provide hard hats with plastic strap type suspension. Require hats

to remain in the work area throughout the work. Thoroughly clean, decontaminate and bag hats before removing them from work area at the end of the work.

10. Provide eye protectives (goggles) as required by OSHA for all workers involved in scraping, spraying, or any other activity which may potentially cause eye injury.
11. Provide work gloves to all workers and require that they be worn at all times in the work area. Do not remove gloves from work area. Dispose of gloves as asbestos contaminated waste at the end of the work.
12. Respirators, disposable coveralls, head covers, and footwear covers shall be provided by the contractor for the Owner, Owner's Representative, and other authorized representatives who may inspect the job site.
13. Provide worker protection as required by the most stringent OSHA and/or EPA standards applicable to the work. The following procedures are minimums to be adhered to regardless of fiber count in the work area.
14. Each time work is entered, remove all street clothes in the changing room of the Personnel Decontamination Unit and put on new disposable coverall, new head cover, and a clean respirator. Proceed through shower room to equipment room and put on work boots.
15. In the event a mini-enclosure is used refer to Paragraph "Work Area Preparation" for personal decontamination procedures.

F. Respiratory Protection

1. Instruct and train each worker involved in asbestos abatement or maintenance and repair of friable asbestos-containing materials in proper respiratory use and require that each worker always wear a respirator, properly fitted on the face in the work area from the start of any operation which may cause airborne asbestos fibers until the work area is completely decontaminated. Use respiratory protection appropriate for the fiber level encountered in the work place or as required for other toxic or oxygen-deficient situations encountered.
2. Except to the extent that more stringent requirements are written directly into the Contract Documents, the following regulations and standards have the same force and effect (and are made a part of the Contract Documents by reference) as if copied directly into the Contract Documents, or as if published copies were bound herewith. Where there is a conflict in requirements set forth in these regulations and standards meet the more stringent requirement.
   a. OSHA - U.S. Department of Labor Occupational Safety and Health Administration, Safety and Health Standards 29 CFR 1910, Section 1001 and Section 1910.134.29 CFR 1926.
   b. ANSI - American National Standard Practices for Respiratory Protection. ANSI Z88.2-1980.
   c. NIOSH - National Institute for Occupational Safety and Health.
   d. MSHA - Mine Safety and Health Administration.

G. Type Of Respiratory Protection Required

1. Provide Respiratory Protection as indicated in paragraph below. Where paragraph below does not apply, determine the proper level of protection by dividing the expected or actual airborne fiber count in the work area by the "protection factors" given below. The level of respiratory protection which supplies an airborne fiber level inside the respirator, at the breathing zone of the wearer, at or below 0.01 fibers/cubic centimeter is the minimum level of protection allowed.
2. Eight-hour Time Weighted Average (TWA) of asbestos fibers to which any worker may be exposed shall not exceed 0.1 fibers/cubic centimeter.
3. For purposes of this section fibers are defined as all fibers regardless of composition as counted in the OSHA Reference Method (ORM), NIOSH P&CAM 239 or 7400 procedure, or asbestos fibers of any size as counted using either a scanning or transmission electron microscope.
4. Require that respiratory protection be used at all times that there is any possibility of disturbance of asbestos-containing materials whether intentional or accidental.
5. Require that a respirator be worn by anyone in a work area at all tunes, regardless of activity, during a period that starts with any operation which could cause airborne fibers until the area has been cleared for re-occupancy.

H. Respiratory Protection Factor

Respirator Type	Protection Factor
Air purifying: Negative pressure respirator High efficiency filter Half facepiece	10
Air purifying: Negative pressure respirator High efficiency filter Full facepiece	50
Powered-air purifying (PAPR): Positive pressure respirator High efficiency filter Half or Full facepiece	100
Type C supplied air: Positive pressure respirator continuous-flow Half or full facepiece	100
Type C supplied air: Positive pressure respirator pressure demand Full facepiece	1000
Type C supplied air: Positive pressure respirator pressure demand Full facepiece Equipped with an auxiliary positive pressure Self-contained breathing apparatus (SCBA)	over 1000
Self-contained breathing apparatus (SCBA): Positive Pressure respirator Pressure demand Full facepiece	over 1000

I. Air Purifying Respirator

1. Provide half face or full face type respirators. Equip full-face respirators with a nose cup or other anti-fogging device as would be appropriate for use in air temperatures less than 32 degrees Fahrenheit.
2. Provide, at a minimum, HEPA type filters labeled with NIOSH and MSHA certification for "Radionuclides, Radon Daughters, Dust, Fumes, Mists including Asbestos-Containing Dusts and Mists" and color coded in accordance with ANSI Z228.2 (1980). In addition, a chemical cartridge section may be added, if required, for solvents, etc., in use. In this case, provide cartridges that have each section of the combination canister labeled with the appropriate color code and NIOSH/MSHA Certification.
3. Supply with a sufficient quantity of respirator filters approved for asbestos, so that workers can change filters during the work day. Require that respirators be wet-rinsed, and filters discarded, each time a worker leaves the work area. Require that new filters be installed each time a worker re-enters the work area. Store respirators and filters at the job site in the changing room and protect totally from exposure to asbestos prior to their use. Do not use single use, disposable or quarterface respirators.

J. Powered Air Purifying Respirator (PAPR)
   1. Provide full-facepiece type respirators. Provide nose-cups for full-facepiece respirators. Provide, at a minimum, HEPA type cartridges approved by NIOSH/MSHA and certified for use in atmospheres containing asbestos dusts.
   2. Provide, at a minimum, one extra battery pack for each respirator so that one can be charging while one is in use.
   3. Provide non-cloth belts capable of being decontaminated in shower.
   4. Supply with a sufficient quantity of high efficiency respirator filters approved for asbestos so that workers can change filters at any time that flow through the face piece decreases to the level at which the manufacturer recommends filter replacement. Require that regardless of flow, filter cartridges be replaced after 40 hours of use. Require that HEPA elements in filter cartridges be protected from wetting during showering. Require entire exterior housing of respirator including blower unit, filter cartridges, hoses, battery pack, face mask, belt, and cords to be washed each time a worker leaves the work area. Caution should be used to avoid shorting battery pack during washing.

K. Required Respiratory Protection
   1. Regardless of airborne fiber levels, require the following minimum level of respiratory protection:
      a. Half-face air purifying respirators may be used during set-up of the containment and removal of the material so long as fiber counts inside the respirator do not exceed .01 f/cc fibers per cubic centimeter.

L. Decontamination Units -Three-Stage
   1. Provide a Personnel Decontamination Unit consisting of a serial arrangement of rooms or spaces, Changing Room, Shower Room, Equipment Room adjacent to each full containment area.
   2. Require all persons without exception to pass through this decontamination unit for entry into and exiting from the work area for any purpose. Do not remove equipment or materials through Personnel Decontamination Unit.
   3. Changing (Clean) Room:
      a. Provide a room that is physically and visually separated from the rest of the building for the purpose of changing into protective clothing.
      b. Locate so that access to work area from changing room is through shower room.
      c. Separate changing room from the building by a double-sheeted polyethylene flapped doorway.
      d. Provide sub-panel at changing room to accommodate all removal equipment. Power sub-panel directly from a building electrical panel. Connect all electrical branch circuits in decontamination unit and particularly any pumps in shower room to a ground-fault circuit protection device.
   4. Shower Room:
      a. Provide a completely water tight operational shower to be used for transit by cleanly dressed workers heading for the work area from the changing room, or for showering by workers headed out of the work area after undressing in the equipment room.
      b. Construct room by providing a shower pan and two shower walls in a configuration that will cause water running down walls to drip into pan. Install a freely draining wood floor in shower pan at elevation of top of pan.
      c. Separate this room from rest of building, drying room and airlock with airtight walls fabricated of 6-mil polyethylene.
      d. Provide splash proof entrances to Drying Room and Airlock.
   5. Equipment Room (contaminated area):
      a. Require work equipment, footwear and additional contaminated work clothing to be left here. This is a change and transit area for workers. Separate this room from the work area by a 6-mil polyethylene flap doorway.
      b. Separate this room from the rest of the building, the shower room and work area with air tight walls fabricated of 6-mil polyethylene.

6. Clean Room: Provide Clean Room to isolate the holding room from the building exterior.
7. Load-out Area:
   a. The load-out area is the transfer area from the building to a truck or dumpster.
   b. Wet wipe bags before they are passed through the equipment decon-chamber.
   c. When cleaning is complete pass items into holding room. Close all doorways except the doorway between the holding room and the Clean Room.
   d. Workers from the area outside the containment area enter holding area and remove decontaminated equipment and/or containers for disposal.
   e. Require these workers to wear full protective clothing and appropriate respiratory protection.
   f. At no time is a worker from an uncontaminated area to enter the enclosure when a removal worker is inside.
   g. Post an approximately 20 inch x 14 inch manufactured caution sign at each entrance to the work area displaying the following legend with letter sizes and styles of a visibility required by OSHA 29 CFR 1926.1101(k)(9)(viii)(J) - Asbestos.

LEGEND
DANGER

ASBESTOS

CANCER AND LUNG DISEASE HAZARD
RESPIRATORS AND PROTECTIVE CLOTHING ARE REQUIRED
IN THIS AREA

   h. Provide spacing between respective lines at least equal to the height of the respective upper line.
   i. Additional Signage: Shall also be posted in accordance with OSHA 29 CFR 1926.1101(k)(9)(viii)(J) - Asbestos

DANGER
ASBESTOS
CANCER AND LUNG DISEASE HAZARD

AUTHORIZED PERSONNEL ONLY
RESPIRATORS AND PROTECTIVE CLOTHING
ARE REQUIRED IN THIS AREA
DANGER
ASBESTOS
CANCER AND LUNG HAZARD
KEEP OUT

   j. Post an approximately 10 inch by 14 inch manufactured sign at each entrance to each work area displaying the following legend with letter sizes and styles of a visibility at least equal to the following:

LEGEND	NOTATION
No Food, Beverages or Tobacco Permitted	3/4 inch Block
All Persons Shall Don Protective Clothing (Coverings) Before Entering the Work Area	3/4 inch Block
All Persons Shall Shower Immediately After Leaving Work Area and Before Entering the Changing Area	3/4 inch Block

M. Decontamination Procedures

1. Contractor shall require all workers and visitors to adhere to the following personal decontamination procedures whenever they leave the work area:

   a. Require that all workers use the following decontamination procedure as a minimum requirement whenever leaving the work area.
   b. When exiting area, remove disposable coveralls, disposable head covers, and disposable footwear covers or boots in the Equipment Room.
   c. Still wearing respirators, proceed to showers. Showering is mandatory. Care must be taken to follow reasonable procedures in removing the respirator to avoid asbestos fibers while showering. The following procedure is required as a minimum:
      1) Thoroughly wet body including hair and face. If using a PAPR, hold blower unit above head to keep canisters dry.
      2) With respirator still in place thoroughly wash body, hair, respirator face piece, and all parts of the respirator except the blower unit and battery pack on a PAPR. Pay particular attention to seal between face and respirator and under straps.
      3) Take a deep breath, hold it and/or exhale slowly, completely wet hair, face, and respirator. While still holding breath, remove respirator and hold it away from face before starting to breathe.
      4) Carefully wash face-piece of respirator inside and out.
   d. If using PAPR, shut down in the following sequence, first cap inlets to filter cartridges, then turn off blower unit (this sequence will help keep debris which has collected on the inlet side of filter from dislodging and contaminating the outside of the unit). Thoroughly wash blower unit and hoses. Carefully wash battery pack with wet rag. Be extremely cautious of getting water in battery pack as this will short out and destroy battery.
      1) Shower completely with soap and water.
      2) Rinse thoroughly.
      3) Rinse shower room walls and floor prior to exit.
      4) Proceed from shower to changing room and change into street clothes or into new disposable work items.
   e. Require that all workers use the following decontamination procedure as a minimum requirement whenever leaving the work area with a half or full face cartridge type respirator:
      1) When exiting area, remove disposable coveralls, disposable headcovers, and disposable footwear covers or boots in the equipment room.
      2) Still wearing respirators, proceed to showers. Showering is mandatory. Care must be taken to follow reasonable procedures in removing the respirator and filters to avoid asbestos fibers while showering. The following procedure is required as a minimum:
      3) Thoroughly wet body from neck down.
      4) Wet hair as thoroughly as possible without wetting the respirator filter if using an air purifying type respirator.
      5) Take a deep breath, hold it and/or exhale slowly, complete wetting of hair, thoroughly wetting face, respirator and filter (air purifying respirator). While still holding breath, remove respirator and hold it away from face before starting to breath.
      6) Dispose of wet filters from air purifying respirator.
      7) Carefully wash facepiece of respirator inside and out.
      8) Shower completely with soap and water.
      9) Rinse thoroughly.
      10) Rinse shower room walls and floor prior to exit.
      11) Proceed from shower to changing room and change into street clothes or into new disposable work items.

N. Project Decontamination

1. If the asbestos abatement work is on damaged or friable materials, then the building space is deemed contaminated before start of the work and in need of decontamination. In this case, the

procedure includes two cleanings of the primary barrier plastic prior to its removal and two cleanings of the room surfaces to remove any new or existing contamination.

2. Work of this section includes the decontamination of air in the work area which has been, or may have been contaminated by the elevated airborne asbestos fiber levels generated during abatement activities, or which may previously have had elevated fiber levels due to friable materials in the space.
3. Work of this section also includes the cleaning, decontamination, and removal of temporary facilities installed prior to abatement work and decontamination of all surfaces (ceiling, walls, floor) of the work area, and all furniture or equipment in the work area.
4. First Cleaning
   a. Carry out a first cleaning of all surfaces of the work area including items of remaining sheeting, tools, scaffolding and/or staging by use of damp-cleaning and mopping, and/or a HEPA filtered vacuum. (Note: A HEPA vacuum will fail if used with wet material). Do not perform dry dusting or dry sweeping. Use each surface of a cleaning cloth one time only and then dispose as contaminated waste. Continue this cleaning until there is no visible debris from removed materials on plastic sheeting or other surfaces. Upon authorization of Owner's Representative proceed with encapsulation of substrate.
   b. Perform encapsulation of substrate where required at this time. Maintain pressure differential system in operation during encapsulation work. Allow encapsulant to dry before proceeding with removal of Secondary layer of plastic.
5. Second Cleaning
   a. Upon authorization of Owner's Representative, remove all Primary Barrier sheeting and Material Decontamination Unit, if there is one, leaving only the following:
      1) Critical Barrier which forms the sole barrier between the work area and other portions of the building or outside.
      2) Critical Barrier Sheeting over lighting fixtures and clocks, ventilation openings, doorways, convectors, speakers and other openings.
      3) Personnel Decontamination Unit.
      4) Pressure Differential System in continuous operation.
   b. Remove all filters in Air Handling System(s) and dispose of as asbestos-containing waste.
6. Final Cleaning: Carry out a final cleaning of all surfaces in the work in the same manner as the first cleaning immediately after removal of primary plastic. This cleaning is now being applied to existing room surfaces. Take care to avoid water marks or other damage to surfaces.
7. Visual Inspection: Perform a complete visual inspection with Owner's Representative of the entire work area including decontamination unit, all plastic sheeting, seals over ventilation openings, doorways, windows, and other openings; look for debris from any sources, residue on surfaces, dust or other matter. If any such debris, residue, dust or other matter is found repeat cleaning and continue decontamination procedure from that point. When the area is visually clean, complete the certification at the end of this section.
8. Final Air Sampling
   a. After the work area is found to be visually clean, air samples will be taken and analyzed in accordance with the procedures set forth in Paragraph “Powered Air Purifying Respirator (PAPR).
   b. If Release Criteria are not met, repeat cleaning and continue decontamination procedure from that point.
   c. If Release Criteria is met, remove the interior of the decontamination unit leaving in place only the Critical Barriers separating the work area from the rest of the building and the operating negative pressure system.
   d. Any small quantities of residual material found upon removal of the plastic sheeting shall be removed with a HEPA filtered vacuum cleaner and local area protection. If significant quantities, as determined by the Owner's Representative, are found then the entire area affected shall be decontaminated as specified herein for the cleaning.

O. Work Area Clearance
   1. Air Monitoring

a. Visual Inspection is required as a prerequisite of air testing.
b. To determine if the elevated airborne asbestos structure concentration during abatement operations have been reduced to the specified level, the Owner's Representative will secure samples and analyze them according to the following procedures.

2. Aggressive Sampling
   a. All air samples will be taken using aggressive sampling techniques as follows. (There are no standards available for flow rate of leaf blowers or large fans. However, this information is not critical to the success of the procedure).
   b. Before sampling pumps are started, the exhaust from forced-air equipment (leaf blower with at least 1 horsepower electric motor) will be swept against all walls, ceilings, floors, ledges and other surfaces in the room. This procedure will be continued for five minutes per 10,000 cubic feet of room volume.
   c. Air samples will be collected in areas subject to normal air circulation away from room corners, obstructed locations, and sites near windows, doors or vents.
3. Schedule of Air Samples
   a. General: The number and volume of air samples taken and analytical methods used by the Owner's Representative will be in accordance with the following schedule. Sample volumes given may vary depending upon the analytical instruments used. In each homogeneous work area after completion of all cleaning work, samples will be taken and analyzed by either PCM of TEM analysis.
   b. Transmission Electron Microscopy (TEM) Samples:
      1) In each homogeneous work area after completion of all cleaning work, samples will be taken and analyzed by either PCM or TEM analysis as follows:
      2) Samples will be collected on 25 mm cassettes with filter media: TEM - 0.45 micrometer mixed cellulose ester or 0.40 micrometer polycarbonate, with 5.0 micron mixed cellulose ester backing filter.

Location **Sampled**	Number of **Samples**	Detection **Limit** (f/cc)	**Minimum** Volume (Liters)	**Rate** LPM
Each Work Area	5	0.005	1,300	2-10

      3) TEM Analysis_will be performed using the analysis method set forth in the AHERA Regulation 40 CFR Part 763 Appendix A.
      4) Asbestos Structures referred to in this Section include asbestos fibers, bundles, clusters, or matrices, as defined by method of analysis.
      5) Decontamination of the work site is complete when all the sample results are below 0.01 fibers per cubic centimeters (f/cc) of air or 70 structures per square millimeter.
   c. Phase Contrast Microscopy (PCM) Samples:
      1) In each homogeneous work area after completion of all cleaning work, samples may be taken and analyzed as follows:
      2) Samples will be analyzed by PCM for clearance in areas where ceiling tile and/or pipe insulation are removed
      3) Samples will be collected on 25 mm cassettes with filter media: PCM - 0.8 micrometer mixed cellulose ester.

Location Sampled	**Number of Samples**	**Detection Limit** (s/cc)	**Minimum Volume** (Liters)	**Rate** LPM
Each Work Area	1-5	0.01	2,400	2-10

      4) PCM Analysis: Fibers on each filter will be measured using the NIOSH 7400 Method entitled "Fibers" published in the NIOSH Manual of Analytical Methods, 3rd Edition, Second Supplement, August 1987.

5) Fibers: Referred to in this section include fibers regardless of composition as counted by the phase contrast microscopy method used
6) Decontamination of the work site is complete when all the sample results are below 0.01 fibers per cubic centimeters (f/cc) of air or 70 structures per square millimeter.

4. Failure of Clearance Sampling: Should results from analysis of final clearance air samples not meet the specified criteria, Contractor will be responsible for the payment of all costs, including Consultant's time for subsequent clearance air sampling. The costs associated with subsequent re-sampling for final clearance shall be deducted from the Contractor's final payment of the contract amount.

P. Removal Of Pipe Insulation
1. The work of this section applied to the removal of asbestos-containing Pipe Insulation.
   a. Place one layer of 6-mil fire retardant polyethylene sheeting directly below the work. The sheet shall be of sufficient size to completely wrap the pipe once it has been removed.
   b. Thoroughly wet the ends of the pipe with amended water and scrape off a minimum of 6 inches of asbestos wrap from both ends of the pipe. Immediately place the wetted material into pre-labeled asbestos disposal bag(s).
   c. Detach the pipe at each scraped end and place the pipe onto one sheet of 6-mil fire retardant polyethylene sheeting. Wrap the pipe with the 6-mil fire retardant polyethylene sheeting. Contractor shall wrap the pipe with a second sheet of 6-mil, fire retardant polyethylene sheeting and label as asbestos-containing material. Dispose of the bag(s) and duct in accordance with the Paragraph "Handling and Disposal of Asbestos Contaminated Waste" of this specification.
   d. Upon clearance from the Owner's Representative, Contractor shall remove the 6-trail, fire retardant polyethylene sheeting from the openings.

Q. Glove Bag Removal
1. The work of this section applies to full containment or glovebag removal.
2. Isolate the area in accordance with Paragraph "Temporary Facilities."
3. Construct a decontamination unit as described in Paragraph "Decontamination Units" and attach to the work area.
4. Set up pressure differential isolation and ventilation of the work area in accordance to Paragraph "Pressure Differential System."
   a. Upon approval of the enclosure by the Owner's Representative, Contractor may proceed to remove the material using the following method.
   b. Thoroughly wet to satisfaction of Owner's Representative, asbestos-containing insulation to be removed prior to stripping and/or tooling to reduce fiber dispersal into the air. Accomplish wetting by a fine spray (mist) of amended water or removal encapsulant. Saturate material sufficiently to wet the substrate without causing excess dripping. Allow time for removal encapsulant to penetrate material thoroughly. If amended water is used, spray material repeatedly during the work process to maintain a continuously wet condition. If a removal encapsulant is used, apply in strict accordance with manufacturer's written instructions. If insulation is covered with canvas, Contractor will wet the exterior covering and slice it with utility knife while saturating the material.
   c. Mist work area continuously with amended water whenever necessary to reduce airborne fiber levels using commercially available "foggers."
   d. Remove saturated asbestos-containing material in small sections from all areas. Do not allow material to dry out. As it is removed, simultaneously pack material while still wet into disposal bags. Twist neck of bags, bend over and seal with minimum three wraps of duct tape. Clean outside and move to wash down station adjacent to material decontamination unit.
   e. Evacuate air from disposal bags with a HEPA filtered vacuum cleaner before sealing.
   f. Contractor must always clean area of visible asbestos debris prior to end of shift.
5. These procedures shall be followed to remove pipe insulation elbows:
   a. Install critical barriers to isolate the work site. Install 2 or 3 Stage Decontamination Units.

b. HEPA vacuum the work site.
c. Provide negative air machine in addition to those required, in the vicinity of the work. Arrange so that exhaust is into the work area, oriented in a direction away from the work. Extend a 2-inch diameter flexible non-collapsing duct from the intake end to a point no more than 4'-0" from any scraping or brushing activity.
d. Locate intake of duct so that airflow is horizontally and slightly downward into intake. Replace primary filter on negative air machine at an interval of no greater than 30 minutes. Allow no more than one scraping or brushing activity per negative air machine.
e. Check pipe where the work will be performed. Wrap damaged (broken lagging, hanging, etc.), pipe in 6 mil plastic and "candy-stripe" with duct tape. Place one layer of duct tape around undamaged pipe at each end where the glovebag will be attached.
f. Place necessary tools into pouch located inside glovebag. This will usually include: bone saw, utility knife, rags, scrub brush, wire cutters, tin snips and pre-wetted cloth.
g. Place one strip of plastic adhesion tape along the edge of the open top slit of glove bag for reinforcement.
h. Place the glove bag around section of pipe to be worked on and staple top together through reinforcing tape. Next, tape the ends of glovebag to pipe itself, where previously covered with plastic or tape.
i. Use smoke tube and aspirator bulb to test seal. Place tube into water sleeve (two-inch opening to glovebag) squeezing bulb and filling bag with visible smoke. Remove smoke tube and twist water sleeve closed. While holding the water sleeve tightly, gently squeeze glovebag and by using a flashlight, look for smoke leaking out, (especially at the top and ends of the glovebag). If leaks are found, tape closed using plastic adhesion tape and re-test.
j. Insert wand from garden sprayer through water sleeve. Plastic adhesion tape water sleeve tightly around the wand to prevent leakage.
k. One person places his hands into the long-sleeved gloves while the second person directs garden sprayer at the work.
l. Use bone saw, if required, to cut insulation at each end of the section to be removed. A bone saw is a serrated heavy gauge wire with ring-type handles at each end. Throughout this process, spray amended water or removal encapsulant on the cutting area to keep dust to a minimum.
m. Remove insulation using putty knives or other tools. Place pieces in bottom of bag without dropping.
n. Rinse all tools with water inside the bag and place back into pouch.
o. Using scrub brush, rags and water, scrub and wipe down the exposed pipe. (Inexpensive horse rub-down mittens work well for this).
p. Remove water wand from water sleeve and attach the small nozzle from HEPA-filtered vacuum. Turn on the vacuum only briefly to collapse the bag.
q. Remove the vacuum nozzle, twist water sleeve closed and seal with plastic adhesion tape.

R. Handling And Disposal Of Asbestos-Containing Waste
1. All waste and asbestos contaminated waste shall be double bagged in pre-labeled 6-mil airtight puncture resistant bags. Labeling shall be in accordance with OSHA and EPA requirements.
   a. Bags of asbestos-containing waste shall be sealed with tape in the work area. Asbestos waste shall not be allowed to dry out prior to sealing bags. While in the work area, bags shall be decontaminated of any bulk debris by wet wiping. Bags shall be pre-labeled in accordance with OSHA and EPA.
   b. The Contractor shall ensure that the sealed bags are transported to the waste disposal site.
2. The Contractor shall establish a manifest system to enable the Owner to report the quantity of asbestos waste being deposited at the landfill. Contractor shall report the quantity of waste in pounds or tons as appropriate. The Contractor must be able to demonstrate custody over all asbestos waste from the time it is removed from the work area until it is deposited at the land fill.

a. Copies of the manifest and any receipts generated during the handling and disposal process shall be provided to Owner's Representative and the Owner.
b. Final manifest and documents must be provided to Owner's Representative and the Owner within two weeks of the removal of the asbestos materials from the site by the waste hauler.

S. Encapsulation Of Asbestos-Containing Materials
1. General provisions of Contract, including General and Supplementary Conditions and Division 01, apply to work of this section.
   a. The work includes the sealing of all piping or vessels from which asbestos-containing insulation has been removed with one coat of a lock down encapsulant.
   b. Where repair work is being performed, the end will be sealed with a minimum of one coat of bridging encapsulant.
2. Submittals
   a. Product Data: Submit manufacturer's technical information including label analysis and application instructions for each material proposed for use.
   b. Installation Instructions: Submit manufacturer's installation instructions with specific project requirements noted.
   c. Performance Warrantee: Submit manufacturer's performance guarantee.
   d. Certification: Submit written approval of entity installing the encapsulant from encapsulant manufacturer.
   e. Material Safety Data Sheet: Submit the Material Safety Data Sheet, or equivalent, in accordance with the OSHA Hazard Communication Standard (29 CFR 1910.1200) for each surfactant and encapsulating material proposed for use on the work. Include a separate attachment for each sheet indicating the specific worker protective equipment proposed for use with the material indicated.
3. Deliver materials to the job site in original, new and unopened packages and containers bearing manufacturer's name and label, and following information:
   a. Name or title of material
   b. Manufacturer's stock number and date of manufacture
   c. Manufacturer's name
   d. Thinning Instructions
   e. Application Instructions
4. Deliver materials together with a copy of the OSHA Material Safety Data Sheet for the material.
5. Job Conditions
   a. Apply encapsulating materials only when environmental conditions in the work area are as required by the manufacturer's instructions.
6. Quality Assurance
   a. Installation of Spray-on Encapsulation Materials: Install spray-on materials by a firm and personnel approved by the manufacturer of the primary materials.
   b. Testing: Test material to be encapsulated using methods set forth in ASTM E1494 "Standard Practice for Encapsulants Spray-or-Trowel-Applied for Friable Asbestos-Containing Building Materials."
   c. Performance Warranty: Submit written Performance Warranty, executed by the manufacturer and co-signed by the Contractor, agreeing to repair/replace spray-on work which has cracked, fallen from substrate, or otherwise deteriorated to a condition where it would not perform effectively for its intended purposes due substantially to defective materials or workmanship and not due to abuse by occupants, improper maintenance, non-foreseeable ambient exposures or other causes beyond anticipated conditions and manufacturer's/contractor's control.
   d. Compatibility: Selection and use of encapsulant shall be compatible with replacement materials. Submit manufacturer's data indicating compatibility with replacement materials.
7. Product Selection
   a. Encapsulants: Provide penetrating or bridging type encapsulants specifically designed for application to asbestos-containing material.

b. Standards: Product shall be rated as acceptable for use intended when field tested in accordance with ASTM E1494 "Standard Practice for Encapsulants Spray-or-Trowel-Applied for Friable Asbestos-Containing Building Materials."

c. Fire Safety: Use only materials that have a flame spread index of less than 25, when dry, when tested in accordance with ASTM E84.

8. Manufacturers

a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products, which may be incorporated in the work, include, but are not limited to the following:

1) Penetrating Encapsulants: As currently accepted by the EPA. Refer to most recent EPA approval list.

2) Bridging Encapsulants: As currently accepted by the EPA. Refer to most recent EPA approval list.

9. General

a. Prior to applying any encapsulating material, ensure that application of the sealer will not cause the base material to fail and allow the sealed material to fall of its own weight or separate from the substrate. Should Contractor doubt the ability of the installation to support the sealant, request direction from the Owner's Representative before proceeding with the encapsulating work.

b. Do Not Commence Application of encapsulating materials until all removal work within the work area has been completed.

10. Worker Protection

a. Before beginning work with any material for which a Material Safety Data Sheet has been submitted, provide workers with the required protective equipment. Require that appropriate protective equipment be used at all times.

b. In addition to protective breathing equipment required by OSHA requirements or by this specification, use painting pre-filters on respirators to protect the dust filters when organic solvent based encapsulants are used.

11. Substrate

a. Apply lock down encapsulant to all substrate after all asbestos-containing materials have been removed. Apply in strict accordance with the manufacturer's printed instructions for use of the encapsulation as an asbestos coating. Any deviations from such printed instructions shall be approved by the Owner's Representative in writing prior to commencing work.

b. Apply encapsulant with an airless spray gun with air pressure and nozzle orifice as recommended by the encapsulant manufacturer.

T. Removal Of Floor Tile

1. This section applies to the removal of floor tile.

a. Prior to start of work, wet wipe all surfaces including floor tile to remove any visible dust.

b. Isolate the room by sealing hallway or doors and installing critical barriers on all ducting, windows and other penetrations of the room, in the specified area. Install a splash guard a minimum of 4 feet high on the walls of the room with one layer of 6-mil fire retardant poly.

c. Install a two-stage decontamination configuration contiguous (under certain conditions may be remote) with the work in accordance with Paragraph “Decontamination Units.”

d. Using water or amended water in a Hudson-type sprayer or garden sprayer, lightly mist the area where the material is to be removed. This may take several passes with the hose of the sprayer. Allow time for the water to soak into the material.

e. Immediately place individual tiles in proper asbestos disposal bags. Vacuum collapse the bag, twist the neck of the bag, tape with duct tape, fold the twisted portion over onto itself and tape again. Wipe the outside of the bag with clean damp cloths and place the bag into a second prelabeled disposal bag. Tape shut the second bag.

U. Removal Of Fireproofing

1. The work of this section applies to the removal of all asbestos containing fireproofing including all over-spray that may be located on concrete block, columns, metal deck, beams, fixtures conduit and ducting.
   a. Isolate the floor per Paragraph “Temporary Enclosure.”
   b. Construct a decontamination unit as described in Paragraph “Decontamination Units” and attach to the work area.
   c. Set up pressure differential isolation and ventilation of the work area in accordance to Paragraph “Temporary Pressure Differential and Air Circulation System.”
   d. Upon approval of the enclosure by the Owner's Representative, contractor may proceed to remove the material using the following method.
   e. Pre-clean columns, beams, electrical, mechanical and plumbing systems in the work area using wet wipe and HEPA vacuuming methods. Mask off with flame retardant polyethylene sheeting to protect from contamination during bulk abatement.
   f. Thoroughly wet to satisfaction of Owner's Representative, asbestos-containing fireproofing to be removed prior to stripping and/or tooling to reduce fiber dispersal into the air. Accomplish wetting by a fine spray (mist) of amended water or removal encapsulant. Saturate material sufficiently to wet the substrate without causing excess dripping. Allow time for removal encapsulant to penetrate material thoroughly. If amended water is used, spray material repeatedly during the work process to maintain a continuously wet condition. If a removal encapsulant is used, apply in strict accordance with manufacturer's written instructions.
   g. Mist work area continuously with amended water whenever necessary to reduce airborne fiber levels using commercially available "foggers."
   h. Remove saturated asbestos-containing material in small sections from all areas. Do not allow material to dry out. As it is removed, simultaneously pack material while still wet into disposal bags. Twist neck of bags, bend over and seal with minimum three wraps of duct tape. Clean outside and move to wash down station adjacent to material decontamination unit.
   i. Evacuate air from disposal bags with a HEPA filtered vacuum cleaner before sealing.
   j. Provide Pressure Differential Machine in addition to those required in Paragraph “Pressure Differential System,” in the vicinity of the work. Arrange so that exhaust is into the work area, oriented in a direction away from the work. Extend a 12" diameter flexible non-collapsing duct from the intake end to a point no more than 4'-0" from any scraping or brushing activity.
   k. Locate intake of duct so that air flow is horizontally and slightly down-ward into intake. Replace primary filter on pressure differential machine at an interval of no greater that 30 minutes. Allow no more than one scraping or brushing activity per pressure differential machine.

V. Removal Of Wall Plaster: HEPA vacuum work site.
   1. Place two layers of 6-mil flame retardant polyethylene sheeting on the floor adjacent to the wall to be demolished. Pull the wall down in manageable sections onto the polyethylene sheeting. Control dust and fiber release by misting the air and lightly wetting the material with amended water from a Hudson-type sprayer or garden sprayer as it is demolished.
   2. Wrap the first layer of polyethylene sheeting around the material and seal with duct tape. Wrap the second layer of polyethylene sheeting around the bundle and seal with duct tape.
   3. Label and dispose of the entire bundle.
   4. Provide Pressure Differential Machine in addition to those required in Paragraph “Pressure Differential System,” in the vicinity of the work. Arrange so that exhaust is unto the work area, oriented in a direction away from the work. Extend a 12-inch diameter flexible non-collapsing duct from the intake end to a point no more than 4'-0" from any scraping or brushing activity.
   5. Locate intake of duct so that air flow is horizontally and slightly down-ward into intake. Replace primary filter on negative air machine at an interval of no greater that 30 minutes.

W. Clean-Up Of Asbestos-Containing Debris On Ceiling Tile Or Solid Ceiling

1. This section applies to the decontamination of the entire plaster ceiling, removal of existing fiberglass on duct work and removal of all batt insulation covering the existing plaster ceiling.
   a. Isolate the floor per Paragraph "Temporary Facilities."
   b. Construct a decontamination unit as described in Paragraph "Decontamination Units" and attach to the work area. General Contractor will give direction regarding exact location of decontamination unit(s).
   c. Set up pressure differential isolation and ventilation of the work area in accordance to Paragraph "Temporary Pressure Differential and Air Circulation System."
   d. Upon approval of the enclosure by the Owner's Representative, contractor may proceed to remove the material using the following method:
2. These procedures shall be followed to for clean up of asbestos-containing debris on existing plaster ceiling:
   a. This work will be performed prior to the removal of fireproofing. The isolation of the work area is considered essential to the pre-cleaning activities for the total area. Isolate the area in accordance with Paragraph “Temporary Facilities.”
   b. Remove asbestos-containing debris and fiberglass batt and duct insulation and decontaminate the area using the following procedures:
      1) Remove all small debris with the HEPA vacuum.
      2) Gently mist all fiberglass insulation, remove from ducts and ceiling and place into pre-labeled hazardous disposal bags and dispose of in accordance with Paragraph “Disposal of Asbestos Containing Waste Material.”
      3) Exposure of ducting will expose all fireproofing overspray, this material may be removed during the removal of fireproofing from decks and beams.
      4) Pick up all large visible debris on the ceiling or any horizontal surfaces and place in the bottom of a 6-mil polyethylene disposal bag conforming to the requirements of Paragraph “Disposal of Asbestos-Containing Waste.” Place pieces in the bag without dropping and avoiding unnecessary disturbance and release of material.
      5) HEPA vacuum the entire plaster ceiling surface.
   c. Upon completion of the decontamination of the area request a visual inspection of the ceiling and other horizontal surfaces. This area will be considered a portion of work area for the duration of the work and will be included in the final encapsulation of the area.

X. Removal Of Adhesive: This section applies to the removal of all asbestos-containing floor tile and adhesive, sheet vinyl flooring, vinyl floor tile, and baseboard adhesive, etc.
1. Ensure that workers are equipped with proper respiratory protection. In addition to the HEPA cartridges, respirators must also be equipped with organic solvent cartridges.
2. Provide HEPA filtered fan units in the vicinity of the work. Arrange so that units exhaust outside the building. Replace primary filters on HEPA filtered fan units at an interval of no greater than 30 minutes.
3. Apply adhesive removal solvent as recommended by manufacturer after removal of floor tile has been completed.
4. Provide tile adhesive (mastic) remover that meets the following criteria:
   a. Flash Point: 122E or greater.
   b. Special Precautions: No heavy smoke generated if ignited.
   c. Health Effects: Limited to mild skin rash or eye irritation.
   d. Respiratory Protection: MSHA - NIOSH approved Organic vapor cartridges in conjunction with standard HEPA filters.
   e. Petroleum Distillates: None.
   f. Odor: Pine, Citrus or none.

Use of diesel fuel in the removal of tile and baseboard adhesive is strictly prohibited.

5. Remove adhesive in small sections from all areas. Do not allow material to dry out. As adhesive is removed, simultaneously pack rags contaminated with adhesive material into disposal bags. Twist

neck of bags, bend over and seal with minimum three wraps of duct tape. Clean outside of bag and move to material decontamination unit.

6. Upon completion of adhesive removal, thoroughly clean bare substrate of all solvent residue.
7. Place adhesive residue in proper asbestos disposal bags. Vacuum collapse the bag, twist the neck of the bag, tape with duct tape, fold the twisted portion over onto itself and tape again. Wipe the outside of the bag with clean damp cloths and place bag into second prelabeled disposal bag. Tape shut the second bag.

CERTIFICATE OF WORKER'S ACKNOWLEDGEMENT

PROJECT NAME: _____

PROJECT ADDRESS: _____

CONTRACTOR: _____

WORKING WITH ASBESTOS CAN BE DANGEROUS. INHALING ASBESTOS FIBERS HAS BEEN LINKED WITH VARIOUS TYPES OF CANCER IF YOU SMOKE AND INHALE ASBESTOS FIBERS, THE CHANCE THAT YOU WILL DEVELOP LUNG CANCER IS GREATER THAN THAT OF THE NON-SMOKING PUBLIC.

Your employer's contract with the Owner for the above project requires that: You be supplied with the proper respirator and be trained in its use. You be trained in safe work practices and in the use of the equipment found on the job. You receive a medical examination. These things are to have been done at no cost to you. By signing this certification you are assuring the Owner that your employer has met these obligations to you.

RESPIRATORY PROTECTION: I have been trained in the proper use of respirators, and informed ofthe type respirator to be used on the above referenced project. I have a copy of the written respiratory protection manual issued by my employers. I have been equipped at no cost with the respirator to be used on the above project.

TRAINING COURSE: I have been trained in the dangers inherent in handling asbestos and breathing asbestos dust and in proper work procedures and personal and area protective measures. The topics covered in the course included the following:

Physical characteristics of asbestos
Health hazards associated with asbestos
Respiratory protection
Use of protective equipment
Pressure differential systems
Work practices including hands-on or on-the-job training
Personal decontamination procedures
Air monitoring, personal and area

MEDICAL EXAMINATION: I have had a medical examination within the last 12 months which was paid for by my employer. This examination included: health history, pulmonary function tests and may have included an evaluation of a chest x-ray.

Signature _____ Witness _____

Printed Name _____ Social Security Number _____

CERTIFICATION OF VISUAL INSPECTION

AREA _____

In accordance with Paragraph "Project Decontamination" the Contractor hereby certifies that he has visually inspected the work area (all surfaces including pipes, beams, ledges, walls, ceiling and floor, Decontamination Unit, sheet plastic, etc.) and has found no dust, debris or residue.

By: _____

Signature _____ Date _____

Print Name _____

Print Title _____

OWNER'S REPRESENTATIVE CERTIFICATION

The Owner's Representative hereby certifies that he has accompanied the Contractor on his visual inspection and verifies that this inspection has been thorough and to the best of his knowledge and belief, the Contractor's certification above is a true and honest one.

Signature _____ Date _____

Print Name _____

Print Title _____

RESPIRATORY PROTECTION PROGRAM

Project Name _____

Location _____

Date _____

Based upon airborne asbestos-fiber counts encountered on previous projects of similar type working on materials similar to those found on the above referenced project. The following level of respiratory protection is proposed for the indicated operations to maintain an Airborne Fiber Count (as measured by the NIOSH 7400 Method) below the specified Permissible Exposure Limit (PEL) inside the respirator face piece.

Operation	Anticipated f/cc	Respiratory Protection	Protection Factor	f/cc in Mask
Installing sheet plastic				
Removing trim in contact with asbestos-containing material				
Removal of architectural finish or fireproofing				
Removal of pipe insulation				
Removal of fitting insulation				
Encapsulation of pipe and boiler insulation				
Gross debris removal				
Cleaning "primary" sheet plastic				
Cleaning "critical" barrier				
Removing Decontamination Unit				
Other				

The Contractor certifies that to the best of his knowledge and belief the above represent a true and accurate representation of Airborne Fiber Counts to be expected for the operations indicated, and are based upon airborne fiber data from past projects with similar materials and operations.

Contractor _____

Signature _____ Date _____

Print Name _____ Title _____

END OF SECTION 13281

SECTION 13281a - REMOVAL OF NONFRIABLE ASBESTOS-CONTAINING MATERIALS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for removal of nonfriable asbestos-containing materials. Products shall be as follows or as directed by the the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Definitions

1. ACM: Asbestos Containing material which is any material containing more than one percent asbestos.
2. Amended Water: Water containing a wetting agent or surfactant with a maximum surface tension of 2.9 Pa 29 dynes per centimeter when tested in accordance with ASTM D 1331.
3. Area Sampling: Sampling of asbestos fiber concentrations which approximates the concentrations of asbestos in the theoretical breathing zone but is not actually collected in the breathing zone of an employee.
4. Asbestos: The term asbestos collectively refers to a naturally occurring mineral known by the following specific names: chrysotile, amosite, crocidolite, tremolite, anthophyllite, and actinolite.
5. Asbestos control Area: That area where asbestos removal operations are performed. The area shall be isolated by physical boundaries to assist in the prevention of the uncontrolled access by non-qualified persons.
6. Asbestos Fibers: Those fibers having an aspect ratio of at least 3:1 and longer than-5 micrometers as determined by National Institute for Occupational Safety and Health (NIOSH) Method 7400.
7. Asbestos Permissible Exposure Limit: 0.1 fibers per cubic centimeter of air as an e-hour time weighted average measured in the breathing zone as by defined 29 CFR 1926.1101 or other Federal legislation having legal jurisdiction for the protection of workers health.
8. Background: The ambient airborne asbestos concentration in an uncontaminated area as measured prior to any asbestos hazard abatement efforts. Background concentrations for contaminated areas are measured in similar but asbestos free locations.
9. Contractor: The Contractor is that individual, or entity under contract to the Owner to perform the herein listed work.
10. Contractor/Supervisor (Asbestos abatement): A person who has successfully completed training and is therefore accredited as a Contractor/Supervisor under a State Model Accreditation Plan or EPA Model Accreditation Plan as described in 40 CFR 763.
11. Critical Barrier: The layer of polyethylene sheeting that covers an opening or penetration in a room or area that is to become a negative pressure enclosure.
12. Encapsulation: The abatement of an asbestos hazard through the appropriate use of chemical encapsulants.
13. Encapsulants: Specific materials in various forms used to chemically or physically entrap asbestos fibers in various configurations to prevent these fibers from becoming airborne. There are four types of encapsulants as follows which must comply with performance requirements as specified herein.
    a. Removal Encapsulant (can be used as a wetting agent)
    b. Bridging Encapsulant (used to provide a tough, durable surface coating to asbestos containing material)
    c. Penetrating Encapsulant (used to penetrate the asbestos containing material encapsulating all asbestos fibers and preventing fiber release due to routine mechanical damage)
    d. Lock-Down Encapsulant (used to seal off or "lock-down" minute asbestos fibers left on surfaces from which asbestos containing material has been removed).
14. Friable Asbestos Material: Any material containing more than one percent asbestos that can be crumbled, pulverized, or reduced to powder by hand pressure when dry.

15. Glovebag Technique: Those asbestos removal and control techniques put forth in 29 CFR 1926.1101.
16. HEPA Filter Equipment: High efficiency particulate air (HEPA) filtered vacuum and/or exhaust ventilation equipment with a filter system capable of collecting and retaining asbestos fibers. Filters shall retain 99.97 percent of particles 0.3 microns or larger as indicated in UL 586.
17. the Owner: That qualified person employed directly by the Owner to monitor, sample, inspect the work, and advise the Owner.
18. Negative Pressure Enclosure (NPE): That engineering control technique described as a negative pressure enclosure in 29 CFR 1926.1101.
19. Non-friable Asbestos Material: Material that contains asbestos in which the fibers have been immobilized by a bonding agent, coating, binder, or other material so that the asbestos is well bound and will not normally release asbestos fibers during any appropriate use, handling, storage or transportation. It is understood that asbestos fibers may be released under other conditions such as demolition, renovation, removal, or mishap.
20. Personal Sampling: Air sampling which is performed to determine asbestos fiber concentrations within the breathing zone of a specific employee, as performed in accordance with 29 CFR 1926.1101.
21. Competent Person (CP): A person who has successfully completed training and is therefore accredited under a legitimate State Model Accreditation Plan or EPA Model Accreditation Plan as described in 40 CFR 763 as a Contractor/Supervisor and shall be appropriately licensed according to the Statutes of the State in which the work is to be performed.
22. TEM: Refers to Transmission Electron Microscopy.
23. Time Weighted Average (TWA): The TWA is an 8-hour time weighted average airborne concentration of asbestos fibers.
24. Wetting Agent: A chemical added to water to reduce the water's surface tension thereby increasing the water's ability to soak into the material to which it is applied. An equivalent wetting agent must have a surface tension of at most 2.9 Pa 29 dynes per centimeter when tested in accordance with ASTM D 1331.

C. Requirements

1. Description of Work: The work covered by this section includes the handling and control of asbestos containing materials and describes some of the resultant procedures and equipment required to protect workers, the environment and occupants of the building or area, or both, from contact with airborne asbestos fibers. The work also includes the disposal of any asbestos containing materials generated by the work. More specific operational procedures shall be outlined in the Asbestos Hazard Abatement Plan called for elsewhere in this specification. The asbestos work includes the use of non-friable removal technique(s) which is governed by 40 CFR 763 as indicated. Provide non-friable removal technique(s) as outlined in this specification for the locations indicated.
2. Medical Requirements: Provide medical requirements including but not limited to medical surveillance and medical record keeping as listed in 29 CFR 1926.1101.
   a. Medical Examinations: Before exposure to airborne asbestos fibers, provide workers with a comprehensive medical examination as required by 29 CFR 1926.1101 or other pertinent State or local directives. This requirement must have been satisfied within the 12 months prior to the start of work on this contract. The same medical examination shall be given on an annual basis to employees engaged in an occupation involving asbestos and within 30 calendar days before or after the termination of employment in such occupation. Specifically identify x-ray films of asbestos workers to the consulting radiologist and mark medical record jackets with the word "ASBESTOS."
   b. Medical Records: Maintain complete and accurate records of employees' medical examinations, medical records, and exposure data for a period of 30 years after termination of employment and make records of the required medical examinations and exposure data available for inspection and copying to: The Assistant Secretary of Labor for Occupational

Safety and Health (OSHA), or authorized representatives of them, and an employee's physician upon the request of the employee or former employee.

c. Medical Certification: Submit written certification for each worker and contractor/supervisor, signed by a licensed physician indicating that the worker and contractor/supervisor has met or exceeded all of the medical prerequisites listed herein and in 29 CFR 1926.1101 and 29 CFR 1910.134 as prescribed by law.

3. Training: Train all personnel involved in the asbestos control work in accordance with United States Environmental Protection Agency (USEPA) Asbestos Hazard Emergency Response Act (AHERA) training criteria or State training criteria whichever is more stringent. The Contractor shall document the training by providing a copy of a current training certification to the the Owner for each person assigned to work on this project. Furnish each employee with respirator training and fit testing documentation as required by 29 CFR 1910.134. Provide instruction on the engineering and other hazard control techniques and procedures to be used on this project.

   a. Employee Training: Submit copies of training certificates for each employee indicating that the employee has received training at the appropriate level in accordance with 40 CFR 763.

4. Permits, Licenses, and Notifications: Notify the local air pollution control district/agency and the the Owner in writing 10 working days prior to commencement of work in accordance with 40 CFR 61-SUBPART M or applicable state and local regulations. Obtain necessary permits or licenses in conjunction with asbestos removal, encapsulation, hauling, and disposal. Post the permit and/or license at the work site, visible from a non-controlled area. Notify the local fire department 3 days prior to removing fire-proofing material from the building including notice that the material contains asbestos.

5. Environment, Safety and Health Compliance: Comply with the applicable requirements of the current issue of 29 CFR 1926.1101, 40 CFR 61-SUBPART A, and 40 CFR 61-SUBPART M or applicable State or local regulations regarding handling, storing, transporting, and disposing of asbestos waste materials. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting the work. Where the requirements of this specification, applicable regulations, or referenced documents vary, the most stringent requirement shall apply.

   a. Site Inspection: While performing asbestos engineering control work, the Contractor shall be subject to on-site inspection by the Federal, State, or local regulatory agencies and the Contracting Officer or his designated representative. If the work is found to be in violation of Federal, State, or local regulations or this specification, the Contracting Officer or his representative will issue a stop work order to be in effect immediately and until the violation is resolved. All related costs including standby time required to resolve the. violation shall be at the Contractor's expense.

6. Respiratory Protection Program: Establish and implement a respirator program as required by ANSI 288.2 and 29 CFR 1910.134. Submit a written program manual or operating procedure including methods of compliance with regulatory statutes.

   a. Respirator Program Records: Submit records of the respirator program as required by ANSI 288.2 and 29 CFR 1910.134.

7. Contractor/Supervisor (Asbestos Abatement): The Contractor shall be represented on-site by a trained contractor/Supervisor. This person shall be on-site at all times when asbestos work is in progress. The Qualified Person, as defined herein, can be the Contractor/Supervisor.

8. Hazard Communication: Adhere to all parts of 29 CFR 1910.1200 and 29 CFR 1926.59. Provide the Contracting Officer with a copy of the Material Safety Data Sheets (MSDS) for all materials brought to the site. Review the Asbestos Survey Report(s) provided by the the Owner, if any.

9. Asbestos Hazard Abatement Plan: Submit a detailed plan of the safety precautions such as lockout, tag-out, tryout, fall protection, and confined space entry procedures and equipment and work procedures to be used in the removal of materials containing asbestos. The plan shall be prepared by the Contractor (and reviewed and signed by an asbestos consultant (LAC) licensed according to the Statutes of the State in which the work is to be performed) for review and recommendation for approval by the the Owner. The plan shall be forwarded to the the Owner for final approval at least 10 days prior to beginning abatement activities. The plan shall include but not be limited to the detailed description of personal protective equipment and work practices to

be used including, but not limited to, respiratory protection, type of whole-body protection , the location of asbestos control areas including clean and dirty areas, buffer zones, showers, storage areas, change rooms, removal method, interface of trades involved in the construction, sequencing of asbestos related work, disposal plan, type of wetting agent and asbestos encapsulant to be used, locations of local exhaust equipment, planned air sampling strategies, and a detailed description of the method to be employed in order to control environmental pollution. The plan shall also include both fire and medical emergency response plans. The Asbestos Hazard Abatement Plan must be approved in writing prior to starting any asbestos work.

10. Testing Laboratory: Submit the name, address, and telephone number of each testing laboratory selected for the sampling, analysis, and reporting of airborne concentrations of asbestos fibers along with evidence that each laboratory selected holds the appropriate State license and/or permits and certification that each laboratory is American Industrial Hygiene Association (AIHA) accredited and that persons counting the samples have been judged proficient by current inclusion on the AIHA Asbestos Analysis Registry (AAR) and successful participation of the laboratory in the Proficiency Analytical Testing (PAT) Program. Where analysis to determine asbestos content in bulk materials or transmission electron microscopy is required, submit evidence that the laboratory is accredited by the National Institute of Science and Technology (NIST) under National Voluntary Laboratory Accreditation Program (NVLAP) for asbestos analysis.
11. Landfill Approval: Submit written evidence that the landfill for disposal is approved for asbestos disposal by the USEPA and State and local regulatory agency(s).
12. Waste Shipment Records/Asbestos Waste Manifest: Submit waste shipment records and/or asbestos manifest records, prepared in accordance with applicable Federal, State, or local regulations, signed and dated by an agent of the landfill, certifying the amount of asbestos materials delivered to the landfill, within 3 days after delivery.
13. Negative Exposure Assessment: Submit objective data demonstrating that the method(s) used for the specified non-friable ACM removal does not release airborne concentrations of asbestos fibers exceeding the TWA PEL or excursion limit. This data may be from previous work within the last 12 months or from initial exposure assessments on this project. Data from previous work must have been gathered by the firm employed on this contract, using workers trained to the same level, with the ACM and workplace conditions "closely resembling" the conditions for this contract.
14. Contractor Daily Reports: Prepare a written report for each day that asbestos work is being accomplished. The report should be submitted to the the Owner monthly. The report as a minimum shall include the following, where applicable:
    a. Daily Visual Inspection Reports: Prepare a written report documenting compliance with the Asbestos Hazard Abatement Plan and Federal, State, or local regulations.
    b. Air Sampling Reports: Complete fiber counting within 24 hours of the "time off" of the sample pump. Notify the the Owner immediately of any airborne levels of asbestos fibers in excess of the acceptable limits. Sampling results shall be submitted to the the Owner the day following receipt. The affected employees will be provided copies of the results where required by law within 3 working days. These results shall be signed by the air sampler and the testing laboratory employee that analyzed the sample.
    c. Pressure Differential Recordings for Local Exhaust System-Not Used
    d. Asbestos Disposal Quantity Report: The Contractor shall record and report daily the amount of asbestos containing material removed and the amount transported for disposal. Deliver the report for the previous day and cumulative totals with amounts of material removed reported in linear meters or square meters linear feet or square feet as described initially in this specification and the amounts of material transported for disposal reported in cubic meters yards.

D. Submittals
1. Submit the following in accordance with Section "Submittal Procedures."
    a. Vacuums and tools

b. Respirators
c. Wetting Agent
d. Material Safety Data Sheets (MSDS) for all materials proposed for transport to the project site
e. Local exhaust system
f. Pressure differential automatic recording instrument
g. Daily Reports
h. Asbestos hazard abatement plan
i. Testing laboratory
j. Training Certificates
k. Landfill approval
l. Employee training
m. Medical certification requirements
n. Waste shipment records/Asbestos waste manifest
o. Respiratory Protection Program
p. Negative Exposure Assessment
q. Local Exhaust system
r. Show compliance with ANSI Z9.2 by providing manufacturers' certifications.
s. Permits, licenses, and Notifications
t. Rental equipment
u. Respirator program records
v. Protective clothing decontamination quality control records
w. Protective clothing decontamination facility notification.

E. Quality Assurance
1. Glovebags-Not Used
2. Rental Equipment: Provide a copy of the written notification to the rental company concerning the intended use of the equipment and the possibility of asbestos contamination of the equipment.
3. Protective Clothing Decontamination Quality Control Records: Provide all records that document quality control for the decontamination of reusable outer protective clothing.
4. Protective Clothing Decontamination Facility Notification: Submit written evidence that persons who decontaminate, store, or transport asbestos contaminated clothing used in the performance of this contract were duly notified in accordance with 29 CFR 1926.1101.

1.2 PRODUCTS

A. Encapsulants
1. See Division 02 Section "Facility Fire-suppression Water-service Piping".

1.3 EXECUTION

A. Equipment
1. Respirators: Select respirators from those approved by the National Institute for Occupational Safety and Health (NIOSH). Provide personnel engaged in pre-cleaning, cleanup, handling, and removal of asbestos containing materials with the appropriate respiratory protection as specified in 29 CFR 1910.134.
2. Exterior Whole Body Protection
a. Outer Protective Clothing: Provide personnel exposed to asbestos with disposable "non-breathable," or reusable "non-breathable" whole body outer protective clothing, head coverings, gloves, and foot coverings. Provide disposable plastic or rubber gloves to protect hands. Cloth gloves may be worn inside the plastic or rubber gloves for comfort, but shall not be used alone. Make sleeves secure at the wrists, make foot coverings secure at the ankles, and make clothing secure at the neck by the use of tape. Reusable whole body

outer protective clothing shall be either disposed of as asbestos contaminated waste upon exiting from the asbestos regulated work area or be properly decontaminated.

b. Work Clothing-Not Used

c. Decontamination of Reusable Outer Protective Clothing: When reusable outer protective clothing is used, transport the double bagged clothing to a previously notified commercial/industrial decontamination facility for decontamination. Perform non-destructive testing to determine the effectiveness of asbestos decontamination. If representative sampling is used, ensure the statistical validity of the sampling results. If representative sampling is used, reject any entire batch in which any of the pieces exceed 40 fibers per square millimeter. Inspect reusable protective clothing prior to use to ensure that it will provide adequate protection and is not or is not about to become ripped, torn, deteriorated, or damaged, and that it is not visibly contaminated. Notify, in writing, all personnel involved in the decontamination of reusable outer protective clothing as indicated in 29 CFR 1926.1101.

d. Eye Protection: Provide goggles to personnel engaged in asbestos abatement operations when the use of a full face respirator is not required.

3. Warning Signs and Labels: Provide bilingual warning signs printed in English and Spanish at all approaches to asbestos control areas. Locate signs at such a distance that personnel may read the sign and take the necessary protective steps required before entering the area. Provide labels and affix to all asbestos materials, scrap, waste, debris, and other products contaminated with asbestos.

a. Warning Sign: Provide vertical format conforming to 29 CFR 1926.1101 minimum 20 by 14 inches (500 by 355 mm) displaying the following legend in the lower panel:

Legend	Notation
Danger	25 mm one inch Sans Serif Gothic or Block
Asbestos	25 mm one inch Sans Serif Gothic or Block
Cancer and Lung Disease Hazard	6 mm 1/4 inch Sans Serif Gothic or Block
Authorized Personnel only	6 mm 1/4 inch Gothic
Respirators and Protective Clothing are Required in this Area	6 mm 1/4 inch Gothic

Spacing between lines shall be at least equal to the height of the upper of any two lines.

b. Warning Labels: Provide labels conforming to 29 CFR 1926.1101 of sufficient size to be clearly legible, displaying the following legend:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD
BREATHING ASBESTOS DUST MAY
CAUSE SERIOUS BODILY HARM

4. Vacuums and Tools: Vacuums shall be leak proof to the filter and equipped with HEPA filters. Filters on vacuums shall conform to ANSI Z9.2 and UL 586. Do not use power tools to remove asbestos containing materials unless the tool is equipped with effective, integral HEPA filtered exhaust ventilation systems. Remove all residual asbestos from reusable tools prior to storage or reuse.

B. General

1. Pre-Asbestos Work Conference: The Contractor and the Contractor/Supervisor shall meet with the Contracting officer prior to beginning work, to discuss in detail the Asbestos Hazard Abatement Plan, including work procedures and safety precautions. Once approved by the Owners Engineer, the plan will be enforced as if a part of this specification. Any changes required in the specification as a result of the plan shall be identified specifically in the plan to allow for free discussion and approval by the Owners Engineer prior to starting work.
2. Asbestos Control Area Requirements: The Contractor shall demarcate the asbestos control area(s) using physical barriers and signs to prevent access by unauthorized personnel. This area is defined by 29 CFR 1926.1101 as the regulated area.
3. Work Procedure: Perform asbestos related work in accordance with 29 CFR 1926.1101, 40 CFR 61-SUBPART M, applicable State or local regulation, and as specified herein. Use wet removal procedures. Personnel shall wear and utilize protective clothing and equipment as specified herein. Eating, smoking, drinking, chewing gum or tobacco, or applying cosmetics shall not be permitted in the asbestos control area(s). Personnel of other trades not engaged in the removal of asbestos containing material shall not be exposed at any time to airborne concentrations of asbestos. If an asbestos fiber release or spill, stop work immediately, correct the condition to the satisfaction of the Owners Engineer, including clean-up and clearance sampling, if appropriate, prior to resumption of work.
4. Furnishings: Furniture will be removed from the area of work by the Owner before asbestos work begins.
5. Pre-cleaning: Wet wipe and HEPA vacuum all surfaces potentially contaminated with asbestos prior to establishment of an enclosure.

C. Removal Procedures: Wet asbestos containing material with a fine spray of amended water during removal, cutting, or other handling so as to reduce the emission of airborne fibers. Remove material and immediately place in 0.15 mm 6 mil plastic disposal bags. Remove asbestos containing material in a gradual manner, with continuous application of the amended water in such a manner that no asbestos material is disturbed prior to being adequately wetted. Where unusual circumstances prohibit the use of 0.15 mm 6 mil plastic bags, submit an alternate proposal for containment of asbestos fibers to the Owner's Engineer for approval. Asbestos containing material shall be containerized while wet. At no time shall asbestos containing material be allowed to accumulate or become dry. Handle asbestos containing material as indicated in 40 CFR 61-SUBPART M, applicable State or local regulation, and 29 CFR 1926.1101.

1. Exposed Pipe Insulation Edges-Not Used
2. Negative Pressure Enclosure: Block and seal openings in areas where the release of airborne asbestos fibers can be expected. Establish an asbestos negative pressure enclosure with the use of curtains, portable partitions, or other enclosures in order to prevent the escape of asbestos fibers from the contaminated asbestos work area.
   a. Personnel/Equipment Decontamination Unit: Provide a temporary facility with a separate equipment/dirty change room and clean change room. Provide a shower that complies with 29 CFR 1926.51 in between the dirty room and clean room for personnel required to wear whole body protective clothing. Provide two separate lockers for each asbestos worker, one in each locker room. Keep street clothing and street shoes in the clean locker. HEPA vacuum and remove asbestos contaminated disposable protective clothing while still wearing respirators at the boundary of the asbestos work area and seal in impermeable bags or containers for disposal. Do not wear work clothing between home and work. All employees shall shower before changing into street clothes. Collect used shower water and filter with approved water filtration equipment to remove asbestos contamination. Dispose of filters and residue as asbestos waste. Discharge clean water to the sanitary system. Dispose of asbestos contaminated work clothing as asbestos contaminated waste or properly decontaminate as specified in the Asbestos Hazard Abatement Plan.
   b. Waste Load-Out Unit: Provide a separate temporary area expressly for short-term storage of bagged asbestos containing material that is ready for disposal. The unit shall be the only port used to transfer waste to a truck, dumpster, or other approved on-site storage facility. It

shall not be used for personnel egress. A waste load-out unit shall be integral to each negative pressure enclosure.

3. Non-friable Removal Procedures:
   a. Under normal conditions EPA Category II, non-friable asbestos containing materials may not be considered hazardous; however, this material may release airborne asbestos fibers during demolition and removal; therefore it must be handled in a manner to prevent the release of asbestos fibers. At no time will this material be mechanically chipped, sawed, sanded, or ground.
   b. Prior to beginning removal, establish an Asbestos Control Area and install Critical Barriers as specified elsewhere in this section. Submit a Negative Exposure Assessment which is less than 12 months old to the the Owner for approval or conduct air sampling as specified elsewhere in this section to establish the exposure levels for the exact removal method being used. The Contractor will establish the correct level of Personal Protective Equipment required.
   c. Acceptable methods of removal include, but are not limited to, the use of dry ice, a heat gun or lamp, citrus-based solvents, and hand tools with amended water. Removal shall be accomplished to keep the ACM substantially intact. Breakage into small pieces is an unacceptable work practice. The method shall-be detailed in the Asbestos Abatement Plan and shall not be changed during the removal without Contracting Officer approval.
   d. Upon completion of the removal and clean-up, but prior to removal of critical barriers, the Contractor Testing company shall conduct a visual inspection of all areas affected by the removal. Re-clean as required.

D. Field Quality Control Requirements
   1. Visual Inspections: The the Owner will conduct periodic inspections of all areas where asbestos removal and activities are in progress to ensure compliance with the approved Asbestos Hazard Abatement Plan and Federal/State regulatory requirements. This inspection shall include confirmation of proper control/containment/enclosure, worker protection, housekeeping, exhaust equipment operation, decontamination procedures, proper wetting and disposal, and inspection of work progress and work practices. Each activity will be documented as acceptable or noted as unacceptable with justification for the non-compliance.
   2. Air Sampling: Sampling of airborne concentrations of asbestos fibers shall be performed in accordance with 29 CFR 1926.1101 and as specified herein. Unless otherwise specified, use NIOSH Method 7400 for sampling and analysis. Air Sampling may be duplicated by the Government at the discretion of the Contracting Officer. If the air sampling results obtained by the Government differ from those results obtained by the Contractor, the Government will determine which results predominate.
      a. Sampling Prior to Asbestos Work (Not Used)
      b. Sampling During Asbestos Work
         1) The Contractor's testing company shall perform area sampling as indicated in 29 CFR 1926.1101 and governing environmental regulations. Perform area sampling at least once every week close to the work inside the enclosure, outside the personnel/equipment decontamination unit entrance to the enclosure.
         2) If sampling outside the enclosure shows airborne levels have exceeded background or 0.01 fibers per cubic centimeter, whichever is greater, stop all work, correct the condition(s) causing the fiber release, and notify the the Owner immediately. Determine by testing if adjacent areas are contaminated. If so the Contractor shall clean the contaminated areas, visually inspect, and sample the areas as specified herein.
         3) The Contractor shall conduct personal sampling of at least 25% of the workers engaged in asbestos handling (removal, disposal, transport and other associated work) throughout the duration of the project. If the quantity of airborne asbestos fibers monitored at the breathing zone of the workers at any time exceeds 0.1 fibers

per cubic centimeter, notify the PQP immediately, evaluate work practices, and take corrective action to reduce airborne asbestos fibers.

E. Clean-Up And Disposal

1. Housekeeping

a. Essential parts of asbestos dust control are housekeeping and clean-up procedures. Maintain surfaces of the asbestos control area free of accumulations of asbestos fibers. Give meticulous attention to restricting the spread of dust and debris; keep waste from being distributed over the general area. Use HEPA filtered vacuum cleaners. DO NOT BLOW DOWN THE SPACE WITH COMPRESSED AIR. All asbestos waste shall be placed in an approved on-site storage facility or transported for disposal daily. When asbestos removal is complete, all asbestos waste is removed from the work-site, and final clean-up is completed, the PQP shall visually inspect the asbestos control area for cleanliness. After final clean-up and acceptable pre-clearance airborne concentrations are attained but before the local exhaust system is turned off and the negative pressure enclosure removed), remove all pre-filters on the building HVAC system and provide new pre-filters.

b. Dispose of filters as asbestos contaminated materials. Reestablish HVAC,. mechanical, and electrical systems in proper working order.

2. Title to Materials: All waste materials, except as specified otherwise, shall become the property of the Contractor and shall be disposed of as specified in applicable Federal, State, and local regulations and herein.

3. Disposal of Asbestos

a. Collect all removed asbestos containing material, contaminated materials, contaminated water, scrap, debris, bags, containers, expendable equipment, and asbestos contaminated clothing which may produce airborne asbestos fibers and place in sealed fiber-proof, waterproof, non-returnable containers (e.g. double plastic bags 0.15 mm 6 mils thick, cartons, drums or cans). Wastes within the containers must be adequately wet in accordance with 40 CFR 61-SUBPART M. Affix a warning and Department of Transportation (DOT) label to each container including the bags or use at least 0.15 mm 6 mils thick bags with the approved warnings and DOT labeling preprinted on the bag.

b. Each container or bag shall clearly indicate that the waste generator is the Owner and the development at which the waste is generated, and the Job Order number of the project.

c. Prevent contamination of the transport vehicle (especially if the transport vehicle is a rented truck likely to be used in the future for non-asbestos purposes). These precautions include lining the vehicle cargo area with plastic sheeting (similar to work area enclosure) and thorough cleaning of the cargo area after transport and unloading of asbestos debris is complete. Dispose of waste asbestos material at an Environmental Protection Agency (EPA) or State-approved asbestos landfill off the Owner's property. For temporary storage, store sealed impermeable bags in asbestos waste drums or skids. An area for interim storage of asbestos waste-containing drums or skids will be coordinated with the the Owner. Procedure for hauling and disposal shall comply with 40 CFR 61-SUBPART M, State, regional, and local standards. Sealed plastic bags may be dumped from drums into the burial site unless the bags have been broken or damaged. Damaged bags shall remain in the drum and the entire contaminated drum shall be buried. Uncontaminated drums may be recycled. Workers unloading the sealed drums shall wear appropriate respirators and personal protective equipment when handling asbestos materials at the disposal site.

END OF SECTION 13281a

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SECTION 13281b - ENCAPSULATION (LOCK-DOWN) OF ASBESTOS-CONTAINING MATERIALS

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for encapsulation (lock-down) of asbestos-containing materials. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Submittals
1. Product Data: Manufacturers technical information including label analysis and application instructions for each material proposed for use.
2. Installation Instructions: Manufacturer's installation instructions with specific project requirements noted.
3. Performance Warrantee: Manufacturers performance guarantee.
4. Material Safety Data Sheet: Material Safety Data Sheet in accordance with the OSHA Hazard Communication Standard (29 CFR 1910.1200) for each surfactant and encapsulating material proposed for use on the work. Include a separate attachment for each sheet indicating the specific worker protective equipment proposed for use with the material indicated.

C. Delivery And Storage: Deliver materials to the job site in original, new and unopened packages and containers bearing manufacturer's name and label, and following information:
1. Name or title of material
2. Manufacturer's stock number and date of manufacture
3. Manufacturer's name
4. Thinning instructions
5. Application instructions
6. Deliver materials together with a copy of the OSHA Material
7. Safety Data Sheet for the material.

D. Job Conditions: Apply encapsulating materials only when environmental conditions in the work area are as required by the manufacturer's instructions.

E. Quality Assurance
1. Testing: Test material to be encapsulated using methods set forth in ASTM E1494 “Standard Practice for Encapsulants for Spray-or-Trowel-Applied Friable Asbestos- Containing Building Materials."

F. Warranty
1. Performance Warranty: Contractor shall submit written Performance Warranty, executed by the contractor, agreeing to repair/replace spray-on work which has cracked, fallen from substrate, or otherwise deteriorated to a condition where it would not perform effectively for its intended purposes due substantially to defective materials or workmanship and not due to abuse by occupants, improper maintenance, unforeseeable ambient exposures or other causes beyond anticipated conditions and contractors control. Warranty period shall be for at least one year after date of substantial completion.

1.2 PRODUCTS

A. Materials

1. Encapsulant system shall be an acrylic, elastomeric type, spray, brush or roller-applied, tinted penetrating or tinted bridging type, specifically designed for application to asbestos-containing material. System shall be equal to Global Encasement System as manufactured by GLOBAL Encasement Inc., 132-32nd Street, Union City, NJ 07087 U.S.A., Tel. (800) 266-3982/(201) 902-9770.
    a. All encasement topcoat materials shall be warranted to be heavy-bodied, from the same manufacturer, and shall be long lasting, highly-pure (low VOC) materials that remain flexible, chalk resistant and resist cracking, peeling, algae and fungus that can cause future indoor air quality concerns.
    b. To allow for building movement without cracking or disturbing fibrous materials, coating systems shall have passed testing to ASTM standards for adhesion, permeability, aged flexibility and with aged elasticity for the encasement system of over 250%.
    c. Coatings shall be Class A Fire Rated, water-based, non-toxic, safe and easy to use, contain no hazardous ingredients by OSHA definition, comply with all known building codes and be non-flammable.
    d. Coating materials shall have low VOC (Volatile Organic Compound) content.
    e. Coating materials shall not release health threatening toxic smoke and fumes in a fire and shall comply with all known building codes.
    f. Coating materials shall have passed the following testing standards:
        1) ASTM E 119 fire tests demonstrating that applying a multi-layer system over fireproofing does not adversely affect the fireproof rating of the fireproofing (3 hour test).
        2) UPITT Combustion Toxicity Test proving nothing toxic is released in a fire.
        3) ASTM E 84 and E162 fire tests for "Class A" - Surface Flammability and Burning Characteristics (Flame Spread = 0, Smoke Developed = 5).
        4) "Pull-off Adhesion" test per ASTM E736 equals or exceeds 9,950 lbs./sq. ft. (89.1 lbs./sq. in.).
        5) ASTM D 1653 and E96 "Water Vapor Permeability" (showing the rate that water vapor can pass through the system).
        6) Impact Resistance, "Tensile Strength" shall exceed 150 psi; "Elongation" shall exceed 250%.
        7) System shall be mildew resistant, impact resistant, scrub resistant, non-yellowing, non-chalking, highly blister resistant, rust resistant, highly chemical resistant and shall remain flexible after 1000 hour ASTM Accelerated Weather testing.
        8) Water-Based materials (low VOC) Volatile Organic Content of Primer-Sealer-Neutralizer = 0.1 g/L (0.001 lb./gal.) and Encasement Top Coat = 0.1 g/L (0.001 lb./gal.) as tested by EPA Method 24.
        9) Materials comply with applicable standards for installation on interior and/or exterior surfaces of a building.
        10) Encasement Systems shall provide additional water-proofing protection.

B. Related Materials:
    1. Elastomeric architectural sealants, caulking compounds, primers, and similar materials shall be approved by the manufacturer of the encasement coatings. All materials used shall be applied in accordance with its manufacturer's recommendations.

C. Applicable Standards
    1. Product shall be rated as acceptable for use intended when field tested in accordance with ASTM E 1494.

1.3 EXECUTION

A. General

1. Prior to applying any encapsulating material in Work Areas, Contractor shall obtain final visual inspection approval by the Project Administrator.
2. Prior to applying any encapsulating material, Contractor shall ensure that application of the sealer will not cause the base material to fail and allow the sealed material to fall of its own weight or separate from the substrate. Should Contractor doubt the ability of the installation to support the sealant, request direction from the Owner's Representative before proceeding with the encapsulating work.
3. Do Not Commence Application of encapsulating materials until all removal work within the work area has been completed.

B. Worker Protection
1. Before beginning work with any material for which a Material Safety Data Sheet has been submitted provide workers with the required protective equipment. Require that appropriate protective equipment be used at all times.

C. Application
1. Comply with all manufacturer's instructions for particular conditions of installation. Consult with manufacturer's technical representative for conditions not covered.
2. Encapsulate all surfaces in full compliance with manufacturer's procedures.
3. At completion of Encapsulation and before removal of Work Area enclosures and Pressure Differential System, decontaminate space in accordance with requirements of manufacturer’s instructions.
4. Remove all debris from the project site and restore area to proper conditions by cleaning all surfaces in accordance with manufacturer’s written recommendations.
5. At completion of work submit manufacturer’s record of inspection of completed work and Manufacturers Performance Guarantee executed by both manufacturer and Contractor.

END OF SECTION 13281b

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Task	Specification	Specification Description
13281	01352	No Specification Required
13281	02116	Disposal Of Hazardous Materials

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SECTION 13283 - MOLD REMEDIATION

1.1 GENERAL

A. Description Of Work
1. This specification covers the removal and disposal of mold. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Submittals
1. List of all personnel to be involved in the work with their training and certifications.
2. List of all products and procedures proposed for use in performance of the work.
3. Test reports.
4. Certificates.

C. References
1. U.S. EPA “Mold Remediation in Schools and Commercial Buildings”
2. U.S. EPA “A Brief Guide to Mold, Moisture, and Your Home”

D. Quality Assurance
1. Conform to all Federal, State, and Local regulations which govern the handling and disposal of mold materials.

1.2 PRODUCT - (Not Used)

1.3 EXECUTION

A. Environmental Assessment: The presence of mold, water damage, or musty odors shall be addressed immediately. In all instances, any source(s) of water must be stopped and the extent of water damaged determined. Water damaged materials shall be dried and repaired. Mold damaged materials shall be remediated in accordance with this document.
1. Visual Inspection: A visual inspection is the most important initial step in identifying a possible contamination problem. The extent of any water damage and mold growth shall be visually assessed. This assessment is important in determining remedial strategies. Ventilation systems shall also be visually checked, particularly for damp filters but also for damp conditions elsewhere in the system and overall cleanliness. Ceiling tiles, gypsum wallboard (sheetrock), cardboard, paper, and other cellulosic surfaces shall be given careful attention during a visual inspection. The use of equipment such as a boroscope, to view spaces in ductwork or behind walls, or a moisture meter, to detect moisture in building materials, may be helpful in identifying hidden sources of fungal growth and the extent of water damage.
2. Bulk/Surface Sampling
a. Bulk or surface sampling is not required to undertake a remediation. Remediation of visually identified fungal contamination shall proceed without further evaluation.
b. Bulk or surface samples may need to be collected to identify specific fungal contaminants as part of a medical evaluation if occupants are experiencing symptoms which may be related to fungal exposure or to identify the presence or absence of mold if a visual inspection is equivocal (e.g., discoloration, and staining).
c. An individual trained in appropriate sampling methodology shall perform bulk or surface sampling. Bulk samples shall be collected from visibly moldy surfaces by scraping or cutting materials with a clean tool into a clean plastic bag. Surface samples shall be collected by wiping a measured area with a sterile swab or by stripping the suspect surface

with clear tape. Surface sampling is less destructive than bulk sampling. Other sampling methods may also be available. A laboratory specializing in mycology shall be consulted for specific sampling and delivery instructions.

3. Air Monitoring
   a. Air sampling for fungi shall not be part of a routine assessment. This is because decisions about appropriate remediation strategies can usually be made on the basis of a visual inspection. In addition, air-sampling methods for some fungi are prone to false negative results and therefore cannot be used to definitively rule out contamination.
   b. Air monitoring may be necessary if an individual(s) has been diagnosed with a disease that is or may be associated with a fungal exposure (e.g., pulmonary hemorrhage/hemosiderosis, and aspergillosis).
   c. Air monitoring may be necessary if there is evidence from a visual inspection or bulk sampling that ventilation systems may be contaminated. The purpose of such air monitoring is to assess the extent of contamination throughout a building. It is preferable to conduct sampling while ventilation systems are operating.
   d. Air monitoring may be necessary if the presence of mold is suspected (e.g., musty odors) but cannot be identified by a visual inspection or bulk sampling (e.g., mold growth behind walls). The purpose of such air monitoring is to determine the location and/or extent of contamination.
   e. If air monitoring is performed, for comparative purposes, outdoor air samples shall be collected concurrently at an air intake, if possible, and at a location representative of outdoor air. For additional information on air sampling, refer to the American Conference of Governmental Industrial Hygienists' document, "Bioaerosols: Assessment and Control."
   f. Personnel conducting the sampling shall be trained in proper air sampling methods for microbial contaminants. A laboratory specializing in mycology shall be consulted for specific sampling and shipping instructions.
4. Analysis of Environmental Samples
   a. Microscopic identification of the spores/colonies requires considerable expertise. These services are not routinely available from commercial laboratories. Documented quality control in the laboratories used for analysis of the bulk/surface and air samples is necessary. The American Industrial Hygiene Association (AIHA) offers accreditation to microbial laboratories (Environmental Microbiology Laboratory Accreditation Program (EMLAP)). Accredited laboratories must participate in quarterly proficiency testing (Environmental Microbiology Proficiency Analytical Testing Program (EMPAT)).
5. Evaluation of bulk/surface and air sampling data shall be performed by an experienced health professional. The presence of few or trace amounts of fungal spores in bulk/surface sampling shall be considered background. Amounts greater than this or the presence of fungal fragments (e.g., hyphae, and conidiophores) may suggest fungal colonization, growth, and/or accumulation at or near the sampled location. Air samples shall be evaluated by means of comparison (i.e., indoors to outdoors) and by fungal type (e.g., genera, and species). In general, the levels and types of fungi found should be similar indoors (in non-problem buildings) as compared to the outdoor air. Differences in the levels or types of fungi found in air samples may indicate that moisture sources and resultant fungal growth may be problematic.

B. Remediation
1. General
   a. **In all situations, the underlying cause of water accumulation must be rectified or fungal growth will recur.** Any initial water infiltration shall be stopped and cleaned immediately. An immediate response (within 24 to 48 hours) and thorough clean up, drying, and/or removal of water damaged materials will prevent or limit mold growth. If the source of water is elevated humidity, relative humidity shall be maintained at levels below 60% to inhibit mold growth. Emphasis shall be on ensuring proper repairs of the building infrastructure, so that water damage and moisture buildup does not recur.
   b. Five different levels of abatement are described below. The size of the area impacted by fungal contamination primarily determines the type of remediation. The sizing levels below

are based on professional judgment and practicality; currently there is not adequate data to relate the extent of contamination to frequency or severity of health effects. **The goal of remediation is to remove or clean contaminated materials in a way that prevents the emission of fungi and dust contaminated with fungi from leaving a work area and entering an occupied or non-abatement area, while protecting the health of workers performing the abatement.** The listed remediation methods were designed to achieve this goal, however, due to the general nature of these methods it is the responsibility of the people conducting remediation to ensure the methods enacted are adequate. The listed remediation methods are not meant to exclude other similarly effective methods. Any changes to the remediation methods listed in these guidelines, however, shall be carefully considered prior to implementation.

c. Non-porous (e.g., metals, glass, and hard plastics) and semi-porous (e.g., wood, and concrete) materials that are structurally sound and are visibly moldy can be cleaned and reused. Cleaning shall be done using a detergent solution. Porous materials such as ceiling tiles and insulation, and wallboards with more than a small area of contamination shall be removed and discarded. Porous materials (e.g., wallboard, and fabrics) that can be cleaned, can be reused, but should be discarded if possible. A professional restoration consultant shall be contacted when restoring porous materials with more than a small area of fungal contamination. All materials to be reused shall be dry and visibly free from mold. Routine inspections shall be conducted to confirm the effectiveness of remediation work.

d. The use of gaseous, vapor-phase, or aerosolized biocides for remedial purposes is **not** recommended. The use of biocides in this manner can pose health concerns for people in occupied spaces of the building and for people returning to the treated space if used improperly. Furthermore, the effectiveness of these treatments is unproven and does not address the possible health concerns from the presence of the remaining non-viable mold. For additional information on the use of biocides for remedial purposes, refer to the American Conference of Governmental Industrial Hygienists' document, "Bioaerosols: Assessment and Control."

2. ***Level I***: **Small Isolated Areas** (10 sq. ft or less) - e.g., ceiling tiles, small areas on walls

a. Remediation can be conducted by regular building maintenance staff. Such persons shall receive training on proper clean up methods, personal protection, and potential health hazards. This training can be performed as part of a program to comply with the requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200).

b. Respiratory protection (e.g., N95 disposable respirator), in accordance with the OSHA respiratory protection standard (29 CFR 1910.134), is recommended. Gloves and eye protection shall be worn.

c. The work area shall be unoccupied. Vacating people from spaces adjacent to the work area is not necessary but is recommended in the presence of infants (less than 12 months old), persons recovering from recent surgery, immune suppressed people, or people with chronic inflammatory lung diseases (e.g., asthma, hypersensitivity, pneumonitis, and severe allergies).

d. Containment of the work area is not necessary. Dust suppression methods, such as misting (not soaking) surfaces prior to remediation, are recommended.

e. Contaminated materials that cannot be cleaned shall be removed from the building in a sealed plastic bag. There are no special requirements for the disposal of moldy materials.

f. The work area and areas used by remedial workers for egress shall be cleaned with a damp cloth and/or mop and a detergent solution.

g. All areas shall be left dry and visibly free from contamination and debris.

3. ***Level II***: **Mid-Sized Isolated Areas** (10 - 30 sq. ft.) - e.g., individual wallboard panels.

a. Remediation can be conducted by regular building maintenance staff. Such persons shall receive training on proper clean up methods, personal protection, and potential health hazards. This training can be performed as part of a program to comply with the requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200).

b. Respiratory protection (e.g., N95 disposable respirator), in accordance with the OSHA respiratory protection standard (29 CFR 1910.134), is recommended. Gloves and eye protection shall be worn.

c. The work area shall be unoccupied. Vacating people from spaces adjacent to the work area is not necessary but is recommended in the presence of infants (less than 12 months old), persons having undergone recent surgery, immune suppressed people, or people with chronic inflammatory lung diseases (e.g., asthma, hypersensitivity, pneumonitis, and severe allergies).
d. The work area shall be covered with a plastic sheet(s) and sealed with tape before remediation, to contain dust/debris.
e. Dust suppression methods, such as misting (not soaking) surfaces prior to remediation, are recommended.
f. Contaminated materials that cannot be cleaned shall be removed from the building in sealed plastic bags. There are no special requirements for the disposal of moldy materials.
g. The work area and areas used by remedial workers for egress shall be HEPA vacuumed (a vacuum equipped with a High-Efficiency Particulate Air filter) and cleaned with a damp cloth and/or mop and a detergent solution.
h. All areas shall be left dry and visibly free from contamination and debris.

4. ***Level III*: Large Isolated Areas** (30 - 100 square feet) - e.g., several wallboard panels.
   a. A health and safety professional with experience performing microbial investigations shall be consulted prior to remediation activities to provide oversight for the project.
   b. The following procedures *at a minimum* are recommended:
      1) Personnel trained in the handling of hazardous materials and equipped with respiratory protection, (e.g., N95 disposable respirator), in accordance with the OSHA respiratory protection standard (29 CFR 1910.134), is recommended. Gloves and eye protection shall be worn.
      2) The work area and areas directly adjacent shall be covered with a plastic sheet(s) and taped before remediation, to contain dust/debris.
      3) Seal ventilation ducts/grills in the work area and areas directly adjacent with plastic sheeting.
      4) The work area and areas directly adjacent shall be unoccupied. Further vacating of people from spaces near the work area is recommended in the presence of infants (less than 12 months old), persons having undergone recent surgery, immune suppressed people, or people with chronic inflammatory lung diseases (e.g., asthma, hypersensitivity, pneumonitis, and severe allergies).
      5) Dust suppression methods, such as misting (not soaking) surfaces prior to remediation, are recommended.
      6) Contaminated materials that cannot be cleaned shall be removed from the building in sealed plastic bags. There are no special requirements for the disposal of moldy materials.
      7) The work area and surrounding areas shall be HEPA vacuumed and cleaned with a damp cloth and/or mop and a detergent solution.
      8) All areas shall be left dry and visibly free from contamination and debris.
   c. If abatement procedures are expected to generate a lot of dust (e.g., abrasive cleaning of contaminated surfaces, demolition of plaster walls) or the visible concentration of the fungi is heavy (blanket coverage as opposed to patchy), then it is recommended that the remediation procedures for Level IV are followed.

5. ***Level IV*: Extensive Contamination** (greater than 100 contiguous square feet in an area)
   a. A health and safety professional with experience performing microbial investigations shall be consulted prior to remediation activities to provide oversight for the project. The following procedures are recommended:
      1) Personnel trained in the handling of hazardous materials equipped with:
         a) Full-face respirators with high efficiency particulate air (HEPA) cartridges
         b) Disposable protective clothing covering both head and shoes
         c) Gloves
      2) Containment of the affected area:

a) Complete isolation of work area from occupied spaces using plastic sheeting sealed with duct tape (including ventilation ducts/grills, fixtures, and any other openings)
b) The use of an exhaust fan with a HEPA filter to generate negative pressurization
c) Airlocks and decontamination room

3) Vacating people from spaces adjacent to the work area is not necessary but is recommended in the presence of infants (less than 12 months old), persons having undergone recent surgery, immune suppressed people, or people with chronic inflammatory lung diseases (e.g., asthma, hypersensitivity, pneumonitis, and severe allergies).
4) Contaminated materials that cannot be cleaned shall be removed from the building in sealed plastic bags. The outside of the bags shall be cleaned with a damp cloth and a detergent solution or HEPA vacuumed in the decontamination chamber prior to their transport to uncontaminated areas of the building. There are no special requirements for the disposal of moldy materials.
5) The contained area and decontamination room shall be HEPA vacuumed and cleaned with a damp cloth and/or mop with a detergent solution and be visibly clean prior to the removal of isolation barriers.
6) Air monitoring shall be conducted prior to occupancy to determine if the area is fit to reoccupy.

6. ***Level V***: Remediation of HVAC Systems

a. A Small Isolated Area of Contamination (<10 square feet) in the HVAC System

1) Remediation can be conducted by regular building maintenance staff. Such persons shall receive training on proper clean up methods, personal protection, and potential health hazards. This training can be performed as part of a program to comply with the requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200).
2) Respiratory protection (e.g., N95 disposable respirator), in accordance with the OSHA respiratory protection standard (29 CFR 1910.134), is recommended. Gloves and eye protection shall be worn.
3) The HVAC system shall be shut down prior to any remedial activities.
4) The work area shall be covered with a plastic sheet(s) and sealed with tape before remediation, to contain dust/debris.
5) Dust suppression methods, such as misting (not soaking) surfaces prior to remediation, are recommended.
6) Growth supporting materials that are contaminated, such as the paper on the insulation of interior lined ducts and filters, shall be removed. Other contaminated materials that cannot be cleaned shall be removed in sealed plastic bags. There are no special requirements for the disposal of moldy materials.
7) The work area and areas immediately surrounding the work area shall be HEPA vacuumed and cleaned with a damp cloth and/or mop and a detergent solution.
8) All areas shall be left dry and visibly free from contamination and debris.
9) A variety of biocides are recommended by HVAC manufacturers for use with HVAC components, such as, cooling coils and condensation pans. HVAC manufacturers shall be consulted for the products they recommend for use in their systems.

b. Areas of Contamination (>10 square feet) in the HVAC System: A health and safety professional with experience performing microbial investigations shall be consulted prior to remediation activities to provide oversight for remediation projects involving more than a small isolated area in an HVAC system. The following procedures are recommended:

1) Personnel trained in the handling of hazardous materials equipped with:
a) Respiratory protection (e.g., N95 disposable respirator), in accordance with the OSHA respiratory protection standard (29 CFR 1910.134), is recommended.
b) Gloves and eye protection

c) Full-face respirators with HEPA cartridges and disposable protective clothing covering both head and shoes shall be worn if contamination is greater than 30 square feet.

2) The HVAC system shall be shut down prior to any remedial activities.

3) Containment of the affected area:

a) Complete isolation of work area from the other areas of the HVAC system using plastic sheeting sealed with duct tape.

b) The use of an exhaust fan with a HEPA filter to generate negative pressurization.

c) Airlocks and decontamination room if contamination is greater than 30 square feet.

4) Growth supporting materials that are contaminated, such as the paper on the insulation of interior lined ducts and filters, shall be removed. Other contaminated materials that cannot be cleaned should be removed in sealed plastic bags. When a decontamination chamber is present, the outside of the bags shall be cleaned with a damp cloth and a detergent solution or HEPA vacuumed prior to their transport to uncontaminated areas of the building. There are no special requirements for the disposal of moldy materials.

5) The contained area and decontamination room shall be HEPA vacuumed and cleaned with a damp cloth and/or mop and a detergent solution prior to the removal of isolation barriers.

6) All areas shall be left dry and visibly free from contamination and debris.

7) Air monitoring shall be conducted prior to re-occupancy with the HVAC system in operation to determine if the area(s) served by the system are fit to reoccupy.

8) A variety of biocides are recommended by HVAC manufacturers for use with HVAC components, such as, cooling coils and condensation pans. HVAC manufacturers shall be consulted for the products they recommend for use in their systems.

7. Hazard Communication: When fungal growth requiring large-scale remediation is found, the building owner, management, and/or employer shall notify occupants in the affected area(s) of its presence. Notification shall include a description of the remedial measures to be taken and a timetable for completion. Group meetings held before and after remediation with full disclosure of plans and results can be an effective communication mechanism. Individuals with persistent health problems that appear to be related to bioaerosol exposure should see their physicians for a referral to practitioners who are trained in occupational/environmental medicine or related specialties and are knowledgeable about these types of exposures. Individuals seeking medical attention shall be provided with a copy of all inspection results and interpretation to give to their medical practitioners.

END OF SECTION 13283

SECTION 13285 - REMOVAL AND DISPOSAL OF LEAD-CONTAINING PAINT

1.1 GENERAL

A. Description Of Work

1. This specification covers the removal and disposal of lead-based or lead-containing paint. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Definitions

1. Action Level: Employee exposure, without regard to use of respirators, to an airborne concentration of lead of 30 micrograms per cubic meter of air averaged over an 8 hour period in an occupational/industrial environment.
2. Area Sampling: Sampling of lead concentrations within the lead control area and inside the physical boundaries which is representative of the airborne lead concentrations but is not collected in the breathing zone of personnel.
3. Competent Person (CP): As used in this section, refers to a person employed by the Contractor who is trained in the recognition and control of lead hazards in accordance with current federal, State, and local regulations. An industrial hygienist or safety professional certified for comprehensive practice by the American Board of Industrial Hygiene or by the Board of Certified Safety Professionals is the best choice.
4. Contaminated Room: Room for removal of contaminated personal protective equipment (PPE).
5. Decontamination Shower Facility: That facility that encompasses a clean clothing storage room, and a contaminated clothing storage and disposal rooms, with a shower facility in between.
6. Eight-Hour Time Weighted Average (TWA): Airborne concentration of lead to which an employee is exposed, averaged over an 8 hour workday as indicated in 29 CFR 1926.62.
7. High Efficiency Particulate Air (HEPA) Filter Equipment: HEPA filtered vacuuming equipment with a UL 586 filter system capable of collecting and retaining lead-contaminated paint dust. A high efficiency particulate filter means 99.97 percent efficient against 0.3 micron or larger size particles.
8. Lead: Metallic lead, inorganic lead compounds, and organic lead soaps.
9. Lead-Based Paint (LBP): Paint or other surface coating that contains lead in excess of 1.0 milligrams per centimeter squared or 0.5 percent by weight.
10. Lead-Based Paint Hazard (LBP Hazard): Any condition that causes exposure to lead from lead-contaminated dust, lead-contaminated soil, lead-based paint that is deteriorated or present in accessible surfaces, friction surfaces, or impact surfaces that would result in adverse human health effects.
11. Lead-Containing Paint (LCP): Lead-based paint or other similar surface coating containing lead or lead compound in excess of 0.06 percent by weight of the total nonvolatile content of the paint.
12. Lead Control Area: An enclosed area or structure, constructed as a temporary containment equipped with HEPA filtered local exhaust, which prevents the spread of lead dust, paint chips, or debris existing as a condition of lead-based paint removal operations. The lead control area is also isolated by physical boundaries to prevent unauthorized entry of personnel.
13. Lead Permissible Exposure Limit (PEL): Fifty micrograms per cubic meter of air as an 8 hour time weighted average as determined by 29 CFR 1926.62. If an employee is exposed for more than eight hours in a work day, the PEL shall be determined by the following formula:

    PEL (micrograms/cubic meter of air) = 400/No. hrs. worked per day.
14. Personal Sampling: Sampling of airborne lead concentrations within the breathing zone of an employee to determine the 8 hour time weighted average concentration in accordance with 29 CFR 1926.62. Samples shall be representative of the employees' work tasks. Breathing zone shall be considered an area within a hemisphere, forward of the shoulders, with a radius of 6 to 9 inches (150 to 225 mm) and centered at the nose or mouth of an employee.

15. Physical Boundary: Area physically roped or partitioned off around an enclosed lead control area to limit unauthorized entry of personnel. As used in this section, "inside boundary" shall mean the same as "outside lead control area but inside boundary."

C. Submittals: Submit the following:
1. Product Data:
   a. Vacuum filters
   b. Respirators
2. Test Reports
   a. Sampling results
   b. Assessment data report
3. Certificates
   a. Qualifications of CP
   b. Testing laboratory</SUB> qualifications
   c. Third party consultant qualifications
   d. Lead-Based Paint/Lead-Containing Paint Removal Plan including CP approval (signature, date, and certification number)
   e. Rental equipment notification
   f. Respiratory protection program
   g. Hazard communication program
   h. EPA approved hazardous waste treatment or disposal facility for lead disposal
   i. Hazardous waste management plan
   j. Vacuum filters
4. Manufacturer's Instructions
   a. Chemicals and equipment
   b. Materials
   c. Material safety data sheets for all chemicals
5. Closeout Submittals
   a. Completed and signed hazardous waste manifest from treatment or disposal facility
   b. Certification of medical examinations
   c. Employee training certification

D. Qualifications Of CP
1. Submit name, address, and telephone number of the CP selected to perform responsibilities specified in paragraph entitled "Competent Person (CP) Responsibilities." Provide previous experience of the CP. Submit proper documentation that the CP is trained and licensed and certified in accordance with Federal, State, and local laws.

E. Third Party Consultant Qualifications
1. Submit the name, address, and telephone number of the third party consultant selected to perform the wipe sampling for determining concentrations of lead in dust or soil sampling. Submit proper documentation that the consultant is trained and certified as an inspector technician or inspector/risk assessor by the USEPA authorized State (or local) certification and accreditation program.

F. Testing Laboratory
1. Submit the name, address, and telephone number of the testing laboratory selected to perform the air and wipe and soil sampling, testing, and reporting of airborne concentrations of lead. Use a laboratory accredited under the EPA National Lead Laboratory Accreditation Program (NLLAP) by either the American Association for Laboratory Accreditation (A2LA) or the American Industrial Hygiene Association (AIHA) and that is successfully participating in the Environmental Lead Proficiency Analytical Testing (ELPAT) program to perform sample analysis.

G. Lead-Based Paint/Lead-Containing Paint Removal Plan (LBP/LCPRP)

1. Submit a detailed job-specific plan of the work procedures to be used in the removal of LBP/LCP. The plan shall include a sketch showing the location, size, and details of lead control areas, location and details of decontamination facilities, viewing ports, and mechanical ventilation system. Include in the plan, eating, drinking, smoking and sanitary procedures, interface of trades, sequencing of lead related work, collected waste water and paint debris disposal plan, air sampling plan, respirators, personal protective equipment, and a detailed description of the method of containment of the operation to ensure that airborne lead concentrations of 30 micrograms per cubic meter of air and baseline lead dust/soil concentrations are not reached or exceeded outside of the lead control area. Include site preparation and cleanup procedures. Include occupational and environmental sampling, training and strategy, sampling methodology, frequency, duration of sampling, and qualifications of sampling personnel in the air sampling portion of the plan.

H. Occupational And Environmental Sampling Results
1. Submit occupational and environmental sampling results to the the Owner within three working days of collection, signed by the testing laboratory responsible official, the employee that performed the sampling, and the CP.
   a. The sampling results shall represent each job classification, or if working conditions are similar to previous jobs by the same employer, provide previously collected exposure data that can be used to estimate worker exposures in accordance with 29 CFR 1926.62. The data shall represent the worker's regular daily exposure to lead.
   b. Submit worker exposure data conducted during the task based trigger operations of 29 CFR 1926.62.
   c. The initial monitoring shall determine the requirements for further monitoring and the need to fully implement the control and protective requirements including the compliance program (LBP/LCP) in accordance with 29 CFR 1926.62.

I. Occupational And Environmental Assessment Data Report:
1. Some LBP/LCP removal work may not require full implementation of the requirements of 29 CFR 1926.62. Based on the experience of the Contractor and/or the use of a specific process or method for performing the work, the Contractor may be able to provide historic data (previous 12 months) to demonstrate that airborne exposures are controlled below the action level. Such methods or controls shall be fully presented in the LBP/LCPRP. To reduce the full implementation of 29 CFR 1926.62, the Contractor shall provide documentation in an Assessment Data Report.
2. Submit occupational and environmental assessment report to the the Owner prior to start of work, signed by the testing laboratory responsible official, and the CP.
   a. Submit a report that supports the determination regarding the reduction of the need to fully implement the requirements of 29 CFR 1926.62 and supporting the LBP/LCP. The exposure assessment shall represent each job classification, or if working conditions are similar to previous jobs by the same employer, provide previously collected exposure data that can be used to estimate worker exposures in accordance with 29 CFR 1926.62. The data shall represent the worker's regular daily exposure to lead for stated work.
   b. Submit worker exposure data conducted during the task based trigger operations of 29 CFR 1926.62 with a complete process description in supporting a negative assessment.
   c. The initial assessment shall determine the requirement for further monitoring and the need to fully implement the control and protective requirements including the compliance program (LBP/LCPRP) in accordance with 29 CFR 1926.62.

J. Quality Assurance
1. Medical Examinations: Initial medical surveillance as required by 29 CFR 1926.62 shall be made available to all employees exposed to lead at any time (1 day) above the action level. Full medical surveillance shall be made available to all employees on an annual basis who are or may be exposed to lead in excess of the action level for more than 30 days a year or as required by 29 CFR 1926.62. Adequate records shall show that employees meet the medical surveillance requirements of 29 CFR 1926.33, 29 CFR 1926.62, and 29 CFR 1926.103.

a. Medical Records: Maintain complete and accurate medical records of employees for a period of at least 30 years or for the duration of employment plus 30 years, whichever is longer.
b. Medical Surveillance: Provide medical surveillance to all personnel exposed to lead as indicated in 29 CFR 1926.62.

2. Competent Person (CP) Responsibilities
   a. Certify training as meeting all federal, State, and local requirements.
   b. Review and approve lead-based paint/lead-containing paint removal plan for conformance to the applicable referenced standards.
   c. Continuously inspect lead-based paint removal work for conformance with the approved plan.
   d. Perform air and wipe sampling.
   e. Ensure work is performed in strict accordance with specifications at all times.
   f. Control work to prevent hazardous exposure to human beings and to the environment at all times.
   g. Certify the conditions of the work as called for elsewhere in this specification.
3. Training: Train each employee performing paint removal, disposal, and air sampling operations prior to the time of initial job assignment and annually thereafter, in accordance with 29 CFR 1926.21, 29 CFR 1926.62, and State and local regulations.
   a. Training Certification: Submit a certificate for each employee, signed and dated by the approved training source, stating that the employee has received the required lead training.
4. Respiratory Protection Program
   a. Furnish each employee required to wear a negative pressure respirator or other appropriate type with a respirator fit test at the time of initial fitting and at least annually thereafter as required by 29 CFR 1926.62.
   b. Establish and implement a respiratory protection program as required by ANSI Z88.2, 29 CFR 1926.103, 29 CFR 1926.62, and 29 CFR 1926.55.
5. Hazard Communication Program: Establish and implement a Hazard Communication Program as required by 29 CFR 1926.59.
6. Hazardous Waste Management: The Hazardous Waste Management Plan shall comply with applicable requirements of federal, State, and local hazardous waste regulations and address:
   a. Identification and classification of hazardous wastes associated with the work.
   b. Estimated quantities of wastes to be generated and disposed of.
   c. Names and qualifications of each contractor that will be transporting, storing, treating, and disposing of the wastes. Include the facility location and operator and a 24-hour point of contact. Furnish two copies of EPA, or State and local hazardous waste permit applications or permits or manifests, as required, and EPA Identification numbers.
   d. Names and qualifications (experience and training) of personnel who will be working on-site with hazardous wastes.
   e. List of waste handling equipment to be used in performing the work, to include cleaning, volume reduction, and transport equipment.
   f. Spill prevention, containment, and cleanup contingency measures including a health and safety plan to be implemented in accordance with 29 CFR 1926.65.
   g. Work plan and schedule for waste containment, removal and disposal. Wastes shall be cleaned up and containerized daily.
   h. Unit cost for hazardous waste disposal according to this plan.
7. Environmental, Safety and Health Compliance: In addition to the detailed requirements of this specification, comply with laws, ordinances, rules, and regulations of Federal, State, and local authorities regarding removing, handling, storing, transporting, and disposing of lead waste materials. Comply with the applicable requirements of the current issue of 29 CFR 1926.62. Submit matters regarding interpretation of standards to the the Owner for resolution before starting work. Where specification requirements and the referenced documents vary, the most stringent requirement shall apply.

8. Pre-Construction Conference: Along with the CP, meet with the the Owner to discuss in detail the hazardous waste management plan and the lead-based paint/lead-containing paint removal plan, including work procedures and precautions for the removal plan.

K. Equipment
1. Respirators: Furnish appropriate respirators approved by the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services, for use in atmospheres containing lead dust. Respirators shall comply with the requirements of 29 CFR 1926.62.
2. Special Protective Clothing: Furnish personnel who will be exposed to lead-contaminated dust with proper disposable uncontaminated, reusable protective whole body clothing, head covering, gloves, and foot coverings as required by 29 CFR 1926.62. Furnish proper disposable plastic or rubber gloves to protect hands. Reduce the level of protection only after obtaining approval from the CP.
3. Rental Equipment Notification: If rental equipment is to be used during lead-based paint handling and disposal, notify the rental agency in writing concerning the intended use of the equipment. Furnish a copy of the written notification to the the Owner.
4. Vacuum Filters: UL 586 labeled HEPA filters.
5. Equipment for Owner's Personnel: Furnish the the Owner with two complete sets of personal protective equipment (PPE) daily, as required herein, for entry into and inspection of the paint removal work within the lead controlled area. Personal protective equipment shall include disposable whole body covering, including appropriate foot, head, and hand protection. PPE shall remain the property of the Contractor. Respiratory protection for the the Owner will be provided by the Owner.

L. Removal
1. Title to Materials: Materials resulting from demolition work, except as specified otherwise, shall become the property of the Contractor and shall be disposed of in accordance with Division 01 Section(s) "Selective Demolition" OR Division 02 Section(s) "Building Demolition", except as specified herein.

1.2 PRODUCT

A. Chemicals
1. Submit applicable Material Safety Data Sheets for all chemicals used in paint removal work. Use the least toxic product approved by the the Owner.

B. Materials
1. The soluble metal content and the total metal content shall not exceed values which would cause a material to be classified as a hazardous waste.

1.3 EXECUTION

A. Protection
1. Notification: Notify the the Owner 20 days prior to the start of any paint removal work.
2. Lead Control Area Requirements
   a. If LBP will be removed by means which will not likely create airborne, lead-containing dust (such as careful wet scraping or chemical stripping), establish a lead control area by situating critical barriers and physical boundaries around the area or structure where LBP/LCP removal operations will be performed.
   b. If removal practice will create airborne, lead-containing dust (such as sanding, abrasive blasting, thermal cutting, demolition, or needle gun use), utilize full containment procedures - Contain removal operations by the use of critical barriers and HEPA filtered exhaust **OR** a negative pressure enclosure system with decontamination facilities and with HEPA filtered exhaust if required by the CP, **as directed**. For containment areas larger than 1,000

square feet (100 square meters) install a minimum of two 18 inch (450 mm) square viewing ports. Locate ports to provide a view of the required work from the exterior of the enclosed contaminated area. Glaze ports with laminated safety glass.

3. Protection of Existing Work to Remain: Perform paint removal work without damage or contamination of adjacent areas. Where existing work is damaged or contaminated, restore work to its original condition or better.
4. Boundary Requirements: Provide physical boundaries around the lead control area by roping off the area designated in the work plan or providing curtains, portable partitions or other enclosures to ensure that airborne concentrations of lead will not reach 30 micrograms per cubic meter of air outside of the lead control area.
   a. Physical Boundary: Provide physical boundaries around the lead control area by roping off the area designated in the work plan or providing curtains, portable partitions or other enclosures to ensure that airborne concentrations of lead will not reach 30 micrograms per cubic meter of air outside of the lead control area.
   b. Warning Signs: Provide warning signs at approaches to lead control areas. Locate signs at such a distance that personnel may read the sign and take the necessary precautions before entering the area. Signs shall comply with the requirements of 29 CFR 1926.62.
5. Furnishings:
   a. The Owner will remove furniture and equipment from the building before lead-based paint removal work begins.

      OR

      Furniture and equipment will remain in the building. Protect and cover furnishings or remove furnishings from the work area and store in a location approved by the the Owner.

      OR

      Existing furniture and equipment is lead contaminated, decontaminate, dispose of as lead contaminated waste.
6. Heating, Ventilating and Air Conditioning (HVAC) Systems: Shut down, lock out, and isolate HVAC systems that supply, exhaust, or pass through the lead control areas. Seal intake and exhaust vents in the lead control area with 6 mil (0.15 mm) plastic sheet and tape. Seal seams in HVAC components that pass through the lead control area. Provide temporary HVAC system for areas in which HVAC has been shut down outside the lead control area.
7. Decontamination Shower Facility: Provide clean and contaminated change rooms and shower facilities in accordance with this specification and 29 CFR 1926.62.
8. Eye Wash Station: Where eyes may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes shall be provided within the work area.
9. Mechanical Ventilation System
   a. Use adequate ventilation to control personnel exposure to lead in accordance with 29 CFR 1926.62.
   b. To the extent feasible, use fixed local exhaust ventilation connected to HEPA filters or other collection systems, approved by the CP. Local exhaust ventilation systems shall be designed, constructed, installed, and maintained in accordance with ANSI Z9.2.
   c. Vent local exhaust outside the building only and away from building ventilation intakes.
   d. Use locally exhausted, power actuated, paint removal tools.
10. Personnel Protection: Personnel shall wear and use protective clothing and equipment as specified herein. Eating, smoking, or drinking or application of cosmetics is not permitted in the lead control area. No one will be permitted in the lead control area unless they have been appropriately trained and provided with protective equipment.

B. Work Procedures: Perform removal of lead-based paint in accordance with approved lead-based paint/lead-containing paint removal plan. Use procedures and equipment required to limit occupational and environmental exposure to lead when lead-based paint is removed in accordance with 29 CFR 1926.62, except as specified herein. Dispose of removed paint chips and associated waste in compliance with Environmental Protection Agency (EPA), federal, State, and local requirements.

1. Personnel Exiting Procedures: Whenever personnel exit the lead-controlled area, they shall perform the following procedures and shall not leave the work place wearing any clothing or equipment worn during the work day:
   a. Vacuum themselves off.
   b. Remove protective clothing in the contaminated change room, and place them in an approved impermeable disposal bag.
   c. Shower **OR** Wash hands and face at the site, **as directed**, don appropriate disposable or uncontaminated reusable clothing; move to an appropriate facility; shower.
   d. Change to clean clothes prior to leaving the physical boundary designated around the lead control area.
2. Air and Wipe Sampling
   a. Air sample for lead in accordance with 29 CFR 1926.62 and as specified herein. Air and wipe sampling shall be directed or performed by the CP.
      1) The CP shall be on the job site directing the air and non-clearance wipe sampling and inspecting the lead-based paint removal work to ensure that the requirements of the contract have been satisfied during the entire lead-based paint removal operation.
      2) Collect personal air samples on employees who are anticipated to have the greatest risk of exposure as determined by the CP. In addition, collect air samples on at least 25 percent of the work crew or a minimum of two employees, whichever is greater, during each work shift.
      3) Submit results of air samples, signed by the CP, within 72 hours after the air samples are taken. Notify the the Owner immediately of exposure to lead at or in excess of the action level of 30 micrograms per cubic meter of air outside of the lead control area.
      4) For high profile, sensitive work such as present in family housing, child care facilities, administrative buildings, kitchens, barracks, etc., surface dust sampling to determine clearance (i.e., that the work has not contaminated surfaces within and adjacent to the control area) should be performed by a third party to reduce a conflict of interest. Samples must be conducted by an individual not paid or employed or otherwise compensated by the LBP/LCP removal Contractor. State or local regulations may require third party testing if the LBP/LCP removal operation is considered a lead hazard reduction activity.
      5) Before any work begins, collect and analyze baseline or soil wipe samples in accordance with methods defined in federal, State, and local standards inside and outside of the physical boundary to assess the degree of dust contamination in the facility prior to lead-based paint removal.
   b. Air Sampling During Paint Removal Work: Conduct area air sampling daily, on each shift in which lead-based paint removal operations are performed, in areas immediately adjacent to the lead control area. Sufficient area monitoring shall be conducted to ensure unprotected personnel are not exposed at or above 30 micrograms per cubic meter of air. If 30 micrograms per cubic meter of air is reached or exceeded, stop work, correct the conditions(s) causing the increased levels. Notify the the Owner immediately. Determine if condition(s) require any further change in work methods. Removal work shall resume only after approval is given by the CP and the the Owner. For outdoor operations, at least one sample on each shift shall be taken on the downwind side of the lead control area.
3. Lead-Based Paint Removal
   a. Manual or power sanding of interior and exterior surfaces is not permitted. Provide methodology for removing LBP in work plan. Remove paint within the areas designated on the drawings in order to completely expose the substrate. Take whatever precautions necessary to minimize damage to the underlying substrate.
   b. Avoid flash rusting or deterioration of the substrate. Provide surface preparations for painting in accord with Division 07.
   c. Provide methodology for removing LBP/LCP removal processes to minimize contamination of work areas outside the control area with lead-contaminated dust or other lead-contaminated debris/waste and to ensure that unprotected personnel are not exposed to

hazardous concentrations of lead. Describe this LBP/LCP removal process in the LBP/LCPRP.

d. Indoor Lead Paint Removal: Perform manual **OR** mechanical **OR** thermal **OR** chemical, **as directed**, paint removal in lead control areas using enclosures, barriers, or containments and powered locally exhausted paint removal tools. Collect residue and/or debris for disposal in accordance with federal, State, and local requirements.

e. Outdoor Lead Paint Removal: Perform outdoor removal as indicated in federal, State, and local regulations and in the LBP/CPRP. The worksite preparation (barriers or containments) shall be job dependent and presented in the LBP/LCPRP.

f. Sampling After Paint Removal: After the visual inspection, conduct soil sampling if bare soil is present during external removal operations and collect air samples inside and outside the lead control area to determine the airborne levels of lead inside and outside the work area. Collect wipe samples according to the HUD protocol contained in HUD Guidelines to determine the lead content of settled dust and dirt in micrograms per square foot (square meter) of surface area and parts per million (ppm) or micrograms per gram (µg/g) for soil.

4. Cleanup and Disposal

a. Cleanup: Maintain surfaces of the lead control area free of accumulations of paint chips and dust. Restrict the spread of dust and debris; keep waste from being distributed over the work area. Do not dry sweep or use compressed air to clean up the area. At the end of each shift and when the paint removal operation has been completed, clean the area of visible lead paint contamination by vacuuming with a HEPA filtered vacuum cleaner, wet mopping the area and wet wiping the area as indicated by the CP. Reclean areas showing dust or residual paint chips or debris. After visible dust, chips and debris is removed, wet wipe and HEPA vacuum all surfaces in the work area. If adjacent areas become contaminated at any time during the work, clean, visually inspect, and then wipe sample all contaminated areas. The CP shall then certify in writing that the area has been cleaned of lead contamination before restarting work.

b. Clearance Certification

1) The CP shall certify in writing that the final air samples collected inside and outside the lead control area are less than 30 micrograms per cubic meter of air; the respiratory protection used for the employees was adequate; the work procedures were performed in accordance with 29 CFR 1926.62 and 40 CFR 745; and that there were no visible accumulations of material and dust containing lead left in the work site. Do not remove the lead control area or roped off boundary and warning signs prior to the the Owner's acknowledgement of receipt of the CP certification.

2) A third party consultant shall certify surface wipe sample results collected inside and outside the work area are less than 100 micrograms per square foot (0.1 square meter) on uncarpeted floors, less than 500 micrograms per square foot (0.1 square meter) on interior window sills and less than 800 micrograms per square foot (0.1 square meter) on window troughs **OR** not significantly greater than the initial surface loading determined prior to work, **as directed**.

3) For exterior paint removal work, soil samples taken at the exterior of the work site shall be sued to determine if soil lead levels had increased at a statistically significant level (significant at the 95 percent confidence limit) from the soil lead levels prior to the work. If soil lead levels do show a statistically significant increase above any applicable Federal or State standard for lead in soil, the soil shall be remediated back to the pre-work level.

c. Testing of Lead-Based Paint Residue and Used Abrasive: Test paint residue and used abrasive in accordance with 40 CFR 261 for hazardous waste.

d. Disposal

1) Collect lead-contaminated waste, scrap, debris, bags, containers, equipment, and lead-contaminated clothing which may produce airborne concentrations of lead particles. Label the containers in accordance with 29 CFR 1926.62 and 40 CFR

261. Dispose of lead-contaminated waste material at an EPA or State approved hazardous waste treatment, storage, or disposal facility off Owner's property.

2) Store waste materials in U.S. Department of Transportation (49 CFR 178) approved 55 gallon (208 liter) drums. Properly label each drum to identify the type of waste (49 CFR 172) and the date the drum was filled. The the Owner or an authorized representative will assign an area for interim storage of waste-containing drums. Do not store hazardous waste drums in interim storage longer than 90 calendar days from the date affixed to each drum.

3) Handle, store, transport, and dispose lead or lead-contaminated waste in accordance with 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, and 40 CFR 265. Comply with land disposal restriction notification requirements as required by 40 CFR 268.

4) All material, whether hazardous or non-hazardous shall be disposed in accordance with laws and provisions and Federal, State, or local regulations. Ensure waste is properly characterized. The result of each waste characterization (TCLP for RCRA materials) will dictate disposal requirements.

5. Disposal Documentation: Submit written evidence that the hazardous waste treatment, storage, or disposal facility (TSD) is approved for lead disposal by the EPA and State or local regulatory agencies. Submit one copy of the completed manifest, signed and dated by the initial transporter in accordance with 40 CFR 262.

6. Payment for Hazardous Waste: Payment for disposal of hazardous waste will not be made until a signed copy of the manifest from the treatment or disposal facility certifying the amount of lead-containing materials delivered is returned and a copy is furnished to the Owner.

END OF SECTION 13285

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SECTION 13285a - LEAD PAINT RELATED ABATEMENT PROCEDURES

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for lead paint related abatement procedures. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. General Provisions

1. The site of this work will be occupied while work is being done. Perform the abatement work with the least inconvenience to the residents.
2. Take all necessary precautions to protect the property of the the Owner and its residents. Damaged property shall be repaired and restored to its original condition. If the damage is beyond repair, the Contractor shall replace it with new materials to match existing, at the Contractor's expense.
3. Hazardous waste generated during the abatement process (including lead-base paint) when carted away from the developments shall not be transferred from one vehicle to another except at a licensed transfer station.
4. Develop a work plan to be performed as requested by the the Owner. The detailed plan shall include sequencing of abatement work in a manner that will be least disruptive to the normal use of the non-work areas in the building. The plan should also include emergency procedures in case of fire.
5. The Contractor shall include all supplementary miscellaneous items not specified but implied or required in order to complete the work.
6. Workmanship required in the execution of the work herein specified shall be of good quality and subject to the approval of the the Owner.
7. Make in a timely fashion all applicable and necessary notifications to relevant Federal, State and Local authorities. The Contractor shall indemnify the the Owner and the the Owner's representative from, and pay all claims resulting from failure to adhere to these provisions.
8. the Owner may retain an independent Monitoring Contractor to monitor the abatement contract and conduct all wipe sampling and clearance tests.
9. Contractor performing lead-based paint abatement or renovation activities involving lead-based paint shall be a Certified Lead Abatement Contractor and shall ensure that supervisors and workers are trained and certified by U.S. EPA approved state program or equivalent, to perform lead paint removal operations.
10. Establish and implement a Chemical Hazard Communication Program as required by OSHA regulations 29 CFR 1926.59.
11. Provide workers with a comprehensive medical examination as required by OSHA regulations 29 CFR 1926.62 before exposure to lead contaminated dust. The medical examination shall be conducted to approve use of appropriate respirators and shall include biological monitoring NIOSH/MSHA approved respirators shall be utilized.
12. For employees required to wear a negative pressure respirators: conduct a respirator fit test at the time of initial fitting and at least once every six (6) months thereafter as required by OSHA regulations 29 CFR 1926.62.
13. Determine if any worker will be exposed to lead at or above the action level in accordance with OSHA regulation 29 CFR 1926.62 and 29 CFR 1910.1025. Conduct an exposure assessment to identify the level of exposure a worker would be subjected to without respiratory protection. Assess the exposure level by obtaining personal monitoring samples representative of a full shift of at least an 8-hour TWA.
14. Furnish appropriate respirators approved by NIOSH/MSHA for use in atmospheres containing lead aerosols. Instruct workers in all aspects of respiratory protection. Maintain an adequate supply of HEPA filter elements and spare parts on site for all types of respirators in use.

15. For manual demolition, scraping, sanding, use of heat gun or power tool paint removal with HEPA collection systems, workers shall minimally use the half-mask negative pressure respirator with high efficiency filters (for airborne concentrations not in excess of 500µg/m³).
16. Ensure that work area preparation, work practices, and clean-up procedures comply with these specifications and applicable Federal, State and Local regulations.
17. Notify all applicable agencies five days prior to the date the abatement will begin and provide evidence of notifications to the the Owner at the pre-start meeting.

C. Submissions
1. Within ten (10) consecutive calendar days calculated from the date of the the Owner's Job Order, the Contractor shall tender all required submissions. Six (6) sets of each submission are required. Where physical samples are required two (2) physical samples shall be submitted for each item. In general, items shall include but not be restricted to the following:
   a. Paint remover - corner cutter/Vac-Pac System by Pentek Inc; Decontamination Products Division 1026 Fourth Avenue, Corapolis, PA. 15108. Telephone No. (412) 262-0725 or approved equal.
   b. Description of removal method to be used on each substrate condition including manufacturer's operating instructions and recommendation for equipment usage.
   c. Copies of current training certificates of Staff to be assigned to the contract.
   d. List of three previous lead abatement jobs performed successfully by Contractor and name, address, and telephone number of contact person for verification.
2. In the event that all or any portion of the submitted material is rejected by the the Owner, the Contractor shall tender new submissions. All submissions returned for corrections shall be resubmitted with the required corrections within ten(10) consecutive calendar days calculated from the date of rejection, until final submissions are obtained that require no further correction. In no event shall the Contractor be permitted to tender submissions hereunder beyond twenty (20) days from the the Owner's Job Order, unless duly extended in writing by the the Owner.
3. No work shall begin, nor shall the materials be ordered or delivered to the site until final approval of all submissions.

D. Applicable Regulations
1. 24 CFR Part 35
2. HUD ”Guidelines For the Evaluation and Control of Lead-Based Paint Hazards in Housing”
3. Abatement work shall also be in accordance with applicable regulations of the Environmental Protection Agency (EPA), Occupational Safety & Health Agency (OSHA) and any State or Local LBP standards. Where there is a conflict between Federal, State or Local regulations, the more stringent requirement shall prevail.
4. OSHA Standards
   a. 29 CFR 1926.20 General safety and health provisions;
   b. 29 CFR 1926.21 Safety training and education;
   c. 29 CFR 1925.25 Housekeeping;
   d. 29 CFR 1926-28 Personal protective equipment;
   e. 29 CFR 1926.51(f) Washing facilities;
   f. 29 CFR 1926.55 Gases, vapors, fumes, dusts, and mists;
   g. 29 CFR 1926.57 Ventilation
   h. 29 CFR 1926.59 Hazardous Communication Standards;
   i. 29 CFR 1926.103 Respiratory protection, and
   j. 29 CFR 1926.62 Lead in Construction
5. The Contractor must comply with all applicable requirements of the Resource Conservation & Recovery Act (RCRA) of 1976 as amended in 1980 and 1984 by the Hazardous & Solid Waste Amendments (HSWA).
6. These Specifications refer to many requirements found in the preceding references but in no way is it intended to cite or reiterate all provisions therein or elsewhere. It is the Contractor's responsibility to obtain a copy, and know, understand and abide by all such regulations, guidelines and common practices.

1.2 PRODUCTS – (not used)

1.3 EXECUTION

A. Abatement

1. Have risk assessment or paint inspection performed by certified risk assessor or a certified inspector technician who is independent of the abatement contractor.
2. Develop a site specific lead hazard control plan, reviewed and signed by an asbestos consultant (LAC) who is licensed in the State in which the work is to be performed, and submit for review and approval to the the Owner.
3. Obtain any necessary building or waste permits, notify local authorities as required by applicable codes and laws.
4. Select specific building component replacement items, enclosure materials, paint removal equipment and/or chemicals, tools, and cleaning supplies. Consider waste management and historical preservation implications of selected treatment.
5. Develop project specific specifications.
6. Schedule other work so that leaded surfaces are not inadvertently disturbed and unprotected workers are not place at risk. Include time for clearance examinations and laboratory dust sample analysis in the scheduling process.
7. Select a certified abatement subcontractor.
8. Conduct a pre-construction conference to ensure that the subcontractor fully understands the work involved.
9. Notify residents of the dwelling and adjacent dwellings of the work and date it will begin. Coordinate this with the the Owner.
10. Correct any existing conditions that could impede the abatement work (i.e. trash removal, structural deficiencies).
11. Post warning signs and restrict entry to work area to authorized personnel. Implement worksite preparation procedures.
    a. Place proper warning signs required by OSHA regulations at all entrances to the work area. Signage shall be minimum of 12" x 20" and shall state the following:

WARNING
LEAD WORK AREA
POISON
NO SMOKING OR EATING

12. Coordinate test, pilot or sample portion approach to the project with the Owner.
13. Shut-down forced air heating, ventilation and air conditioning systems and cover all vents, diffusers, windows etc., with a single layer six-mil polyethylene sheet secured with duct tape. Exceptions shall be for minor disturbances of area less than 2 square feet and where if vents, diffusers, and windows are more than 5 feet away from surface being disturbed, they need not be covered.
14. Collect preabatement soil samples, which may not have to be analyzed until post abatement soil samples have been collected, analyzed, and compared to clearance standards. If postabatement soil levels are below applicable limits, the preabatement samples need not be analyzed.
15. Cover entrances to the work area with a single layer of 6 mil polyethylene sheets taped to the top and weighted at bottom.
16. Rig a containment non-flammable polyethylene sheet underneath the work area. This containment method should catch all stripped paint for proper disposal.
17. Execute abatement work.
18. Avoid spreading dust and debris outside the work area.
19. Store all waste in a secure area and make sure it is properly labeled with an accumulation start date.
20. Conduct daily and final cleanup.
21. Execute waste disposal procedures.

22. Maintain appropriate records.

B. Paint Removal

1. Do not use the following prohibited paint removal methods:
   a. Dry scraping or sanding (except for limited areas)
   b. Use of heat gun over 1,100°F
   c. Open flame burning or torching
   d. Machine sanding or grinding without HEPA vacuum exhaust tool
   e. Abrasive blasting or sandblasting without HEPA vacuum exhaust tool
   f. Uncontained hydro blasting or high-pressure wash
   g. Use of chemical strippers containing Methylene chloride.
2. Select the appropriate worksite preparation level.
3. For heat gun work, provide fire extinguishers in the work area and ensure that adequate electrical power is available. Use for limited areas only. Train workers to avoid gouging or abrading the substrate.
4. For mechanical removal methods, use tools equipped with HEPA exhaust capability. Be sure workers keep the shroud against the surface being treated. Vacuum blasting and needle guns should not be used on wood, plaster, drywall, or other soft substrates. Observe all manufacturers directions for the amount of vacuum airflow required.
5. For wet scraping, use a spray bottle or wet sponge attached to the scraper to keep the surface wet while scraping. Apply enough water to moisten the surface completely, but not so much that large amounts of water run onto the ground or floor. Do not moisten areas near electrical circuits.
6. For chemical paint removers, determine if the building component can be removed and stripped offsite. Offsite stripping is generally preferred to onsite paint removal. Observe all manufacturers' directions for use of paint removers.
7. For offsite stripping, determine how to remove the component. Score the edges with a knife or razor blade to minimize the damage to adjacent surfaces. Punch or tag the building component, if similar building components are also being stripped offsite (i.e. doors). This will ensure that the individual component is reinstalled in the same location. Inform the offsite paint remover that the lead-based paint component is present for shipping. Wrap the component in plastic and send to the offsite stripping location. Clean all surfaces before reinstallation and remove any lead residue by HEPA vacuuming all surfaces, cleaning with other lead-specific cleaners, or phosphate detergents, and HEPA vacuuming again.
8. For onsite paint removal, first test the product on a small area to determine its effectiveness. Chemical paint removers may not be effective or desirable on exterior, deteriorated wood surfaces, aluminum, and glass. Provide neoprene, nitrile, rubber, or polyvinyl chloride (PVC) gloves (or other type of glove recommended by the manufacture); face shields; respirators with combination filter cartridges for lead dust and organic vapors(if appropriate); and chemically resistant clothing. Be sure to select the right type of organic vapor filter cartridge, gloves, and clothing for the specific chemical being used. Portable eyewash stations capable of providing a 15-minute flow must be on-site. Apply the chemical and wait the required period of time. Securely store chemical s overnight. For caustic chemical paint removers, neutralize the surface before repainting using glacial acetic acid (not vinegar). Repaint.
9. Make sure all debris is caught in the containment sheet for proper disposal.
10. Mark and legally dispose of waste in accordance with all applicable Federal, State and Local regulations. Most wastes from paint removal projects, such as paint chips and paint remover sludge, will need to be managed as hazardous waste.
11. Conduct clean-up
12. Have a certified risk assessor or inspector technician conduct a clearance examination and provide documentation and a Statement of Lead-Based Paint Compliance.

C. Building Component Replacement

1. Prepare work area by selecting proper worksite preparation level.
2. Prepare the hazardous material building component for removal. Turn off and disconnect any electrical circuits inside or near the building component to be removed.

3. Lightly mist the component to be removed (unless electrical circuits are located nearby).
4. Score all painted seams with a sharp knife.
5. Remove any screw, nails, or other fasteners.
6. Use flat pry instrument and hammer to pry component from the substrate.
7. Remove or bend back all nails.
8. Wrap and seal all bulk components in plastic and take them to a covered truck or secured waste storage area along a pathway covered in plastic. Shovel any debris. Dispose of properly.
9. HEPA vacuum any dust or chips in the area where the component was located.
10. Conduct cleaning and clearance activities.

D. Soil and Exterior Dust Abatement

1. Determine if soil lead hazard exists. For hazard to exist, a total of at least 9 square feet of soil in a single yard or area must be bare and soil concentrations must exceed 2,000µg/gram lead for the yard or building perimeter or 400µg/gram of lead for small, high-contact play areas (pending the development of an EPA soil standard). Bare soil above these levels shall be treated by either interim controls or abatement. Soil abatement is most appropriate when levels of lead are extraordinarily high (greater than 5,000µg/gram lead) and when use patterns indicate contact frequency and exposure will be high.
2. Collect Preabatement soil samples to determine baseline levels. These samples need not be analyzed if post abatement samples are below applicable clearance levels.
3. Determine the method of soil abatement (soil removal and replacement, soil cleaning, or paving). Soil cultivation (rototilling or turning over the soil) is not permitted.
4. If paving, use a high quality concrete or asphalt. Observe normal precautions associate with traffic load weight and thermal expansion and contraction. Obtain necessary permits. Keep soil cultivation to a minimum.
5. If removing and replacing soil.
   a. Determine if waste soil will be placed in an offsite burial pit. Prepare vehicle operation and soil movement plan. Test new replacement soil (should not contain more than 200 µg/gram lead).
   b. Contact local utilities to determine location of underground utilities including water, gas, cable TV, electric, telephone, and sewer. Mark all locations to be avoided
   c. Remove fencing, if necessary to allow equipment access and define set limits with temporary fencing, signs, or yellow caution tape.
   d. Tie and protect existing trees, shrubs, and bushes.
   e. Have enough tools to avoid handling clean soil with contaminated tools.
   f. Remove soil.
   g. Clean all walkways, driveways, and street areas near abatement area.
   h. Replace soil at proper grade to allow drainage. Replacement soil should be at least 2 inches above existing grade to allow for settling.
   i. Install new soil covering (grass or sod) and maintain it through the growing season.
   j. Determine if soil waste is hazardous and manage it accordingly
   k. Conduct clean-up and clearance.
   l. Provide walk-off doormats.
   m. Maintain proper documentation.

E. Encapsulation

1. Determine if the applicable regulations aloe encapsulates to be used. Do not encapsulate the following surfaces:
   a. Friction surfaces, such as window jambs and door jambs.
   b. Surfaces that fail patch tests.
   c. Surfaces with substrates or existing coatings that have a high level of deterioration.
   d. Surfaces I which there is a known incompatibility between two existing paint layers.
   e. Surfaces that cannot support the additional weight stress of encapsulation due to existing paint thickness.
   f. Metal surfaces that are prone to rust or corrosion.
2. Conduct field tests of surfaces to be encapsulated for paint film integrity.

3. Consider special use and environmental requirements (i.e. abrasion resistance and ability to span base substrate cracks).
4. Provide to the the Owner encapsulant test data provided by the manufacturer.
5. Conduct at least one test patch on each type of building component where the encapsulant will be used. Report the results to the the Owner.
6. For both nonreinforced and reinforced coatings, use a 6” x 6” test patch area. Prepare the surface in the manner selected to complete the job. Prepared surfaces for patch testing should be at least 2” larger in each direction than the patch area.
7. For fiber-reinforced wall coverings, use 3” x 3” patch. For rigid coatings that cannot be cut with a knife, use soundness test. For all encapsulants, carry out the appropriate adhesion tests.
8. For liquid coating encapsulants, allow coating to cure, then visually examine it for wrinkling, blistering, cracking, bubbling, or other chemical reaction with the underlying paint.
9. Record results of all patch tests and provide to the the Owner.
10. Implement proper work site preparation level.
11. Repair all building components and substrates as needed (i.e. caulk cracks and repair sources of water leaks).
12. Prepare surfaces. Remove all dirt, grease, chalking paint, mildew and other surface contaminants, remnants of cleaning solutions, and loose paint. All surfaces should be deglossed, as needed.
13. Ventilate the contaminated area whenever solvents or chemicals are used.
14. During encapsulant application or installation, monitor temperature and humidity. For liquid coatings monitor coating thickness to ensure that the encapsulant manufacturer’s installation/application specifications are followed.
15. Conduct clean up and clearance.
16. Provide the the Owner information on how to care for the encapsulation system properly.
17. Maintain records on the exact detailed locations of encapsulant applications, patch test specifications and results, product name, subcontractor, date of application, a copy of the product label and material Data Safety sheet (MSDS) for the product and provide to the the Owner.

F. Enclosure
1. Stamp, label or stencil all lead-based painted surfaces that will be enclosed with a warning approximately every 2 feet both horizontally and vertically on all components. The Warning shall read “**Danger Lead-Based Paint**”. Deteriorated paint should not be removed from the surface to be enclosed.
2. Select the proper worksite preparation level.
3. Attach a durable drawing to the utility room closet showing where lead-based paint has been enclosed in the dwelling.
4. An independent inspector or technician or risk assessor should evaluate the integrity of the enclosure.
5. Repair any unsound substrates and structural members that will support the enclosure, if necessary.
6. Utilize appropriate enclosure material (drywall or fiberboard, wood paneling, laminated products, ridged tile and brick veneers, vinyl, aluminum m, or plywood).
7. Install extension rings for all electrical switches and outlets that will penetrate the enclosure.
8. If enclosing floors, remove all dirt with a HEPA vacuum to avoid small lumps in the new flooring.
9. Seal and back-caulk all seams and joints. Back-caulk means applying caulk to the underside of the enclosure.
10. When installing enclosure directly to painted surfaces, use adhesive and then anchor with mechanical fasteners (screws or nails).
11. Conduct clean up and clearance activities.
12. Maintain proper records and submit a Statement of Lead-Based Paint Compliance.

G. Final Cleaning Procedures
1. Use the following step-by-step procedures

a. Assign responsibilities to specific workers for cleaning and for maintaining the cleaning equipment.
b. Have sufficient cleaning equipment and supplies before beginning work.
c. If contamination is extensive, conduct precleaning of the dwelling unit.
d. Conduct ongoing cleaning during the job, including regular removal of large and small debris and dust. Decontamination of all tools, equipment and worker protection gear is required before it leaves contaminated areas. Electrical equipment should be wiped and high-efficiency particulate air (HEPA) vacuumed, not wetted down, to minimize electrocution hazards.
e. Schedule sufficient time (usually 30 minutes to an hour) for complete daily cleaning, starting at the same time near the end of every workday after lead hazard control activity has stopped.
f. For final cleaning, wait at least 1 hour after active lead hazard control activity has ceased to let dust particles settle.
g. Use a vacuum cleaner equipped with a HEPA exhaust filter. HEPA vacuum all surfaces in the room (ceilings, walls, trim, and floors). Start with the ceiling and work down, moving toward the entry door. Completely clean each room before moving on.
h. Wash all surfaces with lead-specific detergent, high-phosphate detergent, or other suitable cleaning agent to dislodge any ground-in contamination, then rinse. Change the cleaning solution after every room is cleaned.
i. Repeat step g above. To meet clearance standards consistently, a HEPA vacuum, wet wash, and HEPA vacuum cycle is recommended. For interim control projects involving dust removal only, the final HEPA vacuuming step is usually not needed. Other cleaning methods are acceptable, as long as clearance criteria are met and workers are not over exposed.
j. After final cleaning perform visual examination to ensure that all surfaces requiring lead hazard control have been addressed and all visible dust and debris have been removed. Record findings and correct any incomplete work.
k. If other construction work will disturb the lead-based paint surfaces, it should be completed at this point. If those surfaces are disturbed, repeat the final cleaning step after construction work has been completed.
l. Paint and otherwise seal treated surfaces and interior floors.
m. Conduct clearance examination.
n. If clearance is not achieved, repeat final cleaning.
o. Continue clearance testing and repeated cleanings until dwelling unit achieves compliance with all clearance standards. The cost of repeated cleaning, after failure to achieve clearance is to be borne by the contractor.
p. Do not allow residents to enter work area until final cleaning is completed and clearance is established.
q. Cleaning equipment list is as follows:
    1) HEPA Vacuums
    2) Detergent
    3) Waterproof gloves
    4) Rags
    5) Sponges
    6) Mops
    7) Buckets
    8) HEPA vacuum attachments (crevice tools, beater bar for cleaning rugs)
    9) 6-mil plastic bags
    10) Debris containers
    11) Waste water containers
    12) Shovels
    13) Rakes
    14) Water-misting sprayers
    15) 6-mil polyethylene sheeting (or equivalent)

2. Order of execution for final cleaning steps should be as follows:

a. As the first stage in final cleaning, floor plastic shall be misted and swept.
b. Upper level plastic, such as on cabinets and counters should be removed first, after it has been misted and cleaned. All plastic should be carefully folded from the corners/ends to the middle to trap any remaining dust. Next remove both layers of plastic from the floor.
c. Plastic sheets used to isolate contaminated rooms from noncontaminated rooms should remain in place until after cleaning and removal of other plastic sheeting, these sheets may then be misted, cleaned and removed last.
d. Removed plastic should be placed into double 4-mil or single 6-mil plastic bags, or plastic bags with equivalent (or better) performance characteristics, which are sealed and removed from the premises. As with daily cleanings, this plastic removal process usually requires workers to use protective clothing and respirators.
e. After plastic has been removed from the contaminated area, the entire area should be cleaned using the HEPA/wet wash/HEPA cycle.

H. Waste Testing And Disposal

1. General: All materials, whether hazardous or non-hazardous shall be properly disposed of. the Owner may hire an independent Monitoring Consultant to perform TCLP test to determine which of the wastes are hazardous. Contractor shall cooperate in this test. If less than 100kg (200 lbs) or 1/2 of a 55 gallon drum of hazardous waste per month will be generated, it is considered "conditionally exempt" abatement waste, and may be managed as solid non-hazardous waste. The RCRA hazardous waste manifest is not required when shipping this waste to an offsite disposal facility.
2. Separate Abatement Waste into The Following Four Categories:
   a. Category I. Low lead waste (typically non-hazardous) e.g. Filtered personal and commercial wash water.
   b. Category II. Architectural components - (painted finish carpentry items) e.g. Doors, windows, window trim and sills, baseboards, railings, moldings. (May do a TCLP to determine if they are hazardous).
   c. Category III. Concentrated lead waste e.g. sludge from stripping, lead-base paint chip and dust, HEPA vacuum debris and filter, unfiltered wash waste, any waste included in EPA's list of hazardous waste.
   d. Category IV. Material that cannot be determined to be either hazardous or non-hazardous must be tested by TCLP.

   If the hazardous waste generated is greater than 100kg per month, dispose according to the referenced guidelines and RCRA hazardous waste management requirements including those listed below.
3. Disposal Requirements: Contact the regional EPA, state, local and all other pertinent authorities to determine lead-based paint debris disposal requirements. Comply with requirements of the Resource Conservation and Recovery Act (RCRA) and with applicable federal, state, county, or local waste requirements.
4. EPA ID Numbers: Obtain a Generator RCRA Hazardous Material ID number and coordinate this action through the State and secure any additional number as required.
5. Storage Requirements: Keep all hazardous items in a secure area or lockable container that is inaccessible to all persons other than the Contractor's personnel. Label all hazardous waste "Hazardous Waste" with the date that the Contractor began to collect the waste in that container. Keep hazardous and non-hazardous waste in separate containers. Until TCLP testing is completed, considered all items hazardous and store in a secured area or lockable container.
6. Waste Transportation: Transport hazardous waste using a RCRA/DOT/EPA certified Hazardous Waste Transporter. Submit names and qualifications of certified transporter/hauler for the Owner approval. The Contractor shall be responsible for all actions of the waste hauler as pertaining to waste removal and disposal under these procedures and all EPA, DOT and other applicable regulations.
7. Disposal Facility: Supply documents that detail the site(s) to be used for ultimate disposal. Submit documents from these sites proving that they are licensed/permitted to accept such waste and shall accept the waste proposed by the Contractor for treatment or ultimate disposal.

8. Waste Containers: Comply with EPA and DOT regulations for waste containers. Contact the state and local authorities to determine their criteria for containers. In the case of any conflict in regulations, the more stringent shall apply.
9. Emergencies: Contact local fire, police, hospitals or local emergency response teams and inform them of the type of hazardous waste activity and ask for assistance in the event of any accident. Additionally, the container shall provide the following:
   a. Keep and properly maintain a suitable fire extinguisher(s) on site.
   b. Have a immediate means of communication with the regulatory agency in the event of an emergency.
   c. Keep a list of phone numbers of regulatory agencies on site.
   d. Appoint an emergency coordinator and ensure that he is on site to supervise emergency procedures to be carried out in the event of an emergency.
   e. Keep and maintain a "right to know" manual that is in an easily accessible location and in an area that is known to all employees.
10. Transporting Waste: Provide certifications that the transporter is registered with the U.S. Department of Transportation is required by 49 CFR Part 107(a) transport hazardous waste.
   a. Provide certifications that each vehicle dedicated to haul hazardous waste has been assigned a "U.S. DOT Hazardous Material Registration Number" as required by 49 CFR Part 107.
   b. Be responsible for all other applicable permits pertaining to hauling, transport, reduction, and disposal of hazardous waste as they may apply to this project.
   c. <u>Vehicle:</u> Ensure that all non-hazardous waste is transported in covered vehicles to a landfill, or lined landfill, if required.
   d. <u>Container Handling</u>: Carefully place the containers into the truck or dumpster used for disposal. At no time shall debris or containers be thrown or dropped.
   e. <u>Liquid Wastes:</u> Contain and properly dispose of all liquid wastes, including lead-contaminated wash water.
   f. <u>Containers:</u> HEPA vacuum the exterior of all waste containers prior to removing the waste containers from the work area. Wet wipe the containers to ensure that there is no residual contamination. Then move containers out of the work area into the designated storage area.

I. Clearance
1. Clearance on all abatement projects must be done by an independent certified risk assessor or inspector technician. Follow all jurisdictional law with regard to licensure requirements for personnel conducting clearance activities.
2. Clearance step-by-step procedures are as follows:
   a. Finish the lead hazard control clean-up effort. Seal floors before clearance (if necessary).
   b. Wait 1 hour to allow any airborne dust to settle. Do not enter work area during that hour.
   c. Conduct visual examination
      1) Determine if all required work has been completed and all lead-based paint hazards have been controlled.
      2) Determine if there is visible settled dust, paint chips, or debris in the interior or around the exterior.
   d. Complete the Visual Clearance Form required by the the Owner; if all work is not completed inform the the Owner and order completion of the work and repeat cleanup, if necessary.
   e. Conduct clearance dust sampling of the floors, interior window sills, and window troughs using approved protocol.
   f. Conduct soil sampling if bare soil is present that was not sampled previously, or if exterior paint work was completed as part of the lead hazard control effort. Whenever exterior work has been don, it may be necessary to take samples from the soil that is not bare to determine if contamination has occurred. If results are above 1,000 µg/g (or 400 µg/g in high contact play area), compare the results to baseline soil sampling results to determine what additional measures are needed.
   g. Complete the Dust and Soil Sampling Clearance Form required by the the Owner.

h. Submit samples to a U.S. Environmental Protection Agency (EPA) recognized laboratory participating in the National Lead Laboratory Accreditation program (NLLAP) for analysis.

i. Interpret results by comparing them to Interim Clearance Standards as listed below:

1)	Floors	400 µg/ft2
2)	Window sills	250 µg/ft2
3)	Window Troughs	800 µg/ft2
4)	Soils (Play area with children under 6 years of age)	400 µg/gram

j. If clearance is achieved go to step N.

k. Order repeated cleanings or soil treatments if results are above applicable standards. Clean all surfaces the sample represents.

l. Continue sampling and repeated cleanings until the dwelling achieves compliance with all applicable clearance standards.

m. Complete any related construction work that does not disturb a surface with lead-based paint (all work that does disturb painted surfaces or that could generate lead dust should be completed as part of the lead hazard control effort).

n. Issue any necessary statements of lead-based paint compliance or releases and maintain appropriate records.

J. Labels

1. Use the following labels on drums used for disposal.

HAZARDOUS WASTE

FEDERAL LAW PROHIBITS IMPROPER DISPOSAL.

IF FOUND, CONTACT THE NEAREST POLICE OR PUBLIC SAFETY AUTHORITY OR THE U.S. ENVIRONMENTAL PROTECTION AGENCY.

GENERATOR INFORMATION:

NAME _____

ADDRESS _____ PHONE _____

CITY _____ STATE ____ ZIP _____

EPA-ID NO. / MANIFEST DOCUMENT NO. _____ / _____

ACCUMULATION START DATE _____ EPA WASTE NO. _____

HAZARDOUS WASTE, SOLID, N.O.S.

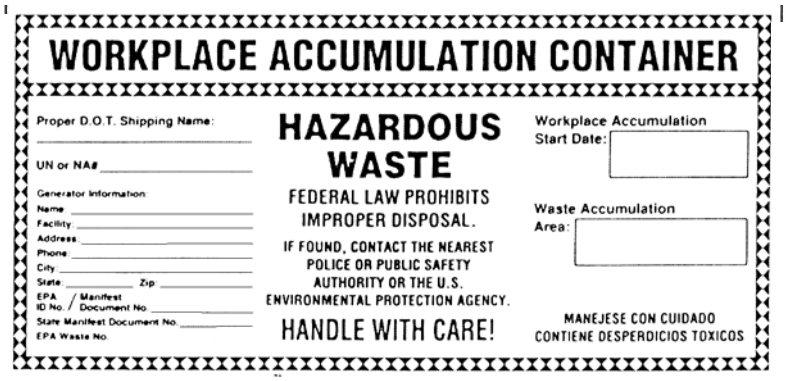
( )

NA3077

D.O.T. PROPER SHIPPING NAME AND UN OR NA NO. WITH PREFIX

HANDLE WITH CARE!

STYLE HWM12



WORKPLACE ACCUMULATION CONTAINER

Proper D.O.T. Shipping Name: _____

UN or NA# _____

Generator Information:
Name: _____
Facility: _____
Address: _____
Phone: _____
City: _____
State: _____ Zip: _____
EPA ID No. / Manifest Document No. _____
State Manifest Document No. _____
EPA Waste No.

HAZARDOUS WASTE

FEDERAL LAW PROHIBITS IMPROPER DISPOSAL.

IF FOUND, CONTACT THE NEAREST POLICE OR PUBLIC SAFETY AUTHORITY OR THE U.S. ENVIRONMENTAL PROTECTION AGENCY.

HANDLE WITH CARE!

Workplace Accumulation Start Date:

Waste Accumulation Area:

MANEJESE CON CUIDADO
CONTIENE DESPERDICIOS TOXICOS

K. Disposal of lead-based paint waste.

1. Follow the RCRA and HUD recommended practices as defined in the table below:

Waste Management Practices	Category I: Low Lead Waste	Category II: Architectural Components	Category III: Concentrated Lead Waste	Category IV: Other waste
RCRA Requirements	Manage as nonhazardous Waste	Depending upon knowledge or TCLP testing results, manage as solid hazardous or nonhazardous waste	If more than 100 kg/ month, manage as hazardous waste. If less than 100 kg/month manage as solid waste.	Use TCP to determine if waste is hazardous.
HUD Recommended Practices	Applicable	Applicable, if knowledge or TCLP testing indicates that it is nonhazardous.	Applicable if less than 100 kg/month otherwise subject to full RCRA regulations	Only applicable if TCLP testing shows waste is nonhazardous
Wrapped in plastic; seal all seams with tape (if acceptable to the disposal facility).	X	X	X	X
Stored in designated, secure area.	X	X	X	X
Covered During Transport	X	X	X	X
Prohibit cutting/breaking outside work area.	X	X	X	X
Cover ground with 6-mil plastic if handling outside.	X	X	X	X
Prohibit disposal in solid waste incinerators and reuse recycling for mulch	X	X	X	X
Recommended disposal in State licensed/permitted	X	X	If appropriate.	X

solid waste landfill.				

L. Safety Requirements

1. To protect the health and safety of all persons involved, it is of the utmost importance that deleading is safely and correctly done in a timely manner. The following specific safety requirements are the responsibility of the Deleading Contractor.

K. General Safety:

1. General
   a. NO ONE is to be allowed in the work area without an approved respirator except for methods that have been documented not requiring a respirator.
   b. Each work area must be sealed from the remainder of the dwelling by taping plastic sheets (6 mil thick). Work areas must remain sealed off until both work and clean-up are completed.
   c. Cover all floors, carpets, furniture and appliances with 6 mil plastic within the work area. Use automotive masking tape (2 inches wide) to seal all edges and seams.
   d. Make certain all electrical connections are properly grounded.
   e. At least three days prior to the start of any deleading work, post appropriate warning signs at all entrances and exits of work areas and leave in place until all clearance testing indicates that these areas are safe for re-occupancy. The signs must include the following phrase: "CAUTION LEAD HAZARD-KEEP OUT". Post bilingual signs when necessary.
2. Worker Safety: The Deleading Contractor shall take the following minimum precautions to protect the health of all individuals involved in the deleading process.
   a. Pre-Abatement Medical Exam: Each employee shall undergo a medical examination to determine both respiratory fitness capability and also pre-existing/current blood lead level. Said results shall be provided to the employee and also to the Owner within 3 days of receipt of same, and in all cases, prior to employee's commencement to active abatement. Records of same are required to be kept by the Contractor for 40 years.
   b. Medical Surveillance is the monitoring of worker blood levels. It is required that the Contractor have blood level monitoring of all active abatement and clean-up workmen and on-site supervisors performed and said results provided to the Owner.
      1) Before assignment to active abatement activity for each worker.
      2) 30 days after active abatement has begun.
      3) At least every two months during the first six months and every six months throughout the deleading job.
      4) At least every two months for each employee whose blood lead analysis indicated a blood lead level at or above 25 micrograms per deciliter. (20 micrograms per deciliter for women of child bearing age).
      5) At termination of employment.
      6) Contractor shall reassign any employee whose blood lead has reached 25 µg/dl (20 µg/dl for women of child bearing age) to a job function deemed safe from lead exposure. Said employee shall remain away from active abatement until such time as 2 consecutive months' blood tests indicate µg/dl below 20 µg/dl.
   c. Respiratory Protection Programs must be established by the Contractor in accordance with OSHA regulations and qualitative respirator fit testing must be conducted daily by the on-site supervisor. Medical examinations must be performed by a physician prior to fit testing and at anytime when a worker demonstrates any difficulty breathing during the use of or the fit testing of respirators. The following are minimal acceptable respiratory protection program requirements as set up and administered by the Contractor:
      1) Written standard operating procedures which oversees the selection and use of respirators.
      2) Selection of respirators on the basis of hazards to which the worker is exposed.
      3) Worker training on the limitations and use of respirators (includes fit testing).
      4) Individual workers assigned respirators for their exclusive use only.

5) Daily cleaning and disinfecting of respirators.
6) Proper storage of all respirators.
7) Proper inspection of all respirators for wear and tear.
8) Continual surveillance of work area conditions and level of worker exposure or stress.
9) Use of approved respirators only, modified as needed by the weekly exposure monitoring results.
10) Supply weekly report covering items 1-9 to the Owner or its Lead Consultant.

d. Exposure Monitoring is the measured concentration of lead in the workers breathing zones. The Contractor shall perform personnel monitoring during active abatement using the NIOSH 7072 method and-shall be responsible for:
1) Monitoring the level of worker protection needed during the abatement process;
2) Evaluating, modifying and improving any engineering and work practice control(s) as needed;
3) Evaluating each employee's personal quality of work and any need for additional worker training or safety instruction;
4) Providing the Owner results of all personnel monitoring tests within 10 days of testing; and
5) Providing half-face APR respirators with HEPA filters unless said monitoring test results dictate differently. OSHA guidelines shall be used to determine respirator PEL protection factors.

e. Protective Clothing Equipment must be provided to all workers to help assure that lead dust is contained to the work areas. The following must be supplied/enforced by the Deleading Contractor:
1) Full body protective clothing and shoe covers of appropriate sizes on a daily basis or as needed.
2) Clean changing areas separated from the dirty/contaminated clothes storage area.
3) Water and wash facilities for washing of hands and face and shower facilities if deemed necessary by the Owner's Lead Advisor.
4) Instructing worker on proper maintenance of clothing and equipment.
5) Proper disposal of disposable clothing and proper permanent work clothes.
6) Enforcing the removal of protective clothing at the end of each work day and before eating, drinking and smoking.
7) Enforcement of the removal of protective shoe covers before leaving work area.

3. Contractor/Worker Daily Safe-Work Procedures

a. Daily Start-Up:
1) Workers to put on protective gear prior to entering work areas.
2) All garment seams to be sealed with duct tape.
3) All non-working garments must be stored in designated changing area.
4) Respirators, as required, must be properly fitted before entering work area. Perform qualitative fit test.

b. Temporary depart:
1) All protective clothing to be HEPA vacuumed while still being worn.
2) All shoe covers to be removed and left in the work area (immediate departure upon removing).
3) Remove all protective gear in designated "contaminated" changing area before eating, drinking, and smoking or before leaving work site.
4) Wash hands and face.
5) Clean respirators.

c. Daily Shut-Down:
1) Dispose of protective clothing with abatement waste by sealing in a 6 mil poly bag.
2) Laundered clothes must be placed in closed container.
3) Wash hands and face.
4) Shower if facilities allow and circumstances dictate.
5) Clean all protective gear (respirators included).

4. Tenant's Safety: Temporary relocation of the tenants is necessary if the lead paint surface is broken. Temporary relocation of the tenants and their belongings is the responsibility of the Owner. However, the Contractor has the joint responsibility to administer and enforce the following safety practices on behalf of the occupants:
   a. Adults
      1) NO OCCUPANT is allowed to enter the work area during paint removal and initial clean-up. A three day clean-up and settlement period may be imposed depending upon the abatement procedures used, at the discretion of the Owner or their Lead Consultant.
      2) the Owner shall notify all occupants in writing when they are allowed to return to their post-abated residence. Contractor shall abide by these notices.
      3) Every resident who has received prior notice of abatement is responsible for placing all personal items (clothing, dishes, linens, etc.) in closed, easy to handle containers; and move such items to the center of each room as requested.
      4) As long as visible dust remains, occupants may not occupy dwelling, and all surfaces within the dwelling must be re-washed with trisodium phosphate and HEPA vacuumed by deleading contractor.
      5) Persons reoccupying dwellings following abatement are required to report any visible dust or debris to the Owner immediately for additional Contractor clean-up.
   b. Pregnant Women and Children
      1) Absolutely no pregnant women nor children under the age of twelve years of age may be allowed in the building while any part of the abatement process is going on.

END OF SECTION 13285a

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SECTION 13285b - XRF TESTING FOR LEAD-BASED PAINT

DESCRIPTION OF WORK

This specification covers the furnishing and installation of materials for XRF testing for lead-based paint. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

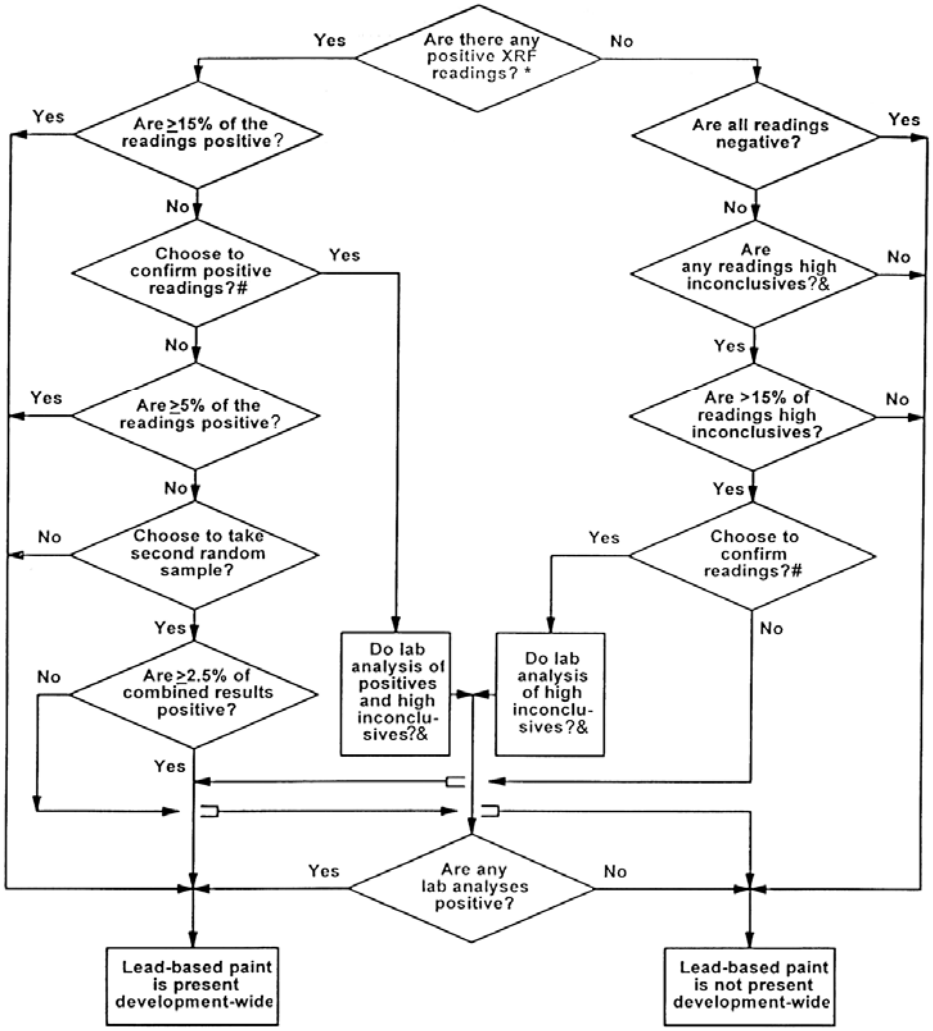
GENERAL

Inspection Rules: The Contractor will be required to comply with the following inspection rules. These inspection rules (the "Inspection Rules"), which appear in this section for the various XRF machines, are also known as "IP-4". The Inspection rules are subject to modification upon written notice by the Owner.

1. Random Sampling Program - Multi-family housing testing rules.
   a. In order to use the Multi-family housing testing rules, there must be:
      1) 21or more units (pre-1960 construction) and all must have a similar construction and original painting history, or
      2) 10 or more units (construction from 1960-1977) and all must have a similar construction and original painting history.
   b. Determine the number of randomly selected units to be tested from Table 7.3, Chapter 7, in the HUD guidelines. Chapter 7 of the HUD Guidelines also describes how to select the units randomly. If a unit or units which were selected as part of the original random sample cannot be entered for a particular reason, a replacement unit(s) must be randomly selected in accordance with the HUD Guidelines.
   c. All testing must be done in strict accordance with the HUD guidelines except as such Guidelines are modified by the Owner in writing in this Agreement. As per the HUD Guidelines, an assessment on each tested component must note four attributes, also called a testing combination.
      1) The room equivalent (where the testing took place i.e. bedroom, bathroom, etc.)
      2) The component type (door, wall #1 - upper left, etc.)
      3) The substrate (brick, wood, concrete, drywall, plaster or metal).
      4) The color of the paint.
   d. These attributes must be included as part of the report.
   e. For each testing combination, the condition of the painted surfaces should be noted as either intact, fair or poor.
   f. One reading with the X-ray fluorescence (XRF) instrument on each testing combination is all that is required.
   g. At least 40 components of a given type must be tested to obtain the desired level of confidence in the results throughout the multi-family development. If less than 40 components of a given type exist in the buildings to be tested i.e. they are unique components, then the measurement should be taken using single family testing rules (described below). If less than 40 components of a given type exist in the units to be tested, additional components of this type can be identified in other units in the complex and tested to bring the total up to 40 so that multi-family testing rules can be used. The decision of which option the Contractor should use will be made by the the Owner.
   h. To increase the number of tested components of a given type, testing combinations with different colors on the same component and substrate may be combined into a single component type. For example, if "wood doors" is the component type, all wood doors tested for lead-based paint could belong to the same component type, regardless of color.
   i. A component type may be differentiated by color as long as there are 40 tested and there is a good reason for differentiation.

j. The XRF measurements, corrected for substrate contribution, if required by the Performance Characteristic Sheet ("PCS") for the particular type of instrument being used, should be sorted by the inspector by component type into the following categories:
   1) Positive- A positive XRF reading in accordance with the XRF's Performance Characteristic Sheet.
   2) Negative- A negative XRF reading in accordance with the XRF's Performance Characteristic Sheet.
   3) High Inconclusive- An inconclusive XRF reading equal to or greater than the midpoint of the XRF's inconclusive range, in accordance with the XRF's Performance Characteristic Sheet.

k. The following Decision analyses will be used to determine which components are positive or negative:



* *"Positive," "negative," and "inconclusive" XRF readings are determined in accordance with the XRF instrument's Performance Characteristics Sheet as described in the HUD Guidelines for the Evaluation and Control of Lead Hazards in Housing, chapter 7.*

& *A high inconclusive reading is an XRF reading at or above the midpoint of the inconclusive range. For example, if the inconclusive range is 0.41 to 1.39, its midpoint (average) is 0.90; a reading in the range from 0.90 to 1.39 would be a high inconclusive reading.*

\# *Any paint or coating may be assumed to be lead-based paint, even without XRF or laboratory analysis. Similarly, any XRF reading may be confirmed by laboratory analysis.*

l. If there are readings on a component type(s) equal to or greater than 1.0 mg/cm² and paint chip samples are submitted to the laboratory, there are two possible results:

1) If all lab samples on a component type are below 0.5% lead by weight, the component type can be classified as negative throughout the development.
2) If one or more lab results are positive, (equal to or greater than 0.5% lead by weight for a component) the the Owner will take one of three options:
   a) Treat the component type as positive throughout the development, or
   b) Test the component type throughout the development, or
   c) If 5% or less of the component type are positive, take a second random sample, just testing that component type.

3) If option 2)c) above is selected by the Owner and the combined results of the first and second random sample are less than 2½% positive, the following additional options are available depending on the results.
   a) If no positives are found in the second sample, no further testing is necessary. Those positives in the first random sample will be monitored/abated (not by this Agreement), but the rest of the component type can be classified as negative.
   b) If positives are found on a component type in the second sample, the the Owner has the option to classify the component type as positive throughout the development or comprehensively test it.
   c) If the combined results of the two random samples are equal to or greater than 2½%, the the Owner also has the option to comprehensively test the remaining components of that type or classify them as positive.

m. Paint Chip Sample Size: The Paint chip samples should be taken from a 4 square inch (25 square centimeter) area that is representative of the paint on the testing combination, as close as possible to any XRF reading locations and, if possible, unobtrusive. This area may be a 2" x 2" (5 x 5 centimeters) square, or a 1" x 4" (2.5 x 10 centimeters) rectangle, or have any other dimensions that equal at least 4 square inches (25 square centimeters). Regardless of shape, the dimensions of the surface area must be accurately measured (to the nearest millimeter or 1/16th of an inch) so that the laboratory results can be reported in mg/cm$^{2.}$ Results should be reported as percent by weight if the surface area cannot be measured accurately or if all paint within the sampled area cannot be removed. In these cases, lead should be reported in ppm or percent weight, not in mg/cm^2. Smaller surface area can be used if acceptable to the laboratory. (See ASTME 1729). In all cases those who take the samples should consult with the NLAAP recognized laboratory selected regarding the requirements for the submission samples for lead-based paint analysis.

n. If the the Owner decides to test in search of these hard-to-find components coated with lead based paint, the inspector must use the single family testing rules described in the next section.

2. Single Family Testing Rules
   a. If the housing development has less
      1) than 10 units built between 1960-1970 or
      2) 20 units built before 1960 or
      3) the random testing rules in a multi-family development are not being used

      then single family testing rules must be followed.
   b. All inconclusive results must be confirmed with laboratory analysis, or as an alternative must be classified as positive. the Owner may also wish to confirm positive XRF results with laboratory analysis. Therefore the Contractor must make a field determination of which XRF readings falls in the inconclusive or positive ranges and take paint chip samples during the XRF testing for possible laboratory analysis. If the majority of XRF readings are positive in the first few units, the inspector must consult with the Owner on whether to continue taking paint chip samples.

      Only the Owner may determine whether to submit collected paint chip samples for laboratory analysis or to classify the element as positive.
3. Similar common areas and similar exterior sites must always be tested, but in some cases they can be sampled in much the same way that dwelling units are. Common areas and building exteriors typically have a similar painting history from one building to the next. In multifamily housing, each common area (such as building lobby, laundry room, or hallway) can be treated as a dwelling unit. If there are multiple similar common areas, they may be grouped for sampling purposes I exactly the same way as regular dwelling units. However, dwelling units, common areas and exterior sites cannot be all mixed together in a single group. All testing combinations within each common area or building exteriors selected for testing must be inspected. This includes playground equipment, benches and miscellaneous testing combinations located throughout the development. The specific common areas and building exteriors to test should be randomly selected, in much the same way as specific units are selected using random numbers.

The number of common areas to be tested should be taken from table 7.3 (HUD Guidelines). In this instance, common areas and building exteriors can be treated in the same way as housing units (although they are not to be confused with true housing units).

4. Unit and common area drawings
   a. Mark-ups of as built drawings depicting room equivalents that are tested must be provided as part of the report.
   b. The Contractor should test in a clockwise path starting from the door through the space and room equivalents so that the approximate location of each component tested can be easily established by referencing the room equivalent and sides.
   c. Each space must have a reference point (side A, B, C, D or wall 1, 2, 3 or 4). The wall with the door should always be referenced as wall 1 or side A. If there is more than one door, wall 1 or side A should be used to refer to the wall with the door through which the room is first entered when moving in a clockwise fashion through the unit.
5. XRF Instruments and testing protocols
   a. The Contractor has the option to use any of the following instruments for the XRF testing: Scitec MAP 4 Spectrum analyzer, Princeton Gamma-Tech XK-3, Warrington MicroLead 1, Revision4, TN Technologies (TN Spectrace) PB analyzer, Radiation Monitoring Devices LPA-1, Advanced Detector-Leadstar, or the Niton XL-309 Spectrum analyzer.
   b. Chapter 7 of the HUD guidelines 1997 Revision, assumes that the standard for classifying paint as toxic for lead is 1.0 mg/cm². The PCS of these instruments have established inconclusive ranges/thresholds by substrate type based on the 1.0 mg/cm² standard. These ranges/thresholds are interim ranges/thresholds which are subject to review by HUD; however they must be used by the Contractor unless and until the Contractor is notified otherwise in writing by the Owner. Therefore the following table should be used to determine which readings falls in the inconclusive ranges/thresholds. the Owner reserves the right to modify these inconclusive ranges/thresholds by notice in writing to the Contractor.
6. Evaluation of the Inspection by the the Owner
   a. The Contractor will be required to carry out retesting at no additional cost to the the Owner, after completion of the Inspection at each the Owner development as described in the HUD Guidelines on page 7-17, section H, and page 7-28, section H, for single family housing and multi-family housing respectively. As per the HUD Guidelines, the the Owner shall randomly select the testing combinations to be retested and the Contractor shall perform the retesting using the same XRF instrument(s) which was/were used to take the original readings. A the Owner inspector shall be present to observe all retesting. The retesting shall be limited to ten (10) testing combinations, and if necessary to repeat the retest, the testing combinations randomly selected for repeating the retest shall also be limited to ten.
   b. If the retest tolerance limit computed from the information provided in the XRF Performance Characteristics Sheet is exceeded, the retest will be repeated as described in the HUD Guidelines page 7-18, section H both for single family and multi-family housing. If the retest tolerance limit is exceeded again, the the Owner may require the Contractor to retest the entire development at no additional cost to the the Owner, or the the Owner may withhold all payments and terminate its agreement with the Contractor.
7. Option to do Laboratory Testing only
   a. The the Owner may, for a specific testing assignment, request in writing that the Contractor, when utilizing the multi-family housing testing rules for random sampling, or the single family housing testing rules, do all testing through laboratory analysis of paint chips rather than through XRF Spectrum Analyzer testing with laboratory confirmation as needed. Please note that under the single family housing testing rules, only one paint chip must be taken and analyzed for each component type.

Scope Of Work: The work shall consist of furnishing all labor, material, insurance and all other incidental items required to do the following:

8. XRF Testing

a. Random or comprehensive testing of various components in apartments in various Projects using any of the X-ray Fluorescence ("XRF") machines listed in section IIID, to determine if the lead-based paint concentration is within permissible limits.
   Note: Testing may be for entire apartments or selected rooms or components within the apartment.
b. The permissible limit shall be defined as a final reading showing a lead concentration of less than 1.0 mg/cm².
c. Refer to the Manufacturer's manual, as well as the "XRF Performance Characteristic Sheet" when determining calibration check tolerance, and other instrument specific information. Use the adjusted "XRF Performance Characteristic Sheets" in this contract when determining the inconclusive range.
d. In addition to the manufacturer's recommended warm up and quality control procedures, a set of three nominal XRF calibration check readings must be taken before the inspection begins and after the inspection has been completed in a particular unit, or every 4 hours, whichever occurs first. All reference material values and calibration check readings must be included in the report provided to the Owner.
e. Do not use the XRF to test highly curved or ornate surfaces, or surfaces inaccessible to the XRF, due to poor reliability of results. For such surfaces, laboratory analysis of paint chips must be done.
f. Only one XRF reading is required per testing combination. A unique testing combination is characterized by the room equivalent, the component, the substrate and the visible color of the paint. However, testing combinations with different colors on the same component and substrate may be combined into a single component type.
g. All inconclusive results must be treated according to the inspection rules using multi-family inspection or single family inspection rules as appropriate.
h. XRF field data sheets shall be filled out as they appear on completed Form 7.1 and 7.5 Guidelines.
i. Room equivalents or sections thereof that are not accessible for testing (i.e. locked bedrooms) shall be noted in the final report to the Owner.

9. Laboratory testing of paint chips.
   a. Collection of paint chips from various painted components in various Projects for laboratory analysis due to XRF substrate corrected inconclusive and/or positive readings as directed by the the Owner.
   b. Laboratory preparation and testing by Flame Atomic Absorption Spectrometry (FAAS) or Graphite Furnace Atomic Absorption Spectrometry (GFAAS) to determine if the lead paint concentration is within permissible limits.
   c. The permissible limit shall be defined as a lead concentration less than 0.5% by weight.
   d. Collect paint chips in accordance with ASTM ES28-94.
   e. Prepare paint chips in the laboratory for testing in accordance with ASTM ES37-94.
   f. Repair and repaint areas from which paint chips have been collected, to match adjacent areas, unless notified by the the Owner in writing to utilize a temporary covering for the tested surfaces. The Contractor shall provide water based latex paint for this purpose. Colors shall be limited to white and off-white; and other colors if provided by the tenant.
   g. Only one paint chip is required per testing combination. A unique testing combination is characterized by the room equivalent, the component, the substrate, and the visible color of the paint. However, testing combinations with different colors on the same component and substrate may be combined into a single component type.
   h. Field data sheets and signed chain of custodies must be attached to the final report to the Owner.
10. The Contractor shall send notices to the Project Superintendent, Residents, and the Department of Planning and Development 48 hours before the scheduled start of work. The Contractor shall make three (3) attempts to gain entry to each apartment, with proper 48 hour notification to the resident each time.
11. The Contractor shall begin work no later than 48 hours after receiving a work proceed order.

12. The Contractor shall perform work in accordance with the latest HUD Guidelines, except as such guidelines are modified by the Owner in writing in this contract or any contract pursuant to this contract, and in accordance with all applicable Federal, State and Local regulations.
13. Workmanship required in the execution of the work herein specified shall be of good quality and subject to the approval of the the Owner.

XRF Testing Report Format

14. All XRF report must be made after a formal submittal and approval by the Owner.
15. A faxed summary report must be provided to the the Owner within 48 hours after completion of testing for a work Authorization. For XRF testing requiring confirmation by laboratory analysis of paint chip samples, the faxed summary report must be provided within 48 hours after the the Owner gives approval for testing of the collected paint chip samples.
16. A detailed report must be provided to the the Owner within 5 business days after completion of the testing.

General Provisions

17. Some of the work of this contract will be in occupied apartments. The Contractor shall perform all of the work of this contract with the least inconvenience to the tenants.
18. The Contractor shall take all necessary precautions to protect the property of the the Owner, its residents and the public. The contractor must repair any damaged property, whether of the the Owner, its residents, or the public, and restore such property to its original condition. If the damage is beyond repair, the Contractor shall replace it with new, that in the judgement of the the Owner, match the existing materials and are of equal quality and workmanship. All such repairs shall be at the Contractor's expense.
19. The Contractor shall begin work no later than 48 hours after receiving a work proceed order.
20. The Contractor shall perform work in accordance with the latest HUD Guidelines, except as such guidelines are modified by the Owner in writing in this Contract, or any Contract pursuant to this Contract, and in accordance with all applicable Federal, State and Local regulations.
21. The Contractor shall include in the bid price all supplementary miscellaneous items not specified but implied or required in order to complete the work.

Applicable Regulations

22. All work of this contract shall be in strict accordance with the HUD Guidelines.
23. All work of this contract shall also be in accordance with applicable regulations of the Environmental Protection Agency (EPA), Occupational Safety & Health Agency (OSHA) and any applicable State or Local standards that may be more stringent than the Federal Standards.
24. OSHA Standards (without limitation), include:
    - 29 CFR 1926.20 - General safety and health provisions;
    - 29 CFR 1926.21 - Safety training and education;
    - 29 CFR 1925.25 - Housekeeping;
    - 29 CFR 1926.28 - Personal protective equipment;
    - 29 CFR 1926.51(f) - Washing facilities;
    - 29 CFR 1926.55 - Gases, vapors, fumes, dusts, and mists;
    - 29 CFR 1926.57 - Ventilations;
    - 29 CFR 1926.59 - Hazardous Communication Standards;
    - 29 CFR 1926.103 - Respiratory protection; and
    - 29 CFR 1926.62 - Lead in Construction
25. The Contractor must comply with all applicable requirements of the Resource Conservation & Recovery Act (RCRA) of 1976 as amended in 1980 and 1984 by the Hazardous & Solid Waste Amendments (HSWA).

Qualification Requirements

26. Copies of the submissions listed below must be tendered with the bid:
    a. Ability to perform XRF testing and paint chip sampling by submitting evidence of the successful completion of lead inspector training by all staff to be assigned to the job including inspector technicians. Training must be provided through a State approved EPA-

Model program. All staff assigned to the Contract must also demonstrate training in the use of the XRF testing machines to be dedicated to this contract. The serial number of such XRF machine shall be provided to the the Owner.

1) Contractor or Subcontractor performing the work must have at least 3 years of satisfactory experience (documented) in performing XRF testing for a City, State or Federal Agency.

b. Laboratory certification by the State Department of Health (or other responsible agency) and by the USEPA through the EPA's National Lead Laboratory Accreditation Program ("NLLAP"), or as an alternative having accreditation application pending before NLLAP, and having acceptable performance on five consecutive rounds of the EPA, Environmental Laboratory Proficiency Analytical Testing (ELPAT) program, including the most recent round; evidence of such accreditation must be provided. Indicate if the laboratory is an independent entity from the Contractor.

c. If a subcontractor will be used for any of the laboratory work of this contract, evidence of certification stated above must also be provided for the subcontractor.

Waste Disposal

27. All waste generated must be legally disposed in accordance with Federal, State and Local regulations.

END OF SECTION 13285b

SECTION 13285c - LEAD DUST WIPE, AIR AND TCLP SAMPLING AND ANALYSIS

DESCRIPTION OF WORK

This specification covers the furnishing and installation of materials for lead dust wipe, air and TCLP sampling and analysis. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

GENERAL

Definitions: Unless otherwise specified the following definitions shall apply:

1. **"Approved"**: shall mean approved by all public agencies having jurisdiction, and the Owner.
2. **"The Owner"**: shall mean the Owner and its designated authorized representatives.
3. **"Contractor"**: shall mean the firm that is awarded this contract and is responsible to ensure compliance with Federal, State and City regulations as well as these Contract documents.
4. **"Development or Project"**: a group of buildings in one or more designated geographical locations, owned or operated by the Owner and referred to by a common name by the Owner.
5. **"Dust Cleaning Firm"**: shall mean the contractor under a separate contract or the Owner responsible for cleaning of lead dust, as directed by the Owner, until the clearance levels are achieved, as defined in the "Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing, June 1995" or latest edition published by the United States Department of Housing and Urban Development (HUD).
6. **"Equal or Approved Equal"**: shall mean equal in the opinion of the Owner.
7. **"HUD"**: the United States Department of Housing and Urban Development.
8. **"HUD Guidelines"**: shall mean Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing issued by HUD'S Office of Lead-Based Paint Abatement and Poisoning Prevention in June 1995 except as such guidelines are later modified by HUD and/or modified by the Owner in writing pursuant to this contract.
9. **"Inspector"**: an individual who has completed training from an accredited program and been licensed or certified by the appropriate State or local agency to (1) perform inspections to determine and report the presence of lead-based paint on a surface-by-surface basis through on-site testing, (2) report the findings of such an inspection, (3) collect environmental samples for laboratory analysis, (4) perform clearance testing, and (5) document successful compliance with lead-based paint hazard control requirements or standards.
10. **"Lead-Based Paint"**: any paint, varnish, shellac, or other coating that contains lead equal to or greater than 1.0 mg/cm² as measured by XRF or laboratory analysis, or 0.5 percent by weight (5,000 µg/g, 5,000 PPM, or 5,000 mg/kg) as measured by laboratory analysis.
11. **"Lead-Based Paint Hazard"**: a condition in which exposure to lead from lead-contaminated dust, lead-contaminated soil or deteriorated lead-based paint would have an adverse effect on human health (as established by the EPA Administrator under Title IV of the Toxic Substance Control Act). Lead-based paint hazards include for example, deteriorated lead-based paint, leaded dust levels above applicable standards and bare leaded soil above applicable standards.
12. **"Lead-Based Paint Hazard Control"**: activities to control or eliminate lead-based paint hazards, including interim controls and complete abatement.
13. **"Lead-Contaminated Dust"**: surface dust in residences that contain an area or mass concentration of lead in excess of the standard established by the EPA Administrator, pursuant to Title IV of the Toxic Substance Control Act. Until the EPA standards are set, the HUD recommended clearance and risk assessment standards for leaded dust are 40 µg/ft² on floors, 250 µg/ft² on interior window sills, and 800 µg/ft² on window troughs.
14. **"Monitoring"**: shall refer to inspection to ensure compliance with all Federal, State and City Standards or guidelines, and contractual specifications.
15. **"Provide"**: shall mean furnish and install.

16. **"Risk Assessor"**: a certified individual who has completed training with an accredited training program and who has been certified to (1) perform risk assessments, (2) identify acceptable abatement and interim control strategies for reducing identified lead-based paint hazards, (3) perform clearance testing and reevaluations, and (4) document the successful completion of lead-based paint hazard control activities.

Applicable Regulations/References

17. The work conducted shall comply with all applicable Federal, State and City regulations. Applicable guidelines and standards listed in the scope of work include, but are not limited to:

24 CFR Parts 35,36,37	HUD Lead-Based Paint Regulations
Guidelines for the Evaluation and Control of Lead-Based Paint in Housing (HUD Guidelines June 1995) & 1997 Revisions	
29 CFR 1910	General Industry Standard
29 CFR 1910.1025	Lead Standard for General Industry
29 CFR 1910.134	Respiratory Protection
29 CFR 1910.1200	Hazard Communication
29 CFR 1910.245	Specification for Accident Prevention
29 CFR 1926	Construction Industry Standards
29 CFR 1926.20	General Safety & Health Provisions
29 CFR 1926.21	Safety Training & Education
29 CFR 1926.25	Housekeeping
29 CFR 1926.28	Personal Protective Equipment
29 CFR 1926.51	Washing Facilities
29 CFR 1926.55	Gases, Vapors, Fumes, Dusts & Mists
29 CFR 1926.59	Hazard Communication Standard
29 CFR 1926.62	Construction Industry Lead Standard
29 CFR 1926.103	Respiratory Protection
40 CFR 61 Subpart A	General Provisions
40 CFR 241	Guidelines for the Land Disposal of Solid Waste
40 CFR 257	Criteria for the Land Disposal of Solid Waste
40 CFR 261/262	Waste Disposal Facilities & Practices
American National Standards Institute (ANSI) Z87.1	Eye Protection
ANSI Z88.2-80	Practices for Respiratory Protection
American Society For Testing Materials (ASTM)	All Applicable Standards

18. The contractor shall ensure that any programs, certifications, licenses or other documentation in accordance with the above and/or any other applicable Federal, State, and Local Regulations/Guidelines are provided.

Scope Of Work

19. The work shall consist of furnishing labor, materials, insurance and all other incidental items required to perform the following:
    a. Dust wipe sampling and analysis
        1) Collect dust wipe samples from various horizontal surfaces, such as floors, window sills, window troughs, etc., as directed by the Owner.
        2) Dust wipe samples shall be collected in accordance with ASTM ES30-94.
        3) Analyze dust wipe sample in the laboratory using Flame Atomic Absorption Spectrometry ("FAAS") or Graphite Furnace Atomic Absorption Spectrometry("GFAAS").
        4) Provide result of analysis in micrograms per square foot.

5) A faxed summary of results must be provided to the Owner within 24 hours after the Owner authorizes the Contractor to perform the laboratory analysis of the collected dust wipe sample. Contractor shall also have the ability to provide results in 4 hours for clearance, following lead-based paint abatement work, if requested by the Owner. The sampling result must be provided in a form approved by the Owner and must include for each dust wipe sample, the Project, the building address, the sample number, the room or room equivalent, the surface type, dimensions of sample areas, total micrograms, micrograms per square feet, and an indication of pass or fail.
6) Turn-around time for results shall be counted from the time the Contractor performs collection of dust wipe samples to the time the results are actually presented to the Owner. This includes travel time from the site to the laboratory of the Contractor and back to the site.
7) A detailed final report covering the results of all dust wipe samples taken and analyzed must be submitted within 5 days from the time the Owner authorizes the performance of the laboratory analysis. The sampling report must include for each dust wipe sample, the Project, the building address, the sample number, the room or room equivalent, the surface type, dimensions of sample areas, total micrograms, micrograms per square feet, and indicate pass or fail in a form approved by the Owner. Also include in the report the method of analysis, i.e. "FAAS" or "GFAAS", and the detection limits. The laboratory test results in the final report must be signed by the Laboratory Director.
8) The sampling data report must contain all required data fields as specified by the Owner. The sampling data report shall be provided to the Owner on 3.5 inch high density diskettes in ASCII file form. The required data fields will be provided by the Owner to the Contractor.
9) The laboratory used for the analysis of the dust wipe samples must be certified by the State Department of Health (or other responsible agency) and by the USEPA through the EPA's National Lead Laboratory Accreditation Program ("NLLAP"), or as an alternative having accreditation application pending before NLLAP, and having acceptable performance on five consecutive rounds of the EPA, Environmental Laboratory Proficiency Analytical Testing (ELPAT) program, including the most recent round; evidence of such accreditation must be provided. Indicate if the laboratory is an independent entity from the Contractor.

b. Dust Spiked Samples
1) Provide dust spiked samples to the Owner. Dust spiked samples shall be prepared in accordance with the HUD Guidelines.

NOTE: These samples are separate from the ones required by the Contractor for his own QA/QC

2) Prepare dust spiked samples in a manner such that they are indistinguishable from the field samples.
3) Prepare dust spiked samples using the same lot as that to be used in the field.
4) Dust spiked samples shall be inserted into the sample stream, randomly, by the Owner Inspector.
5) Blind analysis of dust spiked samples must fall within 80%-120% of the true value. If the laboratory fails to obtain readings within these limits, two more spiked samples shall be sent immediately to the lab for analysis.
6) If the two additional spiked samples fail, the sample batch shall be considered invalid, and the Owner may, at its sole discretion, terminate this contract as well as withhold payment for services already rendered.

c. Air Sampling and Analysis
1) Collect area air samples at various locations and various projects for personal exposure assessment as directed by the Owner.
2) Air samples shall be collected in accordance with ASTM E1553-93.
3) Prepare air samples for analysis in accordance with ASTM E33-94
4) Analyze air samples using FAAS or GFAAS.

5) All equipment required for personal air sampling, including pumps shall be provided by the Contractor at no extra cost to the Owner.
6) Provide results of air samples in micrograms per cubic meter.
7) A faxed summary of result must be provided to the Owner within 24 hours after the Owner authorizes the Contractor to perform the laboratory analysis of the collected air sample. The sampling result must include for each air sample taken the Project, the building address, the sample number, the room or room equivalent, and the reading.
8) Turn-around time shall start after collection of the air samples, and includes travel time to and from the laboratory.
9) A detailed final report covering the results of all air samples taken and analyzed must be submitted within 5 days from the time the Owner authorizes the performance of the laboratory analysis. The sampling report must include for each air sample, the Project, the building address, the sample number, the room or room equivalent, and the reading. The laboratory report contained in the final report must be signed by the Laboratory Director.
10) The sampling data report must contain all required data fields as specified by the Owner. The sampling data report shall be provided to the Owner on 3.5 inch high density diskettes in ASCII file form. The required data fields will be provided by the Owner to the Contractor.
11) The laboratory used for the analysis of the dust wipe samples must be certified by the State Department of Health (or other responsible agency) and by the USEPA through the EPA's National Lead Laboratory Accreditation Program ("NLLAP"),or as an alternative having accreditation application pending before NLLAP, and having acceptable performance on five consecutive rounds of the EPA, Environmental Laboratory Proficiency Analytical Testing (ELPAT) program, including the most recent round; evidence of such accreditation must be provided. Indicate if the laboratory is an independent entity from the Contractor.
12) Air sampling technician shall be present during the entire shift of the air sampling.

d. TCLP Sampling and Analysis
1) Take core samples of construction waste as directed by the Owner and analyze by TCLP testing to determine if waste is hazardous.
2) Waste shall be classified as hazardous if the concentration of lead is greater than 5 parts per million by TCLP testing.
3) The laboratory used for the analysis of the TCLP samples must be certified by the State Department of Health (or other responsible agency) and by the USEPA through the EPA's National Lead Laboratory Accreditation Program ("NLLAP"), or as an alternative having accreditation application pending before NLLAP, and having acceptable performance on five consecutive rounds of the EPA, Environmental Laboratory Proficiency Analytical Testing (ELPAT) program, including the most recent round; evidence of such accreditation must be provided. Indicate if the laboratory is an independent entity from the Contractor.
4) A faxed summary of result must be provided to the Owner within 48 hours after the Owner authorizes the Contractor to perform the TCLP analysis of the waste. Provide results in parts per million (ppm).
5) Final results provided to the Owner by the Contractor must include written sample preparation procedure and laboratory specific written procedures for performing TCLP, including quality control procedures used for performing the TCLP, and a table listing the sample numbers, description of the construction waste, and the result of the TCLP. The laboratory report contained in the final report must be signed by the Laboratory Director.
6) Final report must also specify detection limits.
7) Final report must be provided within 5 days from the time the authorization to perform the TCLP is given by the Owner.

General Provisions

20. Some of the work of this contract may be in occupied apartments. The Contractor shall perform all of the work of this contract with the least inconvenience to the tenants.
21. The Contractor shall take all necessary precautions to protect the property of the Owner, its residents, and the public. The Contractor must repair any damaged property, whether of the Owner, its residents, or the public, and restore such property to its original condition. If the damage is beyond repair, the Contractor shall replace it with new, that in the judgment of the Owner, match the existing materials and/or of equal quality and workmanship. All such repairs shall be at the Contractor's expense.
22. The Contractor shall develop a work plan to be performed as requested by the Department of Planning and Development. The detailed plan shall include coordination of the monitoring and sampling work with the Contractor in a manner that will be least disruptive to the normal use of the non-work areas in the building. The plan should also include emergency procedures in case of fire.
23. The Contractor shall perform work in accordance with the latest HUD Guidelines, except as such Guidelines are modified by the Owner in writing in this Contract, or any Contract pursuant to this Contract, and in accordance with all applicable Federal, State and Local regulations.
24. The Contractor shall include in the bid price all supplementary miscellaneous items not specified but implied or required in order to complete the work.

Submissions

25. Six (6) copies of the submissions listed below must be submitted to the Owner by the Contractor or Subcontractor performing the Work:
    a. Ability to perform lead dust wipe sampling by submitting evidence of the successful completion of lead inspector and/or risk assessor training <u>by all staff to be assigned to the job</u> including inspector technicians. As stated previously, training must be provided through an approved program.
    b. Laboratory certification by the State Department of Health (or other responsible agency) through its ELAP program and by the USEPA through the EPA's National Lead Laboratory Accreditation Program ("NLLAP"), or as an alternative having accreditation application pending before NLLAP and having acceptable performance on five consecutive rounds of the EPA, Environmental Laboratory Proficiency Analytical Testing (ELPAT) program, including the most recent round; evidence of such accreditation must be provided.
    c. If a subcontractor will be used for any of the laboratory work of this contract, evidence of certification stated in (2) above must also be provided for the subcontractor.

Waste Disposal

26. All waste generated must be legally disposed in accordance with the Federal, State and Local Regulations.

END OF SECTION 13285c

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SECTION 13287 - BIRD AND BIRD WASTE ABATEMENT

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for bird and bird waste abatement. Products shall be as follows or as directed by the the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary Of Work
1. Work Included - Conventional Enclosure for Removal of Birds and Bird Waste
   a. Seal off penetrations on perimeter walls into the work area (critical barriers) and establish a decontamination facility for workers.
   b. Coordinate activities with the demolition and well capping activities.
2. Work Included - Removal and disposal of birds and bird waste.
   a. Establish work area by installing construction barrier tape around removal area.
   b. Remove and properly dispose of bulk contamination debris.
   c. Mist bird waste and contaminated material with Biocide or the equivalent (i.e. Sanogene, Oxine, or Envirocon).
   d. Remove and properly dispose of contaminated waste material from all building components.
   e. Utilize low pressure washers or scrub brushes to clean all wall surfaces of bird waste.

C. Quality Criteria
1. Qualifications for Performance of Work
   a. Contractor (or subcontractor engaged to perform the Work of this Section) shall:
      1) Be a licensed bird waste abatement contractor in accordance with the Statutes of the State in which the work is to be performed. Submit notarized documentation confirming current licensure.
      2) Have a record of not less than five years successful experience in bird waste removal or asbestos removal.
2. Reference Standards
   a. Acknowledge, by the executing of the Contract, awareness and familiarity with the contents and requirements of the following regulations, codes, and standards, and assume responsibility for the performance of the Work in strict compliance therewith and for every instance of failure to comply therewith.
   b. Where conflict among requirements or with the Contract Documents exists, the more stringent requirements shall apply.
      1) USEPA Regional National Emissions Standards for Hazardous Air Pollutants (NESHAPS)
      2) U.S. Occupational and Safety and Health Administration (OSHA)
      3) U.S. EPA Office of Pesticide and Toxic Substances Guidance Document
      4) U.S. Department of Transportation, Hazardous Substances: Final Rule (49 CFR 171 and 172), Federal Register November 21, 1986 and corrected February 17, 1987.
      5) Statutes of the State in which the Work is to be Performed: Licensure for Asbestos Consultants and Contractors.
      6) All state, county, and city codes and ordinances as applicable. Make available for review at the site one copy of EPA, OSHA, and applicable State, County, and City Regulations governing the Work.
3. Patent/Copyright Compliance: Contractor shall determine the applicability of any process patents that may be employed and shall be responsible for the payment of all fees, royalties and licenses that may be required for the use of any patented or licensed process. Contractor shall hold the Owner, Engineer and Testing Laboratory harmless for failure to obtain any licenses and to pay any applicable fees and royalties.

D. Product Handling
   1. Deliver all materials in the original packages, containers, or bundles bearing the name of the manufacturer and the brand name.
   2. Store all materials subject to damage off the ground, away from wet or damp surfaces, and under cover sufficient to prevent damage or contamination.
   3. Remove from the premises all damaged or deteriorating materials. Dispose of materials that become contaminated with waste in accordance with applicable regulatory standards.

E. Worksite Conditions
   1. Worker and Visitor Procedures: The Contractor is hereby advised that the birds and bird wastes have been determined to cause diseases by inhalation and Contractor shall provide workers and qualified visitors with respirators that, as a minimum, shall meet the requirements of current applicable OSHA regulations, and protective clothing during preparation of system of enclosures, prior to commencing, during actual removal, and until final clean-up is completed. Also all personnel assigned to work on this project shall attend a training/awareness class for the purpose of explaining the hazards of improperly handling these materials and proper control measures to take in order to protect themselves.

F. Personnel Protection
   1. General
      a. Provide respiratory protection in accordance with OSHA regulations 29 CFR 1910-134 and in accordance with the following paragraphs.
         1) Prior to commencement of work, all workers shall be instructed by the Contractor and shall be knowledgeable in the appropriate procedures of personnel protection and waste removal.
         2) Where respirators with disposable filters are used, provide sufficient filters for replacement as necessary by the workers, or as required by applicable regulations.
         3) Permit no visitors, except for governmental inspectors having jurisdiction, or as authorized by Engineer or Owner, in the work areas after commencement of waste disturbance or removal. Provide authorized visitors with suitable respirators.
         4) Provide workers with sufficient sets of protective disposable clothing, consisting of full-body coveralls, head covers, gloves, and foot covers, of sizes to properly fit individual workers.
         5) Provide authorized visitors with a set of suitable protective disposable clothing, headgear, eye protection, and/or footwear of sizes to properly fit visitors whenever they are required to enter the work area, to a maximum of six sets per day.
         6) Provide, in addition to respirators and protective clothing provided for authorized visitors, protective clothing and respirators for use by Testing Laboratory's representative. Furnish protective clothing in as many sets as required for full-time monitoring by Testing Laboratory.
         7) Provide and post the decontamination and work procedures to be followed by workers.
   2. Respiratory Protection Program
      a. Maintain a respiratory protection program that contains all the elements of the OSHA regulations. Provide a copy to the Engineer for approval.
      b. Appoint a respiratory protection program administrator, who shall be responsible for the program, maintaining all documentation, instructing workers and providing fit tests. Respiratory protection administrator is to be qualified under OSHA requirements and to have attended and passed, as a minimum, OSHA training institute 2-week course on respiratory protection or NIOSH course "Occupational Respiratory Protection." Respiratory protection program administer is to be on-site daily during abatement activities. All written programs and directions are to be in English and/or the language of the abatement workers if they are not fluent in English.
      c. The Contractor is advised that the minimum respiratory requirements as called for in this section and on any drawings/sketches shall be applied unless reported measures indicate

that a lower form of respiratory protection is acceptable according to the appropriate OSHA regulations and the more strict sections of the specification.

3. Respiratory Protection Requirements
   a. Workers shall be provided with respiratory protection equipment. The respirators are to be sanitized and maintained in accordance with the manufacturer's specification. Appropriate respirator selection will be dependent upon the work to be performed and the level of exposure, as given below.
   b. For the clean-up, as a minimum, the use of full-faced air-purifying respirators is required for all preparation, removal and cleaning work.
   c. This specification requires that workers shall wear suitable respiratory protection at all times whenever a potential for exposure to bird and bird waste exists.

1.2 PRODUCTS

A. Materials
1. Polyethylene/Plastic sheeting shall be of the thicknesses specified, in sizes to minimize the frequency of joints. Utilize reinforced plastic sheeting in specified thicknesses on floors.
2. Tape shall be glass fiber or other type capable of sealing joints of adjacent sheets of plastic and for attachment of plastic sheet to finished or unfinished surfaces of dissimilar materials under both dry and wet conditions.
3. Sodium Hypochlorite ("bleach")
4. Impermeable Containers shall be suitable to receive and retain contaminated materials until disposal at an approved site and shall be labeled in accordance with U.S. DOT 49 CFR 171 and 172, and containers shall be both air- and water-tight. Use a minimum of two types of impermeable containers: 1) six millimeter-thick (mil) plastic bags sized to fit within the drum; and 2) metal or fiber drums with tightly fitting lids.
5. Other Materials: Provide all other materials, such as lumber, nails, and hardware, that may be required to construct and dismantle the decontamination area and the barriers that isolate the work area(s).
6. Caulking shall be non-shrinking caulk to be used where insulated pipes continue through areas such as walls and ceilings. Contractor shall determine and submit proof that caulk proposed for use is compatible with the temperature conditions of the surfaces to which it is to be applied.
   a. Tools And Equipment
      1) Water Sprayer - utilize airless or other low pressure sprayer for amended water application.
      2) Air Purifying Equipment (for internal recirculation in the work area) shall be HEPA Filtration Systems or Electronic Precipitators. Ensure that no internal air movement system or purification equipment exhausts contaminated air from the work area(s) outside the work area.
      3) Diminished Air Pressure Equipment shall comply with ANSI 29.2-7, local exhaust ventilation.
      4) Scaffolding shall be as required to accomplish the specified work and shall meet all applicable safety regulations.
      5) Transportation - as required for loading, temporary storage, transit, and unloading of contaminated waste without exposure to persons or property.

1.3 EXECUTION

A. Procedures
1. All personnel assigned to perform the work shall attend a training/awareness class for the purpose of explaining the hazards of improperly handling the waste and the proper control measures to take in order to protect themselves. These work procedures shall be discussed with each individual followed by the individual acknowledging receipt of this training by completing the pertinent information on a Hazardous Awareness Training Form

2. The majority of diseases related to bird waste is related to the inhalation of the airborne dust released by the waste. All personnel performing removal/decontamination waste shall therefore wear Powered Air Purifying Respirators (PAPR) equipped with combination Organic Vapor and High Efficiency Particulate Air (HEPA) filters while handling the waste.
3. Workers shall wear non-porous gloves and boots during all preparatory and removal operations.
4. When entering the building, the removal/decontamination personnel shall mist all surfaces having visible remnants of waste, using a diluted sodium hypochlorite ("bleach") and water solution. This solution shall be diluted at a ratio of 10 parts water to 1 part bleach for a 10 to 1 ration (10:1). The waste shall be continuously misted during occupancy in order to keep airborne dust emissions from the waste to a minimurn.
5. Remove all birds from the building and seal all openings into the building. The main purpose of this is to eliminate the availability for future bird access into the building. The openings may be temporarily sealed or closed up in many ways, including boarding up windows/doors, polyethylene sheeting, or other convenient and cost effective means. It is not the intention of this task to complete seal the building airtight.
6. Designate an area of the facility for the purpose of storing the waste prior to loading for transportation to the appropriate landfill. The area designated shall have easy access to the door which will be utilized as the waste load-out.

END OF SECTION 13287

Task	Specification	Specification Description
13289	01352	No Specification Required
13289	13285	Removal And Disposal Of Lead-Containing Paint
13289	13285a	Lead Paint Related Abatement Procedures
13289	13285b	XRF Testing For Lead-Based Paint
13289	13285c	Lead Dust Wipe, Air And Tclp Sampling And Analysis

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SECTION 13650 - PHOTOVOLTAIC ENERGY EQUIPMENT

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for Photovoltaic Energy Equipment. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section Includes:
a. PV laminates (cells laminated into rigid sheets, with connecting cables).
b. PV modules (laminates in mounting frames).
c. Charge controllers.
d. Inverters.
e. Mounting structures.

C. Definitions
1. CEC: California Energy Commission.
2. ETFE: Ethylene tetrafluoroethylene.
3. FEP: Fluorinated ethylene propylene.
4. IP Code: Required ingress protection to comply with IEC 60529.
5. MPPT: Maximum power point tracking.
6. PTC: USA standard conditions for PV.
7. PV: Photovoltaic.
8. STC: Standard Test Conditions defined in IEC 61215.

D. Action Submittals
1. Product Data: For each type of product.
a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for PV panels.
b. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Shop Drawings: For PV modules.
a. Include plans, elevations, sections, and mounting details.
b. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
c. Detail fabrication and assembly.
d. Include diagrams for power, signal, and control wiring.

E. Informational Submittals
1. Field quality-control reports.
2. Sample Warranty: For manufacturer's special materials and workmanship warranty and minimum power output warranty.

F. Closeout Submittals
1. Operation and Maintenance Data: For PV modules to include in operation and maintenance manuals.

G. Warranty

1. Manufacturer's Special Materials and Workmanship Warranty: Manufacturer agrees to repair or replace components of PV modules that fail in materials or workmanship within specified warranty period.
    a. Manufacturer's materials and workmanship warranties include, but are not limited to, the following:
        1) Faulty operation of PV modules.
    b. Warranty Period: Two **OR** Five years from date of Substantial Completion.
2. Manufacturer's Special Minimum Power Output Warranty: Manufacturer agrees to repair or replace components of PV modules that fail to exhibit the minimum power output within specified warranty period. Special warranty, applying to modules only, applies to materials only, on a prorated basis, for period specified.
    a. Manufacturer's minimum power output warranties include, but are not limited to, the following warranty periods, from date of Substantial Completion:
        1) Specified minimum power output to 80 percent or more, for a period of 25 years.

1.2 PRODUCTS

A. Performance Requirements
1. NRTL (Nationally Recognized Testing Laboratory) Listing: Entire assembly shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for electrical and fire safety, Class A **OR** Class C, according to UL 1703.
2. FM approved for NFPA 70, Class 1, Division 2, Group C and Group D hazardous locations.

B. System Description
1. Grid-Tied PV System:
    a. Connected via a utility meter to the electrical utility.
    b. An array of six modules to generate a total nominal 1000 rated W.
    c. System Components:
        1) Cell materials.
        2) PV modules.
        3) Array frame.
        4) Charge controller.
        5) Inverter.
        6) Overcurrent protection/combiner box.
        7) Mounting structure.
        8) Utility meter.
2. Battery-Storage PV System:
    a. Connected to a battery bank to provide electricity to Project.
    b. An array of six modules to generate a total nominal 1000 rated W.
    c. System Components:
        1) Cell materials.
        2) PV modules.
        3) Array frame.
        4) Charge controller.
        5) Inverter.
        6) Overcurrent protection/combiner box.
        7) Mounting structure.
        8) Battery charge controller(s).
        9) Batteries.
        10) Battery-storage structure.

C. Manufactured Units
1. Cell Materials: Amorphous silicon (a-Si) **OR** Cell Materials: Copper indium (di)selenide (CIS) **OR** Cell Materials: Copper indium gallium (di)selenide (CIGS) **OR** Cadmium telluride (CdTe) **OR**

Cadmium sulfide **OR** Polycrystalline (c-Si) **OR** Polycrystalline (Gallium arsenide (GaAs) **OR** Monocrystalline (c-Si) **OR** Monocrystalline (Gallium arsenide (GaAs), **as directed.**

2. Module Construction:
   a. Nominal Size: 32 inches (800 mm) wide by 64 inches (1600 mm) long.
   b. Weight: 42.8 lb (19.4 kg).
3. Insulating Substrate Film: Flexible **OR** Rigid, polyester **OR** polyimide, **as directed.**
4. Conducting Substrate Film: Flexible **OR** Rigid **OR** luoropolymer, ETFE **OR** FEP, **as directed**.
5. Encapsulant: Ethyl vinyl acetate.
6. Front Panel: Fully tempered glass.
7. Front Panel: 0.125-inch- (3.2-mm-) thick glass.
8. Front Panel: Low iron glass.
9. Front Panel: Antireflective coating glass.
10. Front Panel: Laminating film.
11. Front Panel: Laminating material.
12. Backing Material: Tempered glass.
13. Backing Material: 0.125-inch- (3.2-mm-) thick glass; color **as directed.**
14. Backing Material: Polyester film.
    a. Layers: **as directed.**
    b. Color: White **OR as directed.**
15. Backing Material: PVC film.
    a. Layers: **as directed.**
    b. Color: White **OR as directed.**
16. Bypass Diode Protection: Internal.
17. Junction Box:
    a. Size: 1.56 by 3.96 by 0.52 inch (39.6 by 100.6 by 13.2 mm).
    b. Fully potted, vandal resistant.
    c. IP Code: IP65 **OR** IP66 **OR** IP67, **as directed**.
    d. Flammability Test: UL 1703.
18. Output Cabling:
    a. **0.158 inch (4 mm)**.
    b. Quick, multiconnect, polarized connectors.
    c. Two-Conductor Harness: No traditional return wire is needed from the end of a row back to the source combiner.
19. Series Fuse Rating: **as directed**.

D. Capacities And Characteristics
1. Minimum Electrical Characteristics:
   a. Rated Open Circuit Voltage (V_{oc}): **as directed.**
   b. Maximum System Voltage: **as directed.**
   c. Maximum Power at Voltage (V_{pm}): **as directed.**
   d. Short-Circuit Temperature Coefficient: **as directed.**
   e. Rated Short-Circuit Current (I_{sc}): **as directed.**
   f. Maximum System: **as directed.**
   g. Rated Operation Current (I_{mp}): **as directed.**
   h. Maximum Power at STC (P_{max}): **as directed.**
2. Additional Electrical Characteristics:
   a. PTC Rating: **as directed.**
   b. Peak Power per Unit Area: **as directed.**
   c. Tolerance of Pmax: **as directed.**
   d. Minimum Peak Power: **as directed.**
   e. Series Fuse Rating: **as directed.**
   f. Module Efficiency: **as directed.**
   g. Temperature Cycling Range: **as directed.**
   h. Humidity, Freeze, Damp Heat Condition: **as directed.**
   i. Wind Loading or Surface Pressure: **as directed.**
   j. Maximum Distortion Angle: **as directed.**

k. Hailstone Impact Withstand: **as directed.**
l. Series Fuse Rating: **as directed.**

3. Normal Operating Temperature Characteristics (NOTC):
   a. Temperature at Nominal Operating Cell Temperature: **as directed.**
   b. Temperature Coefficient (NOTC P_{max}): **as directed.**
   c. Temperature Coefficient (NOTC V_{oc}): **as directed.**.
   d. Temperature Coefficient (NOTC I_{sc}): **as directed.**
   e. Temperature Coefficient (NOTC V_{mp}): **as directed.**
   f. Temperature Coefficient (NOTC I_{mp}): **as directed.**

E. Module Framing
1. PV laminates mounted in anodized extruded-aluminum frames.
   a. Entire assembly UL listed for electrical and fire safety, Class A **OR** Class C, according to UL 1703, complying with IEC 61215.
   b. Frame strength exceeding requirements of certifying agencies in subparagraph above.
   c. Finish: Anodized aluminum.
      1) Alloy and temper recommended by framing manufacturer for strength, corrosion resistance, and application of required finish.
      2) Color: As indicated by manufacturer's designations.
   d. Finish: High-performance organic finish.
      1) Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent PVC resin by weight.
      2) Color: As indicated by manufacturer's designations.
   e. Finish: Baked-enamel finish.
      1) Color: As indicated by manufacturer's designations.

F. Array Construction
1. Framing:
   a. Material: Extruded aluminum **OR** Galvanized steel **OR** Coated steel, **as directed**.
   b. Maximum System Weight: Less than 4 lb/sq. ft. (19.53 kg/sq. m).
   c. Minimum Distance to Connectors: **as directed**.
   d. Raceway Cover Plates: Plastic **OR** Aluminum **OR** Galvanized steel, **as directed**.
2. Flat-Roof Mounting:
   a. No roof penetrations.
   b. Self-ballasting.
   c. Wind-tunnel tested to 110-mph (160-km/h) wind.
   d. Service Life: **25** years.
   e. Freestanding system.

G. Charge Controller
1. Charge Controller Electrical Characteristics:
   a. Output Current Rating: **as directed**.
   b. Nominal Battery Voltage: **as directed**.
   c. PV Maximum Open Circuit Voltage: **as directed**.
   d. Equalization Voltage: **as directed**.
   e. Voltage Step-Down Capability: **as directed**.
   f. Power Conversion Efficiency: **as directed**.
2. Charge controllers shall have the following:
   a. Digital display.
   b. Data logging.
   c. Remote interface.
   d. External sensors.
   e. Temperature compensation.

H. Inverter
1. Control Type: Pulse width modulation control.
2. Control Type: Maximum power point tracker control.
3. Inverter Electrical Characteristics:
   a. Maximum Recommended PV Input Power: **as directed**.
   b. Maximum Voc: **as directed**.
   c. PV Start Voltage: **as directed**.
   d. MPPT Voltage Range: **as directed**.
   e. Maximum Input Current: **as directed**.
   f. Number of String Inputs: **as directed**.
   g. Number of Independent MPPT Circuits: **as directed**.
   h. Nominal Output Voltage: **as directed**.
   i. CEC Rated Power: **as directed**.
   j. Nominal Output Voltage: **as directed**.
   k. Maximum Output Current: **as directed**.
   l. Peak Efficiency: **as directed**.
   m. CEC Weighted Efficiency: **as directed**.
   n. CEC Night Tare Loss: **as directed**.
   o. DC/AC Terminal Range (AWG): **as directed**.
   p. NEMA 250 Enclosure Rating: **as directed**.
4. Operating Conditions:
   a. Operating Ambient Temperatures: Minus 4 to plus 122 deg F (20 to plus 50 deg C).
   b. Storage Temperature: Minus 40 to plus 122 deg F (minus 40 to plus 50 deg C).
   c. Relative Humidity: 0 to 95 percent, noncondensing.
5. Charge controllers shall have the following:
   a. Overcurrent protection.
   b. Generator input breaker box.
   c. Automatic transfer relay.
   d. Digital display.
   e. Transformer.
   f. Disconnect switch.
   g. Shunt controller.
   h. Shunt regulator.
   i. Surge overload protection.
6. Enclosure:
   a. NEMA 250, Type 3R.
   b. Enclosure Material: Galvanized steel **OR** Steel, **as directed**.
   c. Cooling Methods:
      1) Fan convection cooling.
      2) Passive cooling.
   d. Protective Functions:
      1) AC over/under voltage.
      2) AC over/under frequency.
      3) Ground over current.
      4) Overtemperature.
      5) AC and dc overcurrent.
      6) DC over voltage.
   e. Standard liquid crystal display, four lines, 20 characters, with user display and on/off toggle switch.
   f. Weight: 260 lb (118 kg).
   g. Dimensions: 54 by 36 by 19 inches (137 by 91 by 48 cm).
7. Disconnects:
   a. Low-voltage disconnect.
   b. Low-voltage reconnect.
   c. High-temperature disconnect.
   d. High-temperature reconnect.

8. Regulatory Approvals:
   a. IEEE 1547.1.
   b. IEEE 1547.3.
   c. UL 1741.
9. Characteristics:
   a. Inverter Dimensions: **as directed**.
   b. Inverter Weight: **as directed**.

I. System Overcurrent Protection
1. Combiner Box:
   a. Fuses: **as directed**.
   b. Circuit Breakers: **as directed**.

J. Mounting Structures
1. Roof Mount: Extruded aluminum, two **OR** four rails, **as directed**, tilt legs, and roof standoffs.
2. Pole Mount: Top **OR** Panel tops **OR** Side, **as directed**.
3. Tracking Mounts: One **OR** Two axis, **as directed**.

1.3 EXECUTION

A. Examination
1. Examine substrate areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
2. Do not begin installation until mounting surfaces have been properly prepared.
3. If preparation of mounting surfaces is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
4. Examine modules and array frame before installation. Reject modules and arrays that are wet, moisture damaged, or mold damaged.
5. Examine roofs, supports, and supporting structures for suitable conditions where PV system will be installed.
6. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Field Quality Control
1. Perform tests and inspections **with the assistance of a factory-authorized service representative**.
2. PV module will be considered defective if it does not pass tests and inspections.
3. Prepare test and inspection reports.

END OF SECTION 13650

Task	Specification	Specification Description
13650	01352	No Specification Required

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SECTION 13700 - SECURITY ACCESS

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for security access. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section Includes:
a. Security access central-control station.
b. One or more security access networked workstations.
c. Security access operating system and application software.
d. Security access controllers connected to high-speed electronic-data transmission network.

C. Definitions
1. CCTV: Closed-circuit television.
2. CPU: Central processing unit.
3. Credential: Data assigned to an entity and used to identify that entity.
4. dpi: Dots per inch.
5. DTS: Digital Termination Service. A microwave-based, line-of-sight communication provided directly to the end user.
6. GFI: Ground fault interrupter.
7. Identifier: A credential card; keypad personal identification number; or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.
8. I/O: Input/Output.
9. LAN: Local area network.
10. Location: A Location on the network having a PC-to-controller communications link, with additional controllers at the Location connected to the PC-to-controller link with a TIA 485-A communications loop. Where this term is presented with an initial capital letter, this definition applies.
11. PC: Personal computer. Applies to the central station, workstations, and file servers.
12. PCI Bus: Peripheral Component Interconnect. A peripheral bus providing a high-speed data path between the CPU and the peripheral devices such as a monitor, disk drive, or network.
13. PDF: Portable Document Format. The file format used by the Acrobat document-exchange-system software from Adobe.
14. RAS: Remote access services.
15. RF: Radio frequency.
16. ROM: Read-only memory. ROM data are maintained through losses of power.
17. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.
18. TWAIN: Technology without an Interesting Name. A programming interface that lets a graphics application, such as an image editing program or desktop publishing program, activate a scanner, frame grabber, or other image-capturing device.
19. UPS: Uninterruptible power supply.
20. USB: Universal serial bus.
21. WAN: Wide area network.
22. WAV: The digital audio format used in Microsoft Windows.
23. WMP: Windows media player.
24. Wiegand: Patented magnetic principle that uses specially treated wires embedded in the credential card.

25. Windows: Operating system by Microsoft Corporation.
26. Workstation: A PC with software that is configured for specific, limited security-system functions.
27. WYSIWYG: What You See Is What You Get. Text and graphics appear on the screen the same as they will in print.

D. Submittals
1. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Reference each product to a location on Drawings. Test and evaluation data presented in Product Data shall comply with SIA BIO-01.
2. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   a. Diagrams for cable management system.
   b. System labeling schedules, including electronic copy of labeling schedules that are part of the cable and asset identification system of the software specified in Parts 1.2 and 1.3.
   c. Wiring Diagrams. For power, signal, and control wiring. Show typical wiring schematics including the following:
      1) Workstation outlets, jacks, and jack assemblies.
      2) Patch cords.
      3) Patch panels.
   d. Cable Administration Drawings: As specified in Part 1.3 "Identification" Article.
   e. Battery and charger calculations for Central Station, workstations, and Controllers.
3. Samples: For workstation outlets, jacks, jack assemblies, and faceplates. For each exposed product and for each color and texture specified.
4. Other Action Submittals:
   a. Project planning documents as specified in Part 1.3.
5. Field quality-control test reports.
6. Operation and Maintenance Data: For security system to include in emergency, operation, and maintenance manuals. Include the following:
   a. Microsoft Windows software documentation.
   b. PC installation and operating documentation, manuals, and software for the PC and all installed peripherals. Software shall include system restore, emergency boot diskettes, and drivers for all installed hardware. Provide separately for each PC.
   c. Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy submittal.
   d. System installation and setup guides, with data forms to plan and record options and setup decisions.

E. Quality Assurance
1. Installer Qualifications: An employer of workers trained and approved by manufacturer.
   a. Cable installer must have on staff a registered communication distribution designer certified by Building Industry Consulting Service International.
2. Source Limitations: Obtain Central Station, workstations, Controllers, Identifier readers, and all software through one source from a single manufacturer.
3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 by a qualified testing agency, and marked for intended use.
4. Comply with NFPA 70, "National Electrical Code."
5. Comply with SIA DC-01 and SIA DC-03 and SIA DC-07, **as directed**.

F. Delivery, Storage, And Handling
1. Central Station, Workstations, and Controllers:
   a. Store in temperature- and humidity-controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 50 and 85 deg F (10 and 30 deg C), and not more than 80 percent relative humidity, noncondensing.
   b. Open each container; verify contents against packing list, and file copy of packing list, complete with container identification for inclusion in operation and maintenance data.

c. Mark packing list with designations that have been assigned to materials and equipment for recording in the system labeling schedules that are generated by cable and asset management system specified in Part 2.
d. Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.

G. Project Conditions
1. Environmental Conditions: System shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
a. Control Station: Rated for continuous operation in ambient conditions of 60 to 85 deg F (16 to 30 deg C) and a relative humidity of 20 to 80 percent, noncondensing.
b. Indoor, Controlled Environment: NEMA 250, Type 1 enclosure. System components, except central-station control unit, installed in air-conditioned **OR** temperature-controlled, **as directed**, indoor environments shall be rated for continuous operation in ambient conditions of 36 to 122 deg F (2 to 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing.
c. Indoor, Uncontrolled Environment: NEMA 250, Type 3R **OR** 4 **OR** 12 **OR** 12K, **as directed**, enclosures. System components installed in non-air-conditioned **OR** non-temperature-controlled, **as directed**, interior environments shall be rated for continuous operation in ambient conditions of 0 to 122 deg F (minus 18 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing.
d. Outdoor Environment: NEMA 250, Type 3 **OR** 3R **OR** 3S **OR** 4 **OR** 4X, **as directed**, enclosures. System components installed in locations exposed to weather shall be rated for continuous operation in ambient conditions of minus 30 to plus 122 deg F (minus 34 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation where exposed to rain as specified in NEMA 250, winds up to 85 mph (137 km/h) and snow cover up to 24 inches (610 mm) thick.
e. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers shall be rated, listed, and installed according to NFPA 70.
f. Corrosive Environment: For system components subjected to corrosive fumes, vapors, and wind-driven salt spray in coastal zones, provide NEMA 250, Type 4X **OR** 6P, **as directed**, enclosures.

1.2 PRODUCTS

A. Description
1. Security Access System: PC-based central station, one or more networked PC-based workstations, and field-installed controllers, connected by a high-speed electronic-data transmission network.
2. System Software: Based on 32-bit, central-station, workstation operating system, server operating system, and application software. Software shall have the following capabilities:
a. Multiuser and multitasking to allow for independent activities and monitoring to occur simultaneously at different workstations.
b. Graphical user interface to show pull-down menus and a menu-tree format that complies with interface guidelines of Microsoft Windows.
c. System license for the entire system including capability for future additions that are within the indicated system size limits specified in this Section.
d. Open-architecture system that allows importing and exporting of data and interfacing with other systems that are compatible with Microsoft Windows.
e. Password-protected operator login and access.
f. Open-database-connectivity compliant.
3. Network connecting the central station and workstations shall be a LAN **OR** WAN, **as directed,** using Microsoft Windows-based TCP/IP with a capacity of connecting up to 99 workstations.

System shall be portable across multiple communication platforms without changing system software.

4. Network(s) connecting PCs and controllers shall consist of one or more of the following:
   a. Local area, IEEE 802.3 Fast Ethernet Gigabit-Ethernet **OR** 100 BASE-TX, **as directed**, star topology network based on TCP/IP.
   b. Direct-connected, RS-232 cable from the COM port of the central station to the first controller, then RS-485 cable to interconnect the remaining controllers at that Location.
   c. Dial-up and cable modem connection using a standard cable or dial-up telephone line.

B. Operation
1. Security access system shall use a single database for access-control and credential-creation functions.
2. Distributed Processing: A fully distributed processing system.
   a. Access-control information, including time, date, valid codes, access levels, and similar data, shall be downloaded to controllers so each controller can make access-control decisions.
   b. Intermediate controllers for access control are prohibited.
   c. In the event that communications with the central controller are lost, controllers shall automatically buffer event transactions until communications are restored, at which time buffered events shall be uploaded to the central station.
3. Number of Locations:
   a. Support at least 32,000 separate Locations using a single PC with combinations of direct-connect, dial-up, or TCP/IP LAN connections to each Location.
   b. Each Location shall have its own database and history in the central station.
   c. Locations may be combined to share a common database.
4. Data Capacity:
   a. 130 different card-reader formats.
   b. 999 comments.
   c. 48 graphic file types for importing maps.
5. Location Capacity:
   a. 128 reader-controlled doors.
   b. 50,000 total-access credentials.
   c. 2048 supervised alarm inputs.
   d. 2048 programmable outputs.
   e. 32,000 custom action messages per Location to instruct operator on action required when alarm is received.
6. System Network Requirements:
   a. System components shall be interconnected and shall provide automatic communication of status changes, commands, field-initiated interrupts, and other communications required for proper system operation.
   b. Communication shall not require operator initiation or response and shall return to normal after partial- or total-network interruption such as power loss or transient upset.
   c. System shall automatically annunciate communication failures to the operator and shall identify the communications link that has experienced a partial or total failure.
   d. Communications controller may be used as an interface between the central-station display systems and the field device network. Communications controller shall provide functions required to attain the specified network communications performance.
7. Central station shall provide operator interface, interaction, display, control, and dynamic and real-time monitoring. Central station shall control system networks to interconnect all system components, including workstations and field-installed controllers.
8. Field equipment shall include controllers, sensors, and controls.
   a. Controllers shall serve as an interface between the central station and sensors and controls.
   b. Data exchange between the central station and the controllers shall include down-line transmission of commands, software, and databases to controllers.

c. The up-line data exchange from the controller to the central station shall include status data such as intrusion alarms, status reports, and entry-control records.
d. Controllers are classified as alarm-annunciation or entry-control type.

9. System Response to Alarms:
   a. Field device network shall provide a system end-to-end response time of one second(s) or less for every device connected to the system.
   b. Alarms shall be annunciated at the central station within one second of the alarm occurring at a controller or at a device controlled by a local controller, and within 100 ms if the alarm occurs at the central station.
   c. Alarm and status changes shall be displayed within 100 ms after receipt of data by the central station.
   d. All graphics shall be displayed, including graphics-generated map displays, on the console monitor within five seconds of alarm receipt at the security console.
   e. This response time shall be maintained during system heavy load.
10. False-Alarm Reduction: The design of the central station and controllers shall contain features to reduce false alarms. Equipment and software shall comply with SIA CP-01.
11. Error Detection:
   a. Use a cyclic code method to detect single- and double-bit errors, burst errors of eight bits or fewer, and at least 99 percent of all other multibit and burst errors between controllers and the central station.
   b. Interactive or product error-detection codes alone will not be acceptable.
   c. A message shall be in error if one bit is received incorrectly.
   d. Retransmit messages with detected errors.
   e. Allow for an operator-assigned two-digit decimal number to each communications link representing the number of retransmission attempts.
   f. Central station shall print a communication failure alarm message when the number of consecutive retransmission attempts equals the assigned quantity.
   g. Monitor the frequency of data transmission failure for display and logging.
12. Data Line Supervision: System shall initiate an alarm in response to opening, closing, shorting, or grounding of data transmission lines.
13. Door Hardware Interface:
   a. Comply with requirements in Division 8 Sections for door hardware required to be monitored or controlled by the security access system.
   b. Electrical characteristics of controllers shall match the signal and power requirements of door hardware.

C. Application Software
1. System Software: Based on 32-bit, Microsoft Windows central-station and workstation operating system and application software.
   a. Multiuser multitasking shall allow independent activities and monitoring to occur simultaneously at different workstations.
   b. Graphical user interface shall show pull-down menus and a menu-tree format.
   c. Capability for future additions within the indicated system size limits.
   d. Open architecture that allows importing and exporting of data and interfacing with other systems that are compatible with operating system.
   e. Password-protected operator login and access.
2. Peer Computer Control Software: Detect a failure of a central computer and cause the other central computer to assume control of all system functions without interruption of operation. Both central computers shall have drivers to support this mode of operation.
3. Application Software: Interface between the alarm annunciation and entry-control controllers to monitor sensors and DTS links, operate displays, report alarms, generate reports, and help train system operators.
   a. Reside at the central station, workstations, and controllers as required to perform specified functions.
   b. Operate and manage peripheral devices.

c. Manage files for disk I/O, including creating, deleting, and copying files; and automatically maintain a directory of all files, including size and location of each sequential and random-ordered record.
d. Import custom icons into graphics to represent alarms and I/O devices.
e. Globally link I/O so that any I/O can link to any other I/O within the same Location without requiring interaction with the host PC. This operation shall be at the controller.
f. Globally code I/O links so that any access-granted event can link to any I/O with the same Location without requiring interaction with the host PC. This operation shall be at the controller.
g. Messages from PC to controllers and controllers to controllers shall be on a polled network that utilizes check summing and acknowledgment of each message. Communication shall be automatically verified, buffered, and retransmitted if message is not acknowledged.
h. Selectable poll frequency and message time-out settings shall handle bandwidth and latency issues for TCP/IP, RF, and other PC-to-controller communications methods by changing the polling frequency and the amount of time the system waits for a response.
i. Automatic and encrypted backups for database and history backups shall be automatically stored at the central-control PC **OR** a selected workstation, **as directed**, and encrypted with a nine-character alphanumeric password that must be used to restore or read data contained in backup.
j. Operator audit trail for recording and reporting all changes made to database and system software.
k. Support network protocol and topology, TCP/IP, Novel Netware, Digital Pathworks, Banyan Vines, LAN/WAN, and RAS.

4. Workstation Software:
   a. Password levels shall be individually customized at each workstation to allow or disallow operator access to program functions for each Location.
   b. Workstation event filtering shall allow user to define events and alarms that will be displayed at each workstation. If an alarm is unacknowledged (not handled by another workstation) for a preset amount of time, the alarm will automatically appear on the filtered workstation.
5. Controller Software:
   a. Controllers shall operate as autonomous, intelligent processing units.
      1) Controllers shall make decisions about access control, alarm monitoring, linking functions, and door-locking schedules for their operation, independent of other system components.
      2) Controllers shall be part of a fully distributed processing-control network.
      3) The portion of the database associated with a controller, and consisting of parameters, constraints, and the latest value or status of points connected to that controller, shall be maintained in the controller.
   b. The following functions shall be fully implemented and operational within each controller:
      1) Monitoring inputs.
      2) Controlling outputs.
      3) Automatically reporting alarms to the central station.
      4) Reporting of sensor and output status to the central station on request.
      5) Maintaining real time, automatically updated by the central station at least once a day.
      6) Communicating with the central station.
      7) Executing controller resident programs.
      8) Diagnosing.
      9) Downloading and uploading data to and from the central station.
   c. Controller Operations at a Location:
      1) Up to 64 controllers connected to TIA 485-A communications loop. Globally operating I/O linking and anti-passback functions between controllers within the same Location without central-station or workstation intervention. Linking and anti-

passback shall remain fully functional within the same Location even when the central station or workstations are off-line.

2) In the event of communication failure between the central station and a Location, there shall be no degradation in operations at the controllers at that Location. Controllers at each Location shall be connected to a memory buffer with a capacity to store up to 10,000 events; there shall be no loss of transactions in system history files until the buffer overflows.

3) Buffered events shall be handled in a first-in-first-out mode of operation.

d. Individual Controller Operation:

1) Controllers shall transmit alarms, status changes, and other data to the central station when communications circuits are operable. If communications are not available, controllers shall function in a stand-alone mode; operational data, including the status and alarm data normally transmitted to the central station, shall be stored for later transmission to the central station. Storage capacity for the latest 1024 events shall be provided at each controller.

2) Card-reader ports of a controller shall be custom configurable for at least 120 different card-reader or keypad formats. Multiple reader or keypad formats may be used simultaneously at different controllers or within the same controller.

3) Controllers shall provide a response to card readers or keypad entries in less than 0.25 seconds, regardless of system size.

4) Controllers that are reset, or powered up from a nonpowered state, shall automatically request a parameter download and reboot to their proper working state. This shall happen without any operator intervention.

5) Initial Startup: When controllers are brought on-line, database parameters shall be automatically downloaded to them. After initial download is completed, only database changes shall be downloaded to each controller.

6) On failure for any reason, controllers shall perform an orderly shutdown and force controller outputs to a predetermined failure-mode state, consistent with the failure modes shown and the associated control device.

7) After power is restored, following a power failure, startup software shall initiate self-test diagnostic routines, after which controllers shall resume normal operation.

8) After controller failure, if the database and application software are no longer resident, controllers shall not restart but shall remain in the failure mode until repaired. If database and application programs are resident, controllers shall immediately resume operation. If not, software shall be restored automatically from the central station.

e. Communications Monitoring:

1) System shall monitor and report status of TIA 485-A communications loop of each Location.

2) Communication status window shall display which controllers are currently communicating, a total count of missed polls since midnight, and which controller last missed a poll.

3) Communication status window shall show the type of CPU, the type of I/O board, and the amount of RAM for each controller.

f. Operating systems shall include a real-time clock function that maintains seconds, minutes, hours, day, date, and month. The real-time clock shall be automatically synchronized with the central station at least once a day to plus or minus 10 seconds. The time synchronization shall be automatic, without operator action and without requiring system shutdown.

6. PC-to-Controller Communications:

a. Central-station or workstation communications shall use the following:

1) Direct connection using serial ports of the PC.

2) TCP/IP LAN interface cards.

3) Dial-up or cable modems for connections to Locations.

b. Each serial port used for communications shall be individually configurable for "direct communications," "modem communications incoming and outgoing," or "modem

communications incoming only," or as an ASCII output port. Serial ports shall have adjustable data transmission rates and shall be selectable under program control.

c. Use multiport communications board if more than two serial ports are needed.
   1) Use a 4-, 8-, or 16-serial port configuration that is expandable to 32- or 64-serial ports.
   2) Connect the first board to an internal PCI bus adapter card.

d. Direct serial, TCP/IP, and dial-up, cable, or satellite communications shall be alike in the monitoring or control of the system except for the connection that must first be made to a dial-up or voice-over IP Location.

e. TCP/IP network interface card (NIV) shall have an option to set the poll-frequency and message-response time-out settings.

f. PC-to-controller and controller-to-controller communications (direct, dial-up, or TCP/IP) shall use a polled-communication protocol that checks sum and acknowledges each message. All communications in this subparagraph shall be verified and buffered, and retransmitted if not acknowledged.

7. Direct Serial or TCP/IP PC-to-Controller Communications:
   a. Communication software on the PC shall supervise the PC-to-controller communications link.
   b. Loss of communications to any controller shall result in an alarm at all PCs running the communication software.
   c. When communications are restored, all buffered events shall automatically upload to the PC, and any database changes shall be automatically sent to the controller.

8. Dial-up Modem or Cable Modem PC-to-Controller Communications:
   a. Communication software on the PC shall supervise the PC-to-controller communications link during dial-up modem connect times.
   b. Communication software shall be programmable to routinely poll each of the remote dial-up or cable modem Locations, collecting event logs and verifying phone lines at operator-selectable time intervals for each Location.
   c. System shall be programmable for dialing and connecting to all dial-up or cable modem Locations and for retrieving the accrued history transactions on an automatic basis as often as once every 10 minutes and up to once every 9999 minutes.
   d. Failure to communicate to a dial-up Location three times in a row shall result in an alarm at the PC.
   e. Time offset capabilities shall be present so that Locations in a different geographical time zone than the host PC will be set to, and maintained at, the proper local time. This feature shall allow for geographical time zones that are ahead of or behind the host PC.
   f. The controller connected to a dial-up or cable modem shall automatically buffer all normal transactions until its buffer reaches 80 percent of capacity. When the transaction buffer reaches 80 percent, the controller shall automatically initiate a call to the central station and upload all transactions.
   g. Alarms shall be reported immediately.
   h. Dial-up or cable modems shall be provided by manufacturer of the system. Modems used at the controller shall be powered by the controller. Power to the modem shall include battery backup if the controller is so equipped.

9. Controller-to-Controller Communications:
   a. TIA 485-A, four-wire, point-to-point, regenerative (repeater) communications network methodology.
   b. TIA 485-A communications signal shall be regenerated at each controller.

10. Database Downloads:
   a. All data transmissions from PCs to a Location, and between controllers at a Location, shall include a complete database checksum to check the integrity of the transmission. If the data checksum does not match, a full data download shall be automatically retransmitted.
   b. If a controller is reset for any reason, it shall automatically request and receive a database download from the PC. The download shall restore data stored at the controller to their normal working state and shall take place with no operator intervention.

c. Software shall provide for setting downloads via dial-up connection to once per 24-hour period, with time selected by the operator.
d. Software shall provide for setting delays of database downloads for dial-up connections. Delays change the download from immediately to a delay ranging from one to 999 minutes.

11. Operator Interface:
    a. Inputs in system shall have two icon representations, one for the normal state and one for the abnormal state.
    b. When viewing and controlling inputs, displayed icons shall automatically change to the proper icon to display the current system state in real time. Icons shall also display the input's state, whether armed or bypassed, and if the input is in the armed or bypassed state due to a time zone or a manual command.
    c. Outputs in system shall have two icon representations, one for the secure (locked) state and one for the open (unlocked) state.
    d. Icons displaying status of the I/O points shall be constantly updated to show their current real-time condition without prompting by the operator.
    e. The operator shall be able to scroll the list of I/Os and press the appropriate toolbar button, or right click, to command the system to perform the desired function.
    f. Graphic maps or drawings containing inputs, outputs, and override groups shall include the following:
        1) Database to import and store full-color maps or drawings and allow for input, output, and override group icons to be placed on maps.
        2) Maps to provide real-time display animation and allow for control of points assigned to them.
        3) System to allow inputs, outputs, and override groups to be placed on different maps.
        4) Software to allow changing the order or priority in which maps will be displayed.
    g. Override Groups Containing I/Os:
        1) System shall incorporate override groups that provide the operator with the status and control over user-defined "sets" of I/Os with a single icon.
        2) Icon shall change automatically to show the live summary status of points in that group.
        3) Override group icon shall provide a method to manually control or set to time-zone points in the group.
        4) Override group icon shall allow the expanding of the group to show icons representing the live status for each point in the group, individual control over each point, and the ability to compress the individual icons back into one summary icon.
    h. Schedule Overrides of I/Os and Override Groups:
        1) To accommodate temporary schedule changes that do not fall within the holiday parameters, the operator shall have the ability to override schedules individually for each input, output, or override group.
        2) Each schedule shall be composed of a minimum of two dates with separate times for each date.
        3) The first time and date shall be assigned the override state that the point shall advance to when the time and date become current.
        4) The second time and date shall be assigned the state that the point shall return to when the time and date become current.
    i. Copy command in database shall allow for like data to be copied and then edited for specific requirements, to reduce redundant data entry.

12. Operator Access Control:
    a. Control operator access to system controls through three password-protected operator levels. System operators and managers with appropriate password clearances shall be able to change operator levels for operators.
    b. Three successive attempts by an operator to execute functions beyond their defined level during a 24-hour period shall initiate a software tamper alarm.
    c. A minimum of 32 passwords shall be available with the system software. System shall display the operator's name or initials in the console's first field. System shall print the operator's name or initials, action, date, and time on the system printer at login and logoff.

d. The password shall not be displayed or printed.
e. Each password shall be definable and assignable for the following:
   1) Selected commands to be usable.
   2) Access to system software.
   3) Access to application software.
   4) Individual zones that are to be accessed.
   5) Access to database.

13. Operator Commands:
   a. Command Input: Plain-language words and acronyms shall allow operators to use the system without extensive training or data-processing backgrounds. System prompts shall be a word, a phrase, or an acronym.
   b. Command inputs shall be acknowledged and processing shall start in not less than one second(s).
   c. Tasks that are executed by operator's commands shall include the following:
      1) Acknowledge Alarms: Used to acknowledge that the operator has observed the alarm message.
      2) Place Zone in Access: Used to remotely disable intrusion-alarm circuits emanating from a specific zone. System shall be structured so that console operator cannot disable tamper circuits.
      3) Place Zone in Secure: Used to remotely activate intrusion-alarm circuits emanating from a specific zone.
      4) System Test: Allows the operator to initiate a system-wide operational test.
      5) Zone Test: Allows the operator to initiate an operational test for a specific zone.
      6) Print reports.
      7) Change Operator: Used for changing operators.
      8) Security Lighting Controls: Allows the operator to remotely turn on or turn off security lights.
      9) Display Graphics: Used to show any graphic displays implemented in the system. Graphic displays shall be completed within 20 seconds from time of operator command.
      10) Run system tests.
      11) Generate and format reports.
      12) Request help with the system operation.
         a) Include in main menus.
         b) Provide unique, descriptive, context-sensitive help for selections and functions with the press of one function key.
         c) Provide navigation to specific topic from within the first help window.
         d) Help shall be accessible outside the application program.
      13) Entry-Control Commands:
         a) Lock (secure) or unlock (open) each controlled entry and exit up to four times a day through time-zone programming.
         b) Arm or disarm each monitored input up to four times a day through time-zone programming.
         c) Enable or disable readers or keypads up to two times a day through time-zone programming.
         d) Enable or disable cards or codes up to four times a day per entry point through access-level programming.
   d. Command Input Errors: Show operator input assistance when a command cannot be executed because of operator input errors. Assistance screen shall use plain-language words and phrases to explain why the command cannot be executed. Error responses that require an operator to look up a code in a manual or other document are not acceptable. Conditions causing operator assistance messages include the following:
      1) Command entered is incorrect or incomplete.
      2) Operator is restricted from using that command.
      3) Command addresses a point that is disabled or out of service.

4) Command addresses a point that does not exist.
5) Command is outside the system's capacity.

14. Alarms:
    a. System Setup:
        1) Assign manual and automatic responses to incoming-point status change or alarms.
        2) Automatically respond to input with a link to other inputs, outputs, or operator-response plans; unique sound with use of WAV files; and maps or images that graphically represent the point location.
        3) Sixty-character message field for each alarm.
        4) Operator-response-action messages shall allow message length of at least 65,000 characters, with database storage capacity of up to 32,000 messages. Setup shall assign messages to access point **OR** zone **OR** sensor**, as directed**.
        5) Secondary messages shall be assignable by the operator for printing to provide further information and shall be editable by the operator.
        6) Allow 25 secondary messages with a field of four lines of 60 characters each.
        7) Store the most recent 1000 alarms for recall by the operator using the report generator.
    b. Software Tamper:
        1) Annunciate a tamper alarm when unauthorized changes to system database files are attempted. Three consecutive unsuccessful attempts to log onto system shall generate a software tamper alarm.
        2) Annunciate a software tamper alarm when an operator or other individual makes three consecutive unsuccessful attempts to invoke functions beyond the authorization level.
        3) Maintain a transcript file of the last 5000 commands entered at each central station to serve as an audit trail. System shall not allow write access to system transcript files by any person, regardless of their authorization level.
        4) Allow only acknowledgment of software tamper alarms.
    c. Read access to system transcript files shall be reserved for operators with the highest password authorization level available in system.
    d. Animated Response Graphics: Highlight alarms with flashing icons on graphic maps; display and constantly update the current status of alarm inputs and outputs in real time through animated icons.
    e. Multimedia Alarm Annunciation: WAV files to be associated with alarm events for audio annunciation or instructions.
    f. Alarm Handling: Each input may be configured so that an alarm cannot be cleared unless it has returned to normal, with options of requiring the operator to enter a comment about disposition of alarm. Allow operator to silence alarm sound when alarm is acknowledged.
    g. Alarm Automation Interface: High-level interface to central-station alarm automation software systems. Allows input alarms to be passed to and handled by automation systems in the same manner as burglar alarms, using a TIA 232-F ASCII interface.
    h. CCTV Alarm Interface: Allow commands to be sent to CCTV systems during alarms (or input change of state) through serial ports.
    i. Camera Control: Provides operator ability to select and control cameras from graphic maps.
15. Alarm Monitoring: Monitor sensors, controllers, and DTS circuits and notify operators of an alarm condition. Display higher-priority alarms first and, within alarm priorities, display the oldest unacknowledged alarm first. Operator acknowledgment of one alarm shall not be considered acknowledgment of other alarms nor shall it inhibit reporting of subsequent alarms.
    a. Displayed alarm data shall include type of alarm, location of alarm, and secondary alarm messages.
    b. Printed alarm data shall include type of alarm, location of alarm, date and time (to nearest second) of occurrence, and operator responses.
    c. Maps shall automatically display the alarm condition for each input assigned to that map if that option is selected for that input location.

d. Alarms initiate a status of "pending" and require the following two handling steps by operators:
   1) First Operator Step: "Acknowledged." This action shall silence sounds associated with the alarm. The alarm remains in the system "Acknowledged" but "Un-Resolved."
   2) Second Operator Step: Operators enter the resolution or operator comment, giving the disposition of the alarm event. The alarm shall then clear.
e. Each workstation shall display the total pending alarms and total unresolved alarms.
f. Each alarm point shall be programmable to disallow the resolution of alarms until the alarm point has returned to its normal state.
g. Alarms shall transmit to the central station in real time except for allowing connection time for dial-up locations.
h. Alarms shall be displayed and managed from a minimum of four different windows.
   1) Input Status Window: Overlay status icon with a large red blinking icon. Selecting the icon will acknowledge the alarm.
   2) History Log Transaction Window: Display name, time, and date in red text. Selecting red text will acknowledge the alarm.
   3) Alarm Log Transaction Window: Display name, time, and date in red. Selecting red text will acknowledge the alarm.
   4) Graphic Map Display: Display a steady colored icon representing each alarm input location. Change icon to flashing red when the alarm occurs. Change icon from flashing red to steady red when the alarm is acknowledged.
i. Once an alarm is acknowledged, the operator shall be prompted to enter comments about the nature of the alarm and actions taken. Operator's comments may be manually entered or selected from a programmed predefined list, or a combination of both.
j. For locations where there are regular alarm occurrences, provide programmed comments. Selecting that comment shall clear the alarm.
k. The time and name of the operator who acknowledged and resolved the alarm shall be recorded in the database.
l. Identical alarms from the same alarm point shall be acknowledged at the same time the operator acknowledges the first alarm. Identical alarms shall be resolved when the first alarm is resolved.
m. Alarm functions shall have priority over downloading, retrieving, and updating database from workstations and controllers.
n. When a reader-controlled output (relay) is opened, the corresponding alarm point shall be automatically bypassed.

16. Monitor Display: Display text and graphic maps that include zone status integrated into the display. Colors are used for the various components and current data. Colors shall be uniform throughout the system.
   a. Color Code:
      1) FLASHING RED: Alerts operator that a zone has gone into an alarm or that primary power has failed.
      2) STEADY RED: Alerts operator that a zone is in alarm and alarm has been acknowledged.
      3) YELLOW: Advises operator that a zone is in access.
      4) GREEN: Indicates that a zone is secure and that power is on.
   b. Graphics:
      1) Support 32,000 graphic display maps and allow import of maps from a minimum of 16 standard formats from another drawing or graphics program.
      2) Allow I/O to be placed on graphic maps by the drag-and-drop method.
      3) Operators shall be able to view the inputs, outputs, and the point's name by moving the mouse cursor over the point on the graphic map.
      4) Inputs or outputs may be placed on multiple graphic maps. The operator shall be able to toggle to view graphic maps associated with I/Os.

5) Each graphic map shall have a display-order sequence number associated with it to provide a predetermined order when toggled to different views.
6) Camera icons shall have the ability to be placed on graphic maps that, when selected by an operator, will open a video window, display the camera associated with that icon, and provide pan-tilt-zoom control.
7) Input, output, or camera placed on a map shall allow the ability to arm or bypass an input, open or secure an output, or control the pan-tilt-zoom function of the selected camera.

17. System test software enables operators to initiate a test of the entire system or of a particular portion of the system.
    a. Test Report: The results of each test shall be stored for future display or printout. The report shall document the operational status of system components.
18. Report-Generator Software: Include commands to generate reports for displaying, printing, and storing on disk and tape. Reports shall be stored by type, date, and time. Report printing shall be the lowest-priority activity. Report-generation mode shall be operator selectable but set up initially as periodic, automatic, or on request. Include time and date printed and the name of operator generating the report. Report formats may be configured by operators.
    a. Automatic Printing: Setup shall specify, modify, or inhibit the report to be generated; the time the initial report is to be generated; the time interval between reports; the end of the period; and the default printer.
    b. Printing on Request: An operator may request a printout of any report.
    c. Alarm Reports: Reporting shall be automatic as initially set up. Include alarms recorded by system over the selected time and information about the type of alarm such as door alarm, intrusion alarm, tamper alarm, etc, the type of sensor, the location, the time, and the action taken.
    d. Access and Secure Reports: Document zones placed in access, the time placed in access, and the time placed in secure mode.
    e. Custom Reports: Reports tailored to exact requirements of who, what, when, and where. As an option, custom report formats may be stored for future printing.
    f. Automatic History Reports: Named, saved, and scheduled for automatic generation.
    g. Cardholder Reports: Include data, or selected parts of the data, as well as the ability to be sorted by name, card number, imprinted number, or by any of the user-defined fields.
    h. Cardholder by Reader Reports: Based on who has access to a specific reader or group of readers by selecting the readers from a list.
    i. Cardholder by Access-Level Reports: Display everyone that has been assigned to the specified access level.
    j. Who Is "In" (Muster) Report:
        1) Emergency Muster Report: One-click operation on toolbar launches report.
        2) Cardholder Report. Contain a count of persons who are "In" at a selected Location and a detailed listing of name, date, and time of last use, sorted by the last reader used or by the group assignment.
    k. Panel Labels Reports: Printout of control-panel field documentation including the actual location of equipment, programming parameters, and wiring identification. Maintain system installation data within system database so that data are available on-site at all times.
    l. Activity and Alarm On-Line Printing: Activity printers for use at workstations; prints all events, or alarms only.
    m. History Reports: Custom reports that allow the operator to select any date, time, event type, device, output, input, operator, Location, name, or cardholder to be included or excluded from the report.
        1) Initially store history on the hard disk of the host PC.
        2) Permit viewing of the history on workstations or print history to any system printer.
        3) The report shall be definable by a range of dates and times with the ability to have a daily start and stop time over a given date range.
        4) Each report shall depict the date, time, event type, event description, and device; or I/O name, cardholder group assignment, and cardholder name or code number.

5) Each line of a printed report shall be numbered to ensure that the integrity of the report has not been compromised.
6) Total number of lines of the report shall be given at the end of the report. If the report is run for a single event such as "Alarms," the total shall reflect how many alarms occurred during that period.

n. Reports shall have the following four options:
1) View on screen.
2) Print to system printer. Include automatic print spooling and "Print To" options if more than one printer is connected to the system.
3) "Save to File" with full path statement.
4) System shall have the ability to produce a report indicating status of system inputs and outputs or of inputs and outputs that are abnormal, out of time zone, manually overridden, not reporting, or in alarm.

o. Custom Code List Subroutine: Allow the access codes of system to be sorted and printed according to the following criteria:
1) Active, inactive, or future activate or deactivate.
2) Code number, name, or imprinted card number.
3) Group, Location access levels.
4) Start and stop code range.
5) Codes that have not been used since a selectable number of days.
6) In, out, or either status.
7) Codes with trace designation.

p. The reports of system database shall allow options so that every data field may be printed.

q. The reports of system database shall be constructed so that the actual position of the printed data shall closely match the position of the data on the data-entry windows.

19. Anti-Passback:

a. System shall have global and local anti-passback features, selectable by Location. System shall support hard and soft anti-passback.

b. Hard Anti-Passback: Once a credential holder is granted access through a reader with one type of designation (IN or OUT), the credential holder may not pass through that type of reader designation until the credential holder passes through a reader of opposite designation.

c. Soft Anti-Passback: Should a violation of the proper IN or OUT sequence occur, access shall be granted, but a unique alarm shall be transmitted to the control station, reporting the credential holder and the door involved in the violation. A separate report may be run on this event.

d. Timed Anti-Passback: A controller capability that prevents an access code from being used twice at the same device (door) within a user-defined amount of time.

e. Provide four separate zones per Location that can operate without requiring interaction with the host PC (done at controller). Each reader shall be assignable to one or all four anti-passback zones. In addition, each anti-passback reader can be further designated as "Hard," "Soft," or "Timed" in each of the four anti-passback zones. The four anti-passback zones shall operate independently.

f. The anti-passback schemes shall be definable for each individual door.

g. The Master Access Level shall override anti-passback.

h. System shall have the ability to forgive (or reset) an individual credential holder or the entire credential-holder population anti-passback status to a neutral status.

20. Visitor Assignment:

a. Provide for and allow an operator to be restricted to only working with visitors. The visitor badging subsystem shall assign credentials and enroll visitors. Allow only those access levels that have been designated as approved for visitors.

b. Provide an automated log of visitor name, time and doors accessed, and name of person contacted.

c. Allow a visitor designation to be assigned to a credential holder.

d. Security access system shall be able to restrict the access levels that may be assigned to credentials issued to visitors.
e. Allow operator to recall visitors' credential-holder file once a visitor is enrolled in the system.
f. The operator may designate any reader as one that deactivates the credential after use at that reader. The history log shall show the return of the credential.
g. System shall have the ability to use the visitor designation in searches and reports. Reports shall be able to print all or any visitor activity.

21. Time and Attendance:
    a. Time and attendance reporting shall be provided to match IN and OUT reads and display cumulative time in for each day and cumulative time in for length designated in the report.
    b. Shall be provided to match IN and OUT reads and display cumulative time in for each day and cumulative time in for length designated in the report.
    c. System software setup shall allow designation of selected access-control readers as time and attendance hardware to gather the clock-in and clock-out times of the users at these readers.
        1) Reports shall show in and out times for each day, total time in for each day, and a total time in for period specified by the user.
        2) Allow the operator to view and print the reports, or save the reports to a file.
        3) Alphabetically sort reports on the person's last name, by Location or location group. Include all credential holders or optionally select individual credential holders for the report.
22. Training Software: Enables operators to practice system operation, including alarm acknowledgment, alarm assessment, response force deployment, and response force communications. System shall continue normal operation during training exercises and shall terminate exercises when an alarm signal is received at the console.
23. Entry-Control Enrollment Software: Database management functions that allow operators to add, delete, and modify access data as needed.
    a. The enrollment station shall not have alarm response or acknowledgment functions.
    b. Provide multiple, password-protected access levels. Database management and modification functions shall require a higher operator access level than personnel enrollment functions.
    c. The program shall provide means to disable the enrollment station when it is unattended, to prevent unauthorized use.
    d. The program shall provide a method to enter personnel identifying information into the entry-control database files through enrollment stations. In the case of personnel identity-verification subsystems, this shall include biometric data. Allow entry of personnel identifying information into the system database using menu selections and data fields. The data field names shall be customized during setup to suit user and site needs. Personnel identity-verification subsystems selected for use with the system shall fully support the enrollment function and shall be compatible with the entry-control database files.
    e. Cardholder Data: Provide 99 user-defined fields. System shall have the ability to run searches and reports using any combination of these fields. Each user-defined field shall be configurable, using any combination of the following features:
        1) MASK: Determines a specific format with which data must comply.
        2) REQUIRED: Operator is required to enter data into field before saving.
        3) UNIQUE: Data entered must be unique.
        4) DEACTIVATE DATE: Data entered will be evaluated as an additional deactivate date for all cards assigned to this cardholder.
        5) NAME ID: Data entered will be considered a unique ID for the cardholder.
    f. Personnel Search Engine: A report generator with capabilities such as search by last name, first name, group, or any predetermined user-defined data field; by codes not used in definable number of days; by skills; or by seven other methods.
    g. Multiple Deactivate Dates for Cards: User-defined fields to be configured as additional stop dates to deactivate any cards assigned to the cardholder.

h. Batch card printing.
i. Default card data can be programmed to speed data entry for sites where most card data are similar.
j. Enhanced ASCII File Import Utility: Allows the importing of cardholder data and images.
k. Card Expire Function: Allows readers to be configured to deactivate cards when a card is used at selected devices.

D. System Database
1. Database and database management software shall define and modify each point in database using operator commands. Definition shall include parameters and constraints associated with each system device.
2. Database Operations:
   a. System data management shall be in a hierarchical menu tree format, with navigation through expandable menu branches and manipulated with use of menus and icons in a main menu and system toolbar.
   b. Navigational Aids:
      1) Toolbar icons for add, delete, copy, print, capture image, activate, deactivate, and muster report.
      2) Point and click feature to facilitate data manipulation.
      3) Next and previous command buttons visible when editing database fields to facilitate navigation from one record to the next.
      4) Copy command and copy tool in the toolbar to copy data from one record to create a new similar record.
   c. Data entry shall be automatically checked for duplicate and illegal data and shall verify that data are in a valid format.
   d. System shall generate a memo or note field for each item that is stored in database, allowing the storing of information about any defining characteristics of the item. Memo field is used for noting the purpose the item was entered for, reasons for changes that were made, and the like.
3. File Management:
   a. File management shall include backup and restoration system, allowing selection of storage media, including 3.5-inch floppy disk, Zip and Jaz drives, and designated network resources.
   b. Operations shall be both manual and automatic mode. The number of automatic sequential backups before the oldest backup becomes overwritten; FIFO mode shall be operator selectable.
   c. Backup program shall provide manual operation from any PC on the LAN and shall operate while system remains operational.
4. Operator Passwords:
   a. Software shall support up to 32,000 individual system operators, each with a unique password.
   b. One to eight alphanumeric characters.
   c. Allow passwords to be case sensitive.
   d. Passwords shall not be displayed when entered.
   e. Passwords shall have unique and customizable password profile, and allow several operators to share a password profile. Include the following features in the password profile:
      1) Allow for at least 32,000 operator password profiles.
      2) Predetermine the highest-level password profile for access to all functions and areas of program.
      3) Allow or disallow operator access to any program operation, including the functions of View, Add, Edit, and Delete.
      4) Restrict which doors an operator can assign access to.

f. Operators shall use a user name and password to log on to system. This user name and password shall be used to access database areas and programs as determined by the associated profile.
g. Make provision to allow the operator to log off without fully exiting program. User may be logged off but program will remain running while displaying the login window for the next operator.

5. Access Card/Code Operation and Management: Access authorization shall be by card, by a manually entered code (PIN), or by a combination of both (card plus PIN).
   a. Access authorization shall verify the facility code first, the card or card-and-PIN validation second, and the access level (time of day, day of week, date), anti-passback status, and number of uses last.
   b. Use data-entry windows to view, edit, and issue access levels. Access authorization entry management system shall maintain and coordinate all access levels to prevent duplication or the incorrect creation of levels.
   c. Allow assignment of multiple cards/codes to a cardholder.
   d. Allow assignment of up to four access levels for each Location to a cardholder. Each access level may contain any combination of doors.
   e. Each door may be assigned four time zones.
   f. Access codes may be up to 11 digits in length.
   g. Software shall allow the grouping of locations so cardholder data can be shared by all locations in the group.
   h. Visitor Access: Issue a visitor badge for data tracking or photo ID purposes without assigning that person a card or code.
   i. Cardholder Tracing: Allow for selection of cardholder for tracing. Make a special audible and visual annunciation at control station when a selected card or code is used at a designated code reader. Annunciation shall include an automatic display of the cardholder image.
   j. Allow each cardholder to be given either an unlimited number of uses or a number from 1 to 9998 that regulates the number of times the card can be used before it is automatically deactivated.
   k. Provide for cards and codes to be activated and deactivated manually or automatically by date. Provide for multiple deactivate dates to be preprogrammed.
6. Security Access Integration:
   a. Photo ID badging and photo verification shall use same database as the security access and may query data from cardholder, group, and other personal information to build a custom ID badge.
   b. Automatic or manual image recall and manual access based on photo verification shall also be a means of access verification and entry.
   c. System shall allow sorting of cardholders together by group or other characteristic for a fast and efficient method of reporting on, and enabling or disabling, cards or codes.
7. Key control and tracking shall be an integrated function of cardholder data.
   a. Provide the ability to store information about which conventional metal keys are issued and to whom, along with key construction information.
   b. Reports shall be designed to list everyone that has possession of a specified key.
8. Facility Codes: System shall accommodate up to 2048 facility codes per Location, with the option of allowing facility codes to work at all doors or only particular doors.
9. Operator Comments:
   a. With the press of one appropriate button on toolbar, the user shall be permitted to make operator comments into history at anytime.
   b. Automatic prompting of operator comment shall occur before the resolution of each alarm.
   c. Operator comments shall be recorded by time, date, and operator number.
   d. Comments shall be sorted and viewed through reports and history.
   e. The operator may enter comments in two ways; either or both may be used:
      1) Manually entered through keyboard data entry (typed), up to 65,000 characters per each alarm.
      2) Predefined and stored in database for retrieval on request.

f. System shall have a minimum of 999 predefined operator comments with up to 30 characters per comment.

10. Group:
    a. Group names may be used to sort cardholders into groups that allow the operator to determine the tenant, vendor, contractor, department, division, or any other designation of a group to which the person belongs.
    b. System software shall have the capacity to assign 1 of 32,000 group names to an access authorization.
    c. Make provision in software to deactivate and reactivate all access authorizations assigned to a particular group.
    d. Allow sorting of history reports and code list printouts by group name.
11. Time Zones:
    a. Each zone consists of a start and stop time for 7 days of the week and three holiday schedules. A time zone is assigned to inputs, outputs, or access levels to determine when an input shall automatically arm or disarm, when an output automatically opens or secures, or when access authorization assigned to an access level will be denied or granted.
    b. Up to four time zones may be assigned to inputs and outputs to allow up to four arm or disarm periods per day or four lock or unlock periods per day; up to three holiday override schedules may be assigned to a time zone.
    c. Data-entry window shall display a dynamically linked bar graph showing active and inactive times for each day and holiday, as start and stop times are entered or edited.
    d. System shall have the capacity for 2048 time zones for each Location.
12. Holidays:
    a. Three different holiday schedules may be assigned to a time zone. Holiday schedule consists of date in format MM/DD/YEAR and a description. When the holiday date matches the current date of the time zone, the holiday schedule replaces the time zone schedule for that 24-hour period.
    b. System shall have the capacity for 32,000 holidays.
    c. Three separate holiday schedules may be applied to a time zone.
    d. Holidays have an option to be designated as occurring on the designated date each year. These holidays remain in system and will not be purged.
    e. Holidays not designated to occur each year shall be automatically purged from database after the date expires.
13. Access Levels:
    a. System shall allow for the creation up to 32,000 access levels.
    b. One level shall be predefined as the Master Access Level. The Master Access Level shall work at all doors at all times and override any anti-passback.
    c. System shall allow for access to be restricted to any area by reader and by time. Access levels shall determine when and where an Identifier is authorized.
    d. System shall be able to create multiple door and time zone combinations under same access level so that an Identifier may be valid during different time periods at different readers even if the readers are on the same Controller.
14. User-Defined Fields:
    a. System shall provide a minimum of 99 user-defined fields, each with up to 50 characters, for specific information about each credential holder.
    b. System shall accommodate a title for each field; field length shall be 20 characters.
    c. A "Required" option may be applied to each user-defined field that, when selected, forces the operator to enter data in the user-defined field before the credential can be saved.
    d. A "Unique" option may be applied to each user-defined field that, when selected, will not allow duplicate data from different credential holders to be entered.
    e. Data format option may be assigned to each user-defined field that will require the data to be entered with certain character types in specific spots in the field entry window.
    f. A user-defined field, if selected, will define the field as a deactivate date. The selection shall automatically cause the data to be formatted with the windows MM/DD/YEAR date format. The credential of the holder will be deactivated on that date.

g. A search function shall allow any one user-defined field or combination of user-defined fields to be searched to find the appropriate cardholder. The search function shall include search for a character string.
h. System shall have the ability to print cardholders based on and organized by the user-defined fields.

15. Code Tracing:
a. System shall perform code tracing selectable by cardholder and by reader.
b. Any code may be designated as a "traced code" with no limit to how many codes can be traced.
c. Any reader may be designated as a "trace reader" with no limit to which or how many readers can be used for code tracing.
d. When a traced code is used at a trace reader, the access-granted message that usually appears on the monitor window of the Central Station shall be highlighted with a different color than regular messages. A short singular beep shall occur at the same time the highlighted message is displayed on the window.
e. The traced cardholder image (if image exists) shall appear on workstations when used at a trace reader.

E. Surge And Tamper Protection
1. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor-entry connection to components.
a. Minimum Protection for Power Connections 120 V and More: Auxiliary panel suppressors complying with requirements in Division 16 Section "Transient Voltage Suppression".
b. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Connections: Comply with requirements in Division 16 Section "Transient Voltage Suppression" as recommended by manufacturer for type of line being protected.
2. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station control-unit alarm display shall identify tamper alarms and indicate locations.

F. Central-Station Hardware
1. Central-Station Computer: Standard unmodified PC of modular design. The CPU word size shall be 32 bytes or larger; the CPU operating speed shall be at least 66 MHz **OR** GHz, **as directed**.
a. Memory: 256 MB of usable installed memory, expandable to a minimum of 1024 MB without additional chassis or power supplies.
b. Power Supply: Minimum capacity of 250 W.
c. Real-Time Clock:
1) Accuracy: Plus or minus 1 minute per month.
2) Time Keeping Format: 24-hour time format including seconds, minutes, hours, date, day, and month; resettable by software.
3) Clock shall function for 1 year without power.
4) Provide automatic time correction once every 24 hours by synchronizing clock with the Time Service Department of the U.S. Naval Observatory.
d. Serial Ports: Provide two TIA 232-F serial ports for general use, with additional ports as required. Data transmission rates shall be selectable under program control.
e. Parallel Port: An enhanced parallel port.
f. LAN Adapter Card: 10/100 Mbps PCI bus, internal network interface card.
g. Sound Card: For playback and recording of digital WAV sound files that are associated with audible warning and alarm functions.
h. Color Monitor: Not less than 17 inches (430 mm), with a minimum resolution of 1280 by 1024 pixels, noninterlaced, and a maximum dot pitch of 0.28 mm. The video card shall support at least 256 colors at a resolution of 1280 by 1024 at a minimum refresh rate of 70 Hz.

i. Keyboard: With a minimum of 64 characters, standard ASCII character set based on ANSI INCITS 154.
j. Mouse: Standard, compatible with the installed software.
k. Special function keyboard attachments or special function keys to facilitate data input of the following operator tasks:
   1) Help.
   2) Alarm Acknowledge.
   3) Place Zone in Access.
   4) Place Zone in Secure.
   5) System Test.
   6) Print Reports.
   7) Change Operator.
l. Disk storage shall include the following, each with appropriate controller:
   1) Minimum 10 GB hard disk, maximum average access time of 10 ms.
   2) Floppy Disk Drive: High density, 3-1/2-inch (90-mm) size.
   3) PCMCIA slot with removable 500 MB media.
   4) 100 MB Iomega Zip drive.
   5) 250 MB Iomega Jaz drive.
m. Magnetic Tape System: 4-mm cartridge magnetic tape system with minimum 2 **OR** 4 **OR** 12 **OR** 20, **as directed**, GB formatted capacity per tape. Provide 10 tapes, each in a rigid cartridge with spring-loaded cover and operator-settable write-protect feature.
n. Modem: 56,600 bps, full duplex for asynchronous communications. With error detection, auto answer/autodial, and call-in-progress detection. Modem shall comply with requirements in ITU-T v.34, ITU-T v.42 for error correction, and ITU-T v.42 BIS for data compression standards; and shall be suitable for operating on unconditioned voice-grade telephone lines complying with 47 CFR 68.
o. Audible Alarm: Manufacturer's standard.
p. CD-ROM Drive:
   1) Nominal storage capacity of 650 MB.
   2) Data Transfer Rate: 1.2 Mbps.
   3) Average Access Time: 150 ms.
   4) Cache Memory: 256 KB.
   5) Data Throughput: 1 MB/second, minimum.
q. Dot Matrix Alarm Printer:
   1) Connected to the Central Station.
   2) Minimum of 96 characters, standard ASCII character set based on ANSI INCITS 154, and with graphics capability and programmable control of top-of-form.
   3) Prints in both red and black without ribbon change.
   4) Adjustable sprockets for paper width up to 11 inches.
   5) 80 columns per line, minimum speed of 200 characters per second.
   6) Character Spacing: Selectable at 10, 12, or 17 characters per inch.
   7) Paper: Sprocket-fed fan fold paper.
r. Report Printer:
   1) Connected to the Central Station and designated workstations.
   2) Laser printer with minimum resolution of 600 dpi.
   3) RAM: 2 MB, minimum.
   4) Printing Speed: Minimum 12 pages per minute.
   5) Paper Handling: Automatic sheet feeder with 250-sheet paper cassette and with automatic feed.
s. Interface: Bidirectional parallel and universal serial bus.
t. LAN Adapter Card: 10/100 Mbps internal network interface card.

2. Redundant Central Computer: One identical redundant central computer, connected in a hot standby, peer configuration. This computer shall automatically maintain its own copies of system software, application software, and data files. System transactions and other activities that alter

system data files shall be updated to system files of redundant computer in near real-time. If central computer fails, redundant computer shall assume control immediately and automatically.

3. UPS: Self-contained; complying with requirements in Division 16 Section "Static Uninterruptible Power Supply".
   a. Size: Provide a minimum of 6 hours of operation of the central-station equipment, including 2 hours of alarm printer operation.
   b. Batteries: Sealed, valve regulated, recombinant, lead calcium.
   c. Accessories:
      1) Transient voltage suppression.
      2) Input-harmonics reduction.
      3) Rectifier/charger.
      4) Battery disconnect device.
      5) Static bypass transfer switch.
      6) Internal maintenance bypass/isolation switch.
      7) External maintenance bypass/isolation switch.
      8) Output isolation transformer.
      9) Remote UPS monitoring.
      10) Battery monitoring.
      11) Remote battery monitoring.

G. Standard Workstation Hardware
   1. Workstation shall consist of a standard unmodified PC, with accessories and peripherals that configure the workstation for a specific duty.
   2. Workstation Computer: Standard unmodified PC of modular design. The CPU word size shall be 32 bytes or larger; the CPU operating speed shall be at least 66 MHz **OR** GH, **as directed**.
      a. Memory: 512 MB of usable installed memory, expandable to a minimum of 8 GB without additional chassis or power supplies.
      b. Power Supply: Minimum capacity of 250 W.
      c. Real-Time Clock:
         1) Accuracy: Plus or minus 1 minute per month.
         2) Time Keeping Format: 24-hour time format including seconds, minutes, hours, date, day, and month; resettable by software.
         3) Provide automatic time correction once every 24 hours by synchronizing clock with the Central Station.
      d. Serial Ports: Provide two TIA 232-F USB serial ports for general use, with additional ports as required. Data transmission rates shall be selectable under program control.
      e. Parallel Port: An enhanced parallel port.
      f. Sound Card: For playback and recording of digital WMP sound files that are associated with audible warning and alarm functions.
      g. Color Monitor: Not less than 17 inches (430 mm), with a minimum resolution of 1280 by 1024 pixels, noninterlaced, and a maximum dot pitch of 0.28 mm. The video card shall support at least 256 colors at a resolution of 1280 by 1024 at a minimum refresh rate of 70 Hz.
      h. Keyboard: With a minimum of 64 characters, standard ASCII character set based on ANSI INCITS 154.
      i. Mouse: Standard, compatible with the installed software. Minimum resolution shall be 400 dpi.
      j. Disk storage shall include the following, each with appropriate controller:
         1) Minimum 20 GB hard disk, maximum average access time of 10 ms.
         2) Floppy Disk Drive: High density, 3-1/2-inch (90-mm) size.
      k. CD-ROM Drive:
         1) Nominal storage capacity of 700 MB.
         2) Data Transfer Rate: 3.6 Mbps.
         3) Average Access Time: 150 ms.
         4) Cache Memory: 512 KB.
         5) Data Throughput: 3.6 MB/second, minimum.

6) Read Speed: 48x.
7) Write Speed: 32x.

l. DVD/DVD-RW Drive:
1) Nominal Storage Capacity: 4.7 GB.
2) Data Transfer Rate: 3.6 Mbps.
3) Cache Memory: 512 KB.
4) Read Speed: 24x.
5) Write Speed: 6x.

m. Printer:
1) Connected to the Central Station and designated workstations.
2) Laser printer with minimum resolution of 600 dpi.
3) RAM: 8 MB, minimum.
4) Printing Speed: Minimum 12 pages per minute.
5) Paper Handling: Automatic sheet feeder with 250-sheet paper cassette and with automatic feed.

n. Interface: Bidirectional parallel, and universal serial bus.

o. LAN Adapter Card: 10/100 Mbps internal network interface card.

3. Redundant Workstation: One identical redundant workstation, connected in a hot standby, peer configuration. This workstation shall automatically maintain its own copies of system software, application software, and data files. System transactions and other activities that alter system data files shall be updated to system files of redundant workstation in near real time. If its associated workstation fails, redundant workstation shall assume control immediately and automatically.

4. UPS: Self-contained, complying with requirements in Division 16 Section "Static Uninterruptible Power Supply".

a. Size: Provide a minimum of 6 hours of operation of the central-station equipment, including 2 hours of alarm printer operation.

b. Batteries: Sealed, valve regulated, recombinant, lead calcium.

c. Accessories:
1) Transient voltage suppression.
2) Input-harmonics reduction.
3) Rectifier/charger.
4) Battery disconnect device.
5) Static bypass transfer switch.
6) Internal maintenance bypass/isolation switch.
7) External maintenance bypass/isolation switch.
8) Output isolation transformer.
9) Remote UPS monitoring.
10) Battery monitoring.
11) UPS operation monitoring.
12) Abnormal operation. Visible and audible indication.
13) Remote battery monitoring.

H. Communications Workstation

1. Standard workstation, modified as follows:

a. Additional TIA 232-F serial ports. The CPU word size shall be 32 bytes or larger; the CPU operating speed shall be at least 66 MHz. Multiplexed serial ports shall be expandable with 8 character transmit and receive buffers for each port. Total buffer size shall be a minimum of 1 MB.

b. Redundant workstation is not required.

c. Printer is not required.

I. Fixed Map Display: A fixed map display shall show layout of the protected facilities. Zones corresponding to those monitored by system shall be highlighted on the display. Status of each zone

shall be displayed using LEDs as required within each designated zone. An LED test switch shall be provided on the map display.

J. Controllers
1. Controllers: Intelligent peripheral control unit, complying with UL 294, that stores time, date, valid codes, access levels, and similar data downloaded from the Central Station or workstation for controlling its operation.
2. Subject to compliance with requirements in this Article, manufacturers may use multipurpose Controllers.
3. Battery Backup: Sealed, lead acid; sized to provide run time during a power outage of 90 minutes, complying with UL 924.
4. Alarm Annunciation Controller:
   a. The Controller shall automatically restore communication within 10 seconds after an interruption with the field device network with dc line supervision on each of its alarm inputs.
      1) Inputs: Monitor dry contacts for changes of state that reflect alarm conditions. Provides at least eight alarm inputs, which are suitable for wiring as normally open or normally closed contacts for alarm conditions.
      2) Alarm-Line Supervision:
         a) Supervise the alarm lines by monitoring each circuit for changes or disturbances in the signal, and for conditions as described in UL 1076 for line security equipment **OR** by monitoring for abnormal open, grounded, or shorted conditions, **as directed**, using dc change measurements. System shall initiate an alarm in response to an abnormal current, which is a dc change of 5 **OR** 10, **as directed**, percent or more for longer than 500 ms.
         b) Transmit alarm-line-supervision alarm to the Central Station during the next interrogation cycle after the abnormal current condition.
      3) Outputs: Managed by Central Station software.
   b. Auxiliary Equipment Power: A GFI service outlet inside the Controller enclosure.
5. Entry-Control Controller:
   a. Function: Provide local entry-control functions including one- and two-way communications with access-control devices such as card readers, keypads, biometric personal identity verification devices, door strikes, magnetic latches, gate and door operators, and exit push-buttons.
      1) Operate as a stand-alone portal Controller using the downloaded database during periods of communication loss between the Controller and the field-device network.
      2) Accept information generated by the entry-control devices; automatically process this information to determine valid identification of the individual present at the portal:
         a) On authentication of the credentials or information presented, check privileges of the identified individual, allowing only those actions granted as privileges.
         b) Privileges shall include, but not be limited to, time of day control, day of week control, group control, and visitor escort control.
      3) Maintain a date-, time-, and Location-stamped record of each transaction. A transaction is defined as any successful or unsuccessful attempt to gain access through a controlled portal by the presentation of credentials or other identifying information.
   b. Inputs:
      1) Data from entry-control devices; use this input to change modes between access and secure.
      2) Database downloads and updates from the Central Station that include enrollment and privilege information.
   c. Outputs:
      1) Indicate success or failure of attempts to use entry-control devices and make comparisons of presented information with stored identification information.
      2) Grant or deny entry by sending control signals to portal-control devices and mask intrusion alarm annunciation from sensors stimulated by authorized entries.

3) Maintain a date-, time-, and Location-stamped record of each transaction and transmit transaction records to the Central Station.
4) Door Prop Alarm: If a portal is held open for longer than 20 seconds **OR** time listed in a schedule, **as directed**, alarm sounds.

d. With power supplies sufficient to power at voltage and frequency required for field devices and portal-control devices.

e. Data Line Problems: For periods of loss of communications with Central Station, or when data transmission is degraded and generating continuous checksum errors, the Controller shall continue to control entry by accepting identifying information, making authentication decisions, checking privileges, and controlling portal-control devices.
1) Store up to 1000 transactions during periods of communication loss between the Controller and access-control devices for subsequent upload to the Central Station on restoration of communication.

f. Controller Power: NFPA 70, Class II power supply transformer, with 12- or 24-V ac secondary, backup battery and charger.
1) Backup Battery: Premium, valve-regulated, recombinant-sealed, lead-calcium battery; spill proof; with a full 1-year warranty and a pro rata 19-year warranty. With single-stage, constant-voltage-current, limited battery charger, comply with battery manufacturer's written instructions for battery terminal voltage and charging current recommendations for maximum battery life.
2) Backup Battery: Valve-regulated, recombinant-sealed, lead-acid battery; spill proof. With single-stage, constant-voltage-current, limited battery charger, comply with battery manufacturer's written instructions for battery terminal voltage and charging current recommendations for maximum battery life.
3) Backup Power Supply Capacity: 5 **OR** 90, **as directed**, minutes of battery supply. Submit battery and charger calculations.
4) Power Monitoring: Provide manual dynamic battery load test, initiated and monitored at the control center; with automatic disconnection of the Controller when battery voltage drops below Controller limits. Report by using local Controller-mounted LEDs and by communicating status to Central Station. Indicate and report the following:
a) Trouble Alarm: Normal power off load assumed by battery.
b) Trouble Alarm: Low battery.
c) Alarm: Power off.

K. Secondary Alarm Annunciator
1. Secondary Alarm Annunciation Site: A workstation with limited I/O capacity, consisting of a secondary alarm annunciation workstation to allow the operator to duplicate functions of the main operator interface, and to show system status changes **OR** to display alarms or system status changes only, **as directed**.

L. Card Readers, Credential Cards, And Keypads
1. Card-Reader Power: Powered from its associated controller, including its standby power source, and shall not dissipate more than 5 W.
2. Response Time: Card reader shall respond to passage requests by generating a signal that is sent to the controller. Response time shall be 800 ms or less, from the time the card reader finishes reading the credential card until a response signal is generated.
3. Enclosure: Suitable for surface, semi-flush, pedestal, or weatherproof mounting. Mounting types shall additionally be suitable for installation in the following locations:
a. Indoors, controlled environment.
b. Indoors, uncontrolled environment.
c. Outdoors, with built-in heaters or other cold-weather equipment to extend the operating temperature range as needed for operation at the site.

4. Display: Digital visual indicator shall provide visible and audible status indications and user prompts. Indicate power on or off, whether user passage requests have been accepted or rejected, and whether the door is locked or unlocked.
5. Stripe Swipe Readers: Bidirectional, reading cards swiped in both directions, powered by the controller. Reader shall be set up for ABA Track.
   a. ABA Track: Magnetic stripe that is encoded on track 2, at 75-bpi density in binary-coded decimal format; for example, 5-bit, 16-character set.
   b. Readers for outdoors shall be in a polymeric plastic enclosure with all electronics potted in plastic. Rated for operation in ambient conditions of minus 40 to plus 160 deg F (minus 40 to plus 70 deg C) in a humidity range of 10 to 90 percent.
6. Wiegand Swipe Reader: Set up for 33 **OR** 26-bit data cards, **as directed.** Comply with SIA AC-01.
7. Wiegand Key-Insert Reader: Set up for 33 **OR** 26-bit data cards, **as directed.**
8. Bar-Code Reader: Set up for Code 39 **OR** 93 **OR** 128**, as directed.**
9. Insert Readers: Requiring the card to be inserted from the bottom **OR** side, **as directed,** powered by the controller.
10. Touch-Plate and Proximity Readers:
    a. Active-detection proximity card readers shall provide power to compatible credential cards through magnetic induction, and shall receive and decode a unique identification code number transmitted from the credential card.
    b. Passive-detection proximity card readers shall use a swept-frequency, RF field generator to read the resonant frequencies of tuned circuits laminated into compatible credential cards. The resonant frequencies read shall constitute a unique identification code number.
    c. The card reader shall read proximity cards in a range from direct contact to at least 6 inches (150 mm) from the reader.
11. Keypads:
    a. Entry-control keypads shall use a unique combination of alphanumeric and other symbols as an Identifier.
    b. Keypads shall contain an integral alphanumeric/special symbols keyboard with symbols arranged in ascending ASCII-code ordinal sequence **OR** random scrambled order, **as directed.**.
    c. Communication protocol shall be compatible with the local processor.
12. Keypad Display:
    a. Keypads shall include a digital visual indicator and shall provide visible **OR** visible and audible status indications and user prompts, **as directed.**
    b. Display shall indicate power on or off and whether user passage requests have been accepted or rejected.
    c. Design of the keypad display or keypad enclosure shall limit viewing angles of the keypad as follows:
       1) Maximum Horizontal Viewing Angle: Plus or minus 5 degrees or less off a vertical plane perpendicular to the plane of the face of the keypad display.
       2) Maximum Vertical Viewing Angle: Plus or minus 15 degrees or less off a horizontal plane perpendicular to the plane of the face of the keypad display.
13. Keypad Response Time:
    a. The keypad shall respond to passage requests by generating a signal to the local processor. The response time shall be 800 ms or less from the time the last alphanumeric symbol is entered until a response signal is generated.
14. Keypad Power:
    a. The keypad shall be powered from the source as shown and shall not dissipate more than 150 W.
15. Keypad Mounting Method:
    a. Keypads shall be suitable for surface, semi-flush, pedestal, or weatherproof mounting as required.
16. Keypad Duress Codes:
    a. Keypads shall provide a means for users to indicate a duress situation by entering a special code.

17. Keypad and Wiegand-Swipe-Reader Combination: Designed to require an entry on the keypad before presenting the credential card.
    a. Keypad: Allow the entry of four numeric digits **OR** alphanumeric characters, **as directed,** that are associated with a specific credential. Keypads shall contain an integral alphanumeric/special symbol keyboard with symbols arranged in ascending ASCII-code ordinal sequence **OR** random scrambled order, **as directed**. Keypad display or enclosure shall limit viewing angles of the keypad as follows:
        1) Maximum Horizontal Viewing Angle: Plus or minus 5 degrees or less off a vertical plane perpendicular to the plane of the face of the keypad display.
        2) Maximum Vertical Viewing Angle: Plus or minus 15 degrees or less off a horizontal plane perpendicular to the plane of the face of the keypad display.
    b. Wiegand Swipe Reader: Set up for 33 OR 26-bit data cards, **as directed**, to generate a unique card identification code. Comply with SIA AC-01.
18. Communication Protocol: Compatible with local processor.
19. Touch-Plate and Contactless Card Reader: The reader shall have "flash" download capability to accommodate card format changes. The card reader shall have capability of transmitting data to security control panel and shall comply with ISO/IEC 7816.
20. Credential Card Modification: Entry-control cards shall be able to be modified by lamination direct print process during the enrollment process without reduction of readability. The design of the credential cards shall allow for the addition of at least one slot or hole to accommodate the attachment of a clip for affixing the credential card to the badge holder used at the site.
21. Specify the standard card size of 2-1/8 by 3-3/8 inches (54 by 85 mm) unless a different size card is needed. If a nonstandard size card is specified, verify that the card size will work with the photo badging system and the card reader specified.
22. Card Size and Dimensional Stability: Credential cards shall be **2-1/8 by 3-3/8 inches (54 by 86 mm)**. The credential card material shall be dimensionally stable so that an undamaged card with deformations resulting from normal use shall be readable by the card reader.
23. Card Material: Abrasion resistant, nonflammable, nontoxic, and impervious to solar radiation and effects of ultraviolet light.
24. Insert additional security enhancements in paragraph below if needed. Retain card lamination and assembly equipment if needed at the site.
25. Card Construction:
    a. Core and laminate or monolithic construction.
    b. Lettering, logos, and other markings shall be hot stamped into the credential material or direct printed.
    c. Incorporate holographic images **OR** phosphorous ink**, as directed,** as a security enhancement.
    d. Furnish equipment for on-site assembly and lamination of credential cards.

M. Biometric Identity Verification Equipment
1. Biometric identity verification templates shall be stored as part of system database files and used as a comparative base by the identity verification equipment to generate an appropriate signal to the associated Controller.
2. Eye Retina Scanner: Designed to incorporate positive measures to establish that the eye retina being scanned by the device belongs to a living human being.
    a. Scanner shall not require eye contact with the retina scan equipment. Scan initiation shall be manual.
    b. The efficiency and accuracy of scanner shall not be affected by contact lenses.
    c. Storage space of each eye template shall not exceed 512 8-bit bytes.
    d. Light-emitting source used for retina scans may not use light levels exceeding 20 percent of the maximum safe level established in the American Conference of Governmental Industrial Hygienists limit values.
    e. Template Update: Eye scanner shall not automatically update a user's template. Significant changes in an individual's eye shall require re-enrollment.

f. Scan acceptance tolerance or template match criteria shall be under system manager/operator control. Eye scanner shall determine automatically when multiple attempts are needed to verify the eye being scanned, prompting automatically for additional attempts, up to a maximum of three. Three failed attempts shall generate an entry-control alarm.

g. Time of Verification: Eye scanner shall respond to passage requests by generating an entry request signal to the Controller. The verification time shall be 1.5 seconds or less from the moment eye scanner initiates the scan process until eye scanner generates a response signal.

h. Modes: Eye scanner shall provide an enrollment mode, a recognition mode, and a code/credential verification mode.

1) In the enrollment mode, eye scanner shall create an eye template for new personnel and enter the template into system database file created for that person. Template information shall be compatible with system application software.

2) In the recognition mode, eye scanner shall allow passage when the eye scan data from the verification attempt match an eye template stored in database files.

3) In the code/credential verification mode, eye scanner shall allow passage when the eye scan data from the verification attempt match the eye scan template associated with the identification code entered into a keypad, or they match the eye scan template associated with credential card data read by a card reader.

i. Reports: Eye scanner shall create and store template match scores for all transactions involving eye retinal scans. Template match scores shall be stored in the matching personnel data file used for report generation.

j. Power: Scanner shall be powered from its associated Controller, requiring not more than 45 W.

k. Enclosure: Eye scanners shall be available with enclosures that are suitable for surface, semiflush, or pedestal mounting. Mounting types shall additionally be suitable for installation in the following locations:

1) Indoors, controlled environment.

2) Indoors, uncontrolled environment.

l. Display: LED or other type of visual indicator display shall provide visual and audible status indications and user prompts. Indicate power on/off, and whether user passage requests have been accepted or rejected.

3. Hand Geometry: Use unique human hand measurements to identify authorized, enrolled personnel. The design of this device shall incorporate positive measures to establish that the hand being measured by the device belongs to a living human being.

a. The user's hand shall remain in full view of the user at all times. The scan process of the hand geometry device shall make three-dimensional measurements of the size and shape of the subject's hand. Scanning shall start automatically once the user's hand is properly positioned by the alignment system.

b. Hand geometry device shall be able to use either left or right hand for enrollment and verification.

c. Storage space of each eye template shall not exceed 50 8-bit bytes.

d. Template Update and Acceptance Tolerances: Hand geometry devices shall not automatically update a user's profile. Significant changes in an individual's hand geometry shall require re-enrollment. Hand geometry devices shall provide an adjustable acceptance tolerance or template match criteria under system manager/operator control. Hand geometry device shall determine when multiple attempts are needed for hand geometry verification and shall automatically prompt the user for additional attempts up to a maximum of three. Three failed attempts shall generate an entry-control alarm.

e. Average Verification Time: Hand geometry device shall respond to passage requests by generating an entry request signal to the Controller. The verification time shall be 1.5 seconds or less from the moment hand geometry device initiates the scan process until hand geometry device generates a response signal.

f. Modes: Hand geometry device shall provide an enrollment mode, a recognition mode, and a code/credential verification mode.

1) In the enrollment mode, hand geometry device shall create a hand template for new personnel and enter the template into system database file created for that person. Template information shall be compatible with system application software.
2) In the recognition mode, hand geometry device shall allow passage when the hand scan data from the verification attempt match a hand geometry template stored in database files.
3) In the code/credential verification mode, hand geometry device shall allow passage when the hand scan data from the verification attempt match the hand geometry template associated with the identification code entered into a keypad, or they match the hand geometry template associated with credential card data read by a card reader.

g. Reports: Hand geometry device shall create and store template match scores for all transactions involving hand geometry scans. Template match scores shall be stored in the matching personnel data file used for report generation.

h. Power: Hand geometry device shall be powered from its associated Controller, requiring not more than 45 W.

i. Enclosure: Geometry readers shall be available with enclosures that are suitable for surface, semiflush, or pedestal mounting. Mounting types shall additionally be suitable for installation in the following locations:
1) Indoors, controlled environment.
2) Indoors, uncontrolled environment.
3) Outdoors.

j. Display: LED or other type of visual indicator display shall provide visual and audible status indications and user prompts. Indicate power on/off, and whether user passage requests have been accepted or rejected.

4. Fingerprint Analysis Scanner: Use a unique human fingerprint pattern to identify authorized, enrolled personnel. The design of this device shall incorporate positive measures to establish that the hand or fingers being scanned by the device belong to a living human being.

a. The user's hand shall remain in full view of the user at all times. The scan process of the fingerprint analysis scanner shall perform an optical or other type of scan of the enrollee's fingers. Scanning shall start automatically when the user's fingers are properly positioned.

b. Storage space for each fingerprint template shall not require more than 1250 8-bit bytes.

c. Template Update and Acceptance Tolerances: Fingerprint analysis scanners shall not automatically update a user's profile. Significant changes in an individual's fingerprints shall require re-enrollment. Fingerprint analysis scanners shall provide an adjustable acceptance tolerance or template match criteria under system manager/operator control. Fingerprint analysis scanner shall determine when multiple attempts are needed for fingerprint verification and shall automatically prompt the enrollee for additional attempts up to a maximum of three. Three failed attempts shall generate an entry-control alarm.

d. Average Verification Time: Fingerprint analysis scanner shall respond to passage requests by generating an entry request signal to the Controller. The verification time shall be 2 seconds or less from the moment fingerprint analysis scanner initiates the scan process until fingerprint analysis scanner generates a response signal.

e. Modes: Fingerprint analysis scanner shall provide an enrollment mode, a recognition mode, and a code/credential verification mode.
1) In the enrollment mode, fingerprint analysis scanner shall create a fingerprint template for new personnel and enter the template into the system database file created for that person.
2) In the recognition mode, fingerprint analysis scanner shall allow passage when the fingerprint data from the verification attempt match a fingerprint template stored in database files.
3) In the code/credential verification mode, fingerprint analysis scanner shall allow passage when the fingerprint data from the verification attempt match the fingerprint template associated with the identification code entered into a keypad, or they match the fingerprint template associated with credential card data read by a card reader.

f. Reports: Fingerprint analysis device shall create and store pattern match scores for all transactions involving fingerprint scans. Template match scores shall be stored in the matching personnel data file used for report generation.

g. Power: Fingerprint analysis scanner shall be powered from its associated Controller, requiring not more than 45 W.

h. Enclosure: Scanners shall be available with enclosures that are suitable for surface, semiflush, or pedestal mounting. Mounting types shall additionally be suitable for installation in the following locations:

1) Indoors, controlled environment.
2) Indoors, uncontrolled environment.
3) Outdoors.

i. Display: LED or other type of visual indicator display shall provide visual and audible status indications and user prompts. Indicate power on/off, and whether user passage requests have been accepted or rejected.

5. Iris Scan Device: Use the unique patterns found in the iris of the human eye to identify authorized, enrolled personnel. The device shall use ambient light to capture an image of the iris of a person for identification. The resulting video image shall be compared against a stored template that was captured during the enrollment process. When the presented image is sufficiently similar to the stored image template, then the device shall authenticate the presenting individual as identified. The threshold of similarity shall be adjustable.

a. Enrollees who wear contact lenses or eyeglasses shall not adversely affect the efficiency and accuracy of the device.

b. Iris scan device shall provide a means for enrollees to align their eye for identification that does not require facial contact with the device. A manual push-button shall be provided to initiate the scan process when the enrollee's eye is aligned in front of the device.

c. The device shall include adjustments to accommodate differences in enrollee height.

d. Template Update: Iris scanners shall not automatically update an enrollee's template. Significant changes in an individual's eye shall require re-enrollment.

e. Scan acceptance tolerance or template match criteria shall be under system manager/operator control. Iris scanner shall determine when multiple attempts are needed to verify the iris being scanned and shall automatically prompt the enrollee for additional attempts up to three. Three failed attempts shall generate an entry-control alarm.

f. Average Verification Time: Iris scanner shall respond to passage requests by generating an entry request signal to the Controller. The verification time shall be 1.5 seconds or less from the moment iris scanner initiates the scan process until iris scanner generates a response signal.

g. Modes: Iris scanner shall provide an enrollment mode, a recognition mode, and a code/credential verification mode.

1) In the enrollment mode, iris scanner shall create an iris template for new personnel and enter the template into system database file created for that person. Template information shall be compatible with system application software.
2) In the recognition mode, iris scanner shall allow passage when the iris scan data from the verification attempt match an iris template stored in database files.
3) In the code/credential verification mode, iris scanner shall allow passage when the iris scan data from the verification attempt match the iris scan template associated with the identification code entered into a keypad, or they match the iris scan template associated with credential card data read by a card reader.

h. Reports: Iris imaging shall create and store template match scores for all transactions involving iris scans. Template match scores shall be stored in the matching personnel data file used for report generation.

i. Power: Iris scanner shall be powered from its associated Controller, requiring not more than 45 W.

j. Enclosure: Eye scanners shall be available with enclosures that are suitable for surface, semiflush, or pedestal mounting. Mounting types shall additionally be suitable for installation in the following locations:

1) Indoors, controlled environment.

2) Indoors, uncontrolled environment.

k. Display: LED or other type of visual indicator display shall provide visual and audible status indications and user prompts. Indicate power on/off, and whether user passage requests have been accepted or rejected.

N. Enrollment Center

1. Equipment for enrolling personnel into, and removing personnel from, system database, using a dedicated workstation PC **OR** central-station equipment, **as directed**.
   a. Include equipment to enroll selected biometric credentials.
2. Enrollment equipment shall support encoding of credential cards including cryptographic and other internal security checks as required for system.
   a. Allow only authorized entry-control enrollment personnel to access the enrollment equipment using passwords.
   b. Include enrollment subsystem configuration controls and electronic diagnostic aids for subsystem setup and troubleshooting with the Central Station.
   c. Enrollment station records printer shall meet requirements of the report printer.
3. Entry-Control Enrollment Software:
   a. Shall include database management functions for the system, and shall allow an operator to change and modify the data entered in the system as needed.
   b. Software shall not have alarm response or acknowledgment functions as a programmable function.
   c. Multiple, password-protected access levels shall be provided at the enrollment station.
   d. Database management and modification functions shall require a higher operator-access level than personnel enrollment functions.
   e. Software shall provide a means for disabling the enrollment station when it is unattended, to prevent unauthorized use.
   f. Software shall provide a method to enter personnel identifying information into the entry-control database files through enrollment stations to include a credential unit in use at the installation.
   g. In the case of personnel identity-verification subsystems, this data shall include biometric data.
   h. Software shall allow entry of this data into the system database files through the use of simple menu selections and data fields. The data field names shall be customized to suit user and site needs.
   i. Personnel identity-verification subsystems selected for use with the system shall fully support the enrollment function and shall be compatible with the entry-control database files.
4. Accessories:
   a. Steel desk-type console, swivel chair on casters, and equipment racks.
   b. Console and Equipment Racks: Comply with EIA-310-D.
   c. Equipment, with the exception of the printers, shall be rack mounted in the console and equipment racks.
   d. Storage Cabinet: Locking cabinet approximately 72 inches (1830 mm) high, 36 inches (915 mm) wide, and 24 inches (610 mm) deep, with 3 adjustable shelves and 2 storage racks for storage of disks, tapes, printouts, printer paper, ribbons, manuals, and other documentation.
5. System Capacity: Number of badges shall be limited only by hard disk space. Badge templates and images shall be in color, supporting the maximum color capability of Microsoft Windows operating system.
6. Badge Configuration:
   a. Software for badge template creation shall include a template consisting of background and predetermined locations of photographs, text objects and data fields for text, and bar-code and biometric information. Include automatic sizing of data fields placed on a badge to compensate for names, which may otherwise be too large to fit in the area designated.
   b. Allow different badge templates to be used for each department, tenant, or visitor.

c. As a setup option, templates shall be automatically selected for the badge, based on the group the credential holder is assigned to. Allow the operator to override the automatic template selection and use a template chosen by the operator for creating a badge.
d. Setup shall determine which graphics and credential holder information will be displayed and where on the card it will be placed. All data in the security access system such as name, code, group, access level, and any of the 99 user-defined fields shall be selectable, with the ability to place them anywhere on the card.
e. System shall include an importing, filing, and recall system of stored images and shapes that can be placed on the badge.
f. Allow multiple images on same badge, including, but not be limited to, bar codes, digital photos, and signatures.
g. Support transparent backgrounds so that image is only surrounded by the intended background, but not its immediate background.

7. Photo Imaging: Integral to security access.
   a. Import images from bitmap file formats, digital cameras, TWAIN cameras, or scanners. Allow image cropping and editing, WYSIWYG badge building application, and badge print preview and printing capabilities.
   b. System shall support multiple images stored for each credential holder, including signatures, portrait views, and profile views.
8. Text Objects: Badge configuration shall provide for creation of custom text as an object, allowing font selection, typing, scaling, and formatting of the text object. Formatting options shall include changing font, font size, text flow, and text alignment; bending or curving the text object into a circle or semicircle; applying 3-D effects; and applying predefined effects such as tilt, extrusion, or beveling. Text shall be placed and optionally automatically centered within any region of the badge layout.
9. Badges and Credential Cards:
   a. Badges are credential cards that do not contain data to be read by card readers.
   b. Credential cards shall store uniquely coded data used by card readers as an Identifier.
      1) Magnetic-Stripe Cards: Comply with ISO 7810, ISO 7811-1, ISO 7811-2, ISO 7811-3, and ISO 7811-6. Use single-layer magnetic tape material that is coated with a plastic slick protective coat and affixed to the back of the credential card near the top.
      2) Wiegand Wire Effect Cards: Ferromagnetic wires laminated into the credential card using binary digits specified for Wiegand readers to generate a unique credential card identification code.
      3) Proximity Cards **OR** Key Fobs, **as directed**: Use proximity detection without physical contact with the proximity reader for proper operation.
   c. Allow entry-control card to be modified by lamination or direct print process during the enrollment process for use as a picture and identification badge without reduction of readability. The design shall allow for the addition of at least one slot or hole to accommodate the attachment of a clip for affixing the credential card to the type of badge holder used at the site.
      1) Card Size and Dimensional Stability: Standard size, 2-1/8 by 3-3/8 inches (54 by 85 mm); dimensionally stable so that an undamaged card with deformations resulting from normal use is readable by the card reader.
      2) Card Material: Abrasion resistant, nonflammable, and nontoxic; and impervious to solar radiation and effects of ultraviolet light.
      3) Card Construction: Core and laminate or monolithic construction. Lettering, logos, and other markings shall be hot stamped into the credential material or direct printed.
         a) With holographic images **OR** phosphorous ink, **as directed**, as a security enhancement.
         b) Furnish equipment for on-site assembly and lamination of credential cards.
      4) Card Durability and Maintainability: Designed and constructed to yield a useful lifetime of at least 5 years or 5000 insertions or swipes, whichever results in a longer

period of time. Allow credential cards to be cleaned by wiping with a sponge or cloth wetted with soap and water.

10. Card-Making Equipment: Consisting of a workstation, video camera, video-imaging equipment, and a printer.
    a. Camera: NTSC color standard, RGB video output, 470 lines minimum horizontal resolution, and automatic white balance with full rated output under illumination of 0.5 fc (5 lx).
    b. Video Imaging: Live-image capture software and hardware and a digital signature capture pad.
    c. Standard workstation, modified as follows:
        1) Redundant workstation is not required.
        2) Printer is not required.
        3) UPS is not required.
        4) Sound card is not required.
    d. Printer: Dye-sublimation resin thermal transfer, 300 dpi resolution, 16.7 million colors, accepting cards ranging in size from 2.1 by 3 inches to 2.6 by 3.7 inches (53 by 76 mm to 66 by 94 mm) and having card thickness ranging from 0.020 to 0.060 inch (0.5 to 1.5 mm). Printer shall have options for encoding magnetic stripe using tracks 1, 2, and 3. Throughput shall be not less than 60 seconds per card.

O. Push-Button Switches
1. Push-Button Switches: Momentary-contact back-lighted push buttons, with stainless-steel switch enclosures.
    a. Electrical Ratings:
        1) Minimum continuous current rating of 10 A at 120 V ac or 5 A at 240-V ac.
        2) Contacts that will make 720 VA at 60 A and that will break at 720 VA at 10 A.
    b. Enclosures: Flush or surface mounting. Push buttons shall be suitable for flush mounting in the switch enclosures.
    c. Enclosures shall additionally be suitable for installation in the following locations:
        1) Indoors, controlled environment.
        2) Indoors, uncontrolled environment.
        3) Outdoors.
    d. Power: Push-button switches shall be powered from their associated Controller, using dc control.

P. Door And Gate Hardware Interface
1. Exit Device with Alarm: Operation of the exit device shall generate an alarm and annunciate a local alarm. Exit device and alarm contacts are specified in Division 08 Section "Door Hardware".
2. Exit Alarm: Operation of a monitored door shall generate an alarm. Exit devices and alarm contacts are specified in Division 08 Section "Door Hardware".
3. Electric Door Strikes: Use end-of-line resistors to provide power line supervision. Signal switches shall transmit data to Controller to indicate when the bolt is not engaged and the strike mechanism is unlocked, and shall report a forced entry. Power and signal shall be from the Controller. Electric strikes are specified in Division 08 Section "Door Hardware".
4. Electromagnetic Locks: End-of-line resistors shall provide power line supervision. Lock status sensing signal shall positively indicate door is secure. Power and signal shall be from the Controller. Electromagnetic locks are specified in Division 08 Section "Door Hardware".
5. Vehicle Gate Operator: Interface electrical operation of gate with controls of this Section. Vehicle gate operators shall be connected, monitored, and controlled, by the security access Controllers. Vehicle gate and accessories are specified in Division 02 Section "Chain-link Fences And Gates".

Q. Field-Processing Software
1. Operating System:
    a. Local processors shall contain an operating system that controls and schedules that local processor's activities in real time.

b. Local processor shall maintain a point database in its memory that includes parameters, constraints, and the latest value or status of all points connected to that local processor.
c. Execution of local processor application programs shall utilize the data in memory resident files.
d. Operating system shall include a real-time clock function that maintains the seconds, minutes, hours, date, and month, including day of the week.
e. Local processor real-time clock shall be automatically synchronized with the central station at least once per day to plus or minus 10 seconds (the time synchronization shall be accomplished automatically, without operator action and without requiring system shutdown).

2. Startup Software:
   a. Causes automatic commencement of operation without human intervention, including startup of all connected I/O functions.
   b. Local processor restart program based on detection of power failure at the local processor shall be included in the local processor software.
   c. Initiates operation of self-test diagnostic routines.
   d. Upon failure of the local processor, if the database and application software are no longer resident, the local processor shall not restart and systems shall remain in the failure mode indicated until the necessary repairs are made.
   e. If the database and application programs are resident, the local processor shall immediately resume operation.
3. Operating Mode:
   a. Local processors shall control and monitor inputs and outputs as specified, independent of communications with the central station or designated workstations.
   b. Alarms, status changes, and other data shall be transmitted to the central station or designated workstations when communications circuits are operable.
   c. If communications are not available, each local processor shall function in a stand-alone mode and operational data, including the status and alarm data normally transmitted to the central station or designated workstations, shall be stored for later transmission to the central station or designated workstations.
   d. Storage for the latest 4000 events shall be provided at local processors, as a minimum.
   e. Local processors shall accept software downloaded from the central station.
   f. Panel shall support flash ROM technology to accomplish firmware downloads from a central location.
4. Failure Mode: Upon failure for any reason, each local processor shall perform an orderly shutdown and force all local processor outputs to a predetermined (failure-mode) state, consistent with the failure modes shown and the associated control device.
5. Functions:
   a. Monitoring of inputs.
   b. Control of outputs.
   c. Reporting of alarms automatically to the central station.
   d. Reporting of sensor and output status to central station upon request.
   e. Maintenance of real time, automatically updated by the central station at least once a day.
   f. Communication with the central station.
   g. Execution of local processor resident programs.
   h. Diagnostics.
   i. Download and upload data to and from the central station.

R. Field-Processing Hardware
1. Alarm Annunciation Local Processor:
   a. Respond to interrogations from the field device network, recognize and store alarm status inputs until they are transmitted to the central station, and change outputs based on commands received from the central station.
   b. Local processor shall also automatically restore communication within 10 seconds after an interruption with the field device network and provide dc line supervision on each of its alarm inputs.

c. Local processor inputs shall monitor dry contacts for changes of state that reflect alarm conditions.
d. Local processor shall have at least eight alarm inputs which allow wiring contacts as normally open or normally closed for alarm conditions; and shall provide line supervision for each input by monitoring each input for abnormal open, grounded, or shorted conditions using dc current change measurements.
e. Local processor shall report line supervision alarms to the central station.
f. Alarms shall be reported for any condition that remains abnormal at an input for longer than 500 milliseconds.
g. Alarm condition shall be transmitted to the central computer during the next interrogation cycle.
h. Local processor outputs shall reflect the state of commands issued by the central station.
i. Outputs shall be a form C contact and shall include normally open and normally closed contacts.
j. Local processor shall have at least four command outputs.
k. Local processor shall be able to communicate with the central station via RS-485 or TCP/IP as a minimum.

2. Processor Power Supply:
   a. Local processor and sensors shall be powered from an uninterruptible power source.
   b. Uninterruptible power source shall provide eight hours of battery back-up power in the event of primary power failure and shall automatically fully recharge the batteries within 12 hours after primary power is restored.
   c. If the facility is without an emergency generator, the uninterruptible power source shall provide 24 hours of battery backup power.
   d. There shall be no equipment malfunctions or perturbations or loss of data during the switch from primary to battery power and vice versa.
   e. Batteries shall be sealed, non-outgassing type.
   f. Power supply shall be equipped with an indicator for ac input power and an indicator for dc output power.
   g. Loss of primary power shall be reported to the central station as an alarm.
3. Auxiliary Equipment Power: A GFI service outlet shall be furnished inside the local processor's enclosure.
4. Entry-Control Local Processor:
   a. Entry-control local processor shall respond to interrogations from the field device network, recognize and store alarm status inputs until they are transmitted to the central station, and change outputs based on commands received from the central station.
   b. Local processor shall also automatically restore communication within 10 seconds after an interruption with the field device network and provide dc line supervision on each of its alarm inputs.
   c. Entry-control local processor shall provide local entry-control functions including communicating with field devices such as card readers, keypads, biometric personnel identity-verification devices, door strikes, magnetic latches, gate and door operators, and exit push buttons.
   d. Processor shall also accept data from entry-control field devices as well as database downloads and updates from the central station that include enrollment and privilege information.
   e. Processor shall send indications of successful or failed attempts to use entry-control field devices and shall make comparisons of presented information with stored identification information.
   f. Processor shall grant or deny entry by sending control signals to portal-control devices and mask intrusion-alarm annunciation from sensors stimulated by authorized entries.
   g. Entry-control local processor shall use inputs from entry-control devices to change modes between access and secure.
   h. Local processor shall maintain a date-time- and location-stamped record of each transaction and transmit transaction records to the central station.

i. Processor shall operate as a stand-alone portal controller using the downloaded database during periods of communication loss between the local processor and the central station.
j. Processor shall store a minimum of 4000 transactions during periods of communication loss between the local processor and the central station for subsequent upload to the central station upon restoration of communication.
k. Local processor inputs shall monitor dry contacts for changes of state that reflect alarm conditions.
l. Local processor shall have at least eight alarm inputs which allow wiring contacts as normally open or normally closed for alarm conditions; and shall also provide line supervision for each input by monitoring each input for abnormal open, grounded, or shorted conditions using dc current change measurements.
m. Local processor shall report line supervision alarms to the central station.
n. Alarms shall be reported for any condition that remains abnormal at an input for longer than 500 ms.
o. Alarm condition shall be transmitted to the central station during the next interrogation cycle.
p. Entry-control local processor shall include the necessary software drivers to communicate with entry-control field devices. Information generated by the entry-control field devices shall be accepted by the local processor and automatically processed to determine valid identification of the individual present at the portal.
q. Upon authentication of the credentials or information presented, the local processor shall automatically check privileges of the identified individual, allowing only those actions granted as privileges.
r. Privileges shall include, but are not limited to, time of day control, day of week control, group control, and visitor escort control. The local processor shall maintain a date-time- and location-stamped record of each transaction.
s. Transaction is defined as any successful or unsuccessful attempt to gain access through a controlled portal by the presentation of credentials or other identifying information.
t. Local processor outputs shall reflect the state of commands issued by the central station.
u. Outputs shall be a form C contact and shall include normally open and normally closed contacts.
v. Local processor shall have at least four addressable outputs.
w. The entry-control local processor shall also provide control outputs to portal-control devices.
x. Local processor shall be able to communicate with the central station via RS-485 or TCP/IP as a minimum.
y. The system manufacturer shall provide strategies for downloading database information for panel configurations and cardholder data to minimize the required download time when using IP connectivity.

S. Tia 232-F Ascii Interface Specifications

1. ASCII interface shall allow TIA 232-F connections to be made between the control station operating as the host PC and any equipment that will accept TIA 232-F ASCII command strings, such as CCTV switches, intercoms, and paging systems.
   a. Alarm inputs in system shall allow for individual programming to output up to four unique ASCII character strings through two different COM ports on the host PC.
   b. Inputs shall have the ability to be defined to transmit a unique ASCII string for alarm and one for restore through one COM port, and a unique ASCII string for a nonalarm, abnormal condition and one for a normal condition through the same or different COM port.
   c. Predefined ASCII character strings shall have the ability to be up to 420 characters long with full use of all the ASCII control characters, such as return or line feed. Character strings shall be defined in the system database and then assigned to the appropriate inputs.
   d. COM ports of the host PC used to interface with external equipment shall be defined in the setup portion of the software. COM port's baud rate, word length, stop bits, and parity shall be definable in the software to match that of the external equipment.

2. Pager-System Interface: Alarms shall be able to activate a pager system with customized message for each input alarm.
   a. TIA 232-F output shall be capable of connection to a pager interface that can be used to call a paging system or service and send a signal to a portable pager. System shall allow an individual alphanumeric message per alarm input to be sent to the paging system. This interface shall support both numeric and alphanumeric pagers.
3. Alarm-System Interface:
   a. TIA 232-F output shall be capable of transmitting alarms from other monitoring and alarm systems to central-station automation software.
   b. Alternatively, alarms that are received by this access-control system are to be transferred to the alarm automation system as if they were sent through a digital alarm receiver.
      1) System shall be able to transmit an individual message from any alarm input to a burglar-alarm automation monitoring system.
      2) System shall be able to append to each message a predefined set of character strings as a prefix and a suffix.

T. Floor Select Elevator Control
1. Elevator access control shall be integral to security access.
   a. System shall be capable of providing full elevator security and control through dedicated Controllers without relying on the control-station host PC for elevator control decisions.
   b. Access-control system shall enable and disable car calls on each floor and floor select buttons in each elevator car, restricting passengers' access to the floors where they have been given access.
   c. System setup shall, through programming, automatically secure and unsecure each floor select button of a car individually by time and day. Each floor select button within a car shall be separately controlled so that some floors may be secure while others remain unsecure.
   d. When a floor select button is secure, it shall require the passenger to use his/her access code and have access to that floor before the floor select button will operate. The passenger's credential shall determine which car call and floor select buttons are to be enabled, restricting access to floors unless authorized by system's access code database. Floor select button shall be enabled only in the car where the credential holder is the passenger.
2. Security access system shall record which call button is pressed, along with credential and time information.
   a. System Controller shall record elevator access data.
   b. The Controller shall reset all additional call buttons that may have been enabled by the user's credential.
   c. The floor select elevator control shall allow for manual override either individually by floor or by cab as a group from a workstation PC.

U. Real-Time Guard Tour
1. Guard tour module shall provide the ability to plan, track, and route tours. Module shall input an alarm during tour if guard fails to make a station. Tours can be programmed for sequential or random tour-station order.
   a. Guard tour setup shall define specific routes or tours for the guard to take, with time restrictions in which to reach every predefined tour station.
   b. Guard tour activity shall be automatically logged to the central-station PC's hard drive.
   c. If the guard is early or late to a tour station, a unique alarm per station shall appear at the Central Station to indicate the time and station.
   d. Guard tour setup shall allow the tours to be executed sequentially or in a random order with an overall time limit set for the entire tour instead of individual times for each tour station.
   e. Setup shall allow recording of predefined responses that will display for the operator at the control station should a "Failed to Check-in" alarm occur.

2. Guard tour module shall allow proprietary direct-connected systems to use security access-control hardware to perform guard tour management in real time.
3. A tour station is a physical location a guard shall reach and perform an action indicating that the guard has arrived. This action, performed at the tour station, shall be 1 of 13 different events with any combination of station types within the same tour. A tour station shall be one of the following event types:
   a. Access Granted.
   b. Access Denied Code.
   c. Access Denied Card plus PIN.
   d. Access Denied Time Zone.
   e. Access Denied Level.
   f. Access Denied Facility.
   g. Access Denied Code Timer.
   h. Access Denied Anti-Passback.
   i. Access Granted Passback Violation.
   j. Alarm.
   k. Restored.
   l. Input Normal.
   m. Input Abnormal.
4. Guard tour and other system features shall operate simultaneously with no interference.
5. Guard Tour Module Capacity: 999 possible guard tour definitions with each tour having up to 99 tour stations. System shall allow all 999 tours to be running at same time.

V. Video And Camera Control
1. Control station or designated workstation displays live video from a CCTV source.
   a. Control Buttons: On the display window, with separate control buttons to represent Left, Right, Up, Down, Zoom In, Zoom Out, Scan, and a minimum of two custom command auxiliary controls.
   b. Provide at least seven icons to represent different types of cameras, with ability to import custom icons. Provide option for display of icons on graphic maps to represent their physical location.
   c. Provide the alarm-handling window with a command button that will display the camera associated with the alarm point.
2. Display mouse-selectable icons representing each camera source, to select source to be displayed. For CCTV sources that are connected to a video switcher, control station shall automatically send control commands through a COM port to display the requested camera when the camera icon is selected.
3. Allow cameras with preset positioning to be defined by displaying a different icon for each of the presets. Provide control with Next and Previous buttons to allow operator to cycle quickly through the preset positions.

W. Cables
1. General Cable Requirements: Comply with requirements in Division 16 Section "Conductors And Cables For Electronic Safety And Security" and as recommended by system manufacturer for integration requirement.
2. PVC-Jacketed, TIA 232-F Cables:
   a. Two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, and individual aluminum-foil/polyester-tape shielded pairs with 100 percent shield coverage; PVC jacket.
   b. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
   c. NFPA 70, Type CM.
   d. Flame Resistance: UL 1581 vertical tray.
3. Plenum-Type, TIA 232-F Cables:

a. Two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, and individual aluminum-foil/polyester-tape shielded pairs with 100 percent shield coverage; plastic jacket.
b. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
c. NFPA 70, Type CMP.
d. Flame Resistance: NFPA 262 flame test.

4. PVC-Jacketed, TIA 485-A Cables: Two pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, PVC insulation, unshielded, PVC jacket, and NFPA 70, Type CMG.
5. Plenum-Type, TIA 485-A Cables:
   a. Two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and fluorinated-ethylene-propylene jacket.
   b. NFPA 70, Type CMP.
   c. Flame Resistance: NFPA 262 flame test.
6. Multiconductor, PVC Readers and Wiegand Keypads Cables:
   a. No. 22 AWG, paired and twisted multiple conductors, stranded (7x30) tinned copper conductors, semirigid PVC insulation, overall aluminum foil-polyester tape shield with 100 percent shield coverage, plus tinned copper braid shield with 65 percent shield coverage, and PVC jacket.
   b. NFPA 70, Type CMG.
   c. Flame Resistance: UL 1581 Vertical Tray.
   d. For TIA 232-F applications.
7. Paired PVC Readers and Wiegand Keypad Cables:
   a. Three pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, individual aluminum foil-polyester tape shielded pairs each with No. 22 AWG, stranded tinned copper drain wire, 100 percent shield coverage, and PVC jacket.
   b. NFPA 70, Type CM.
   c. Flame Resistance: UL 1581 Vertical Tray.
8. Paired PVC Readers and Wiegand Keypads Cable:
   a. Three 3 pairs, twisted, No. 20 AWG, stranded (7x28) tinned copper conductors, polyethylene (polyolefin) insulation, individual aluminum foil-polyester tape shielded pairs each with No. 22 AWG, stranded (19x34) tinned copper drain wire, 100 percent shield coverage, and PVC jacket.
   b. NFPA 70, Type CM.
   c. Flame Resistance: UL 1581 Vertical Tray.
9. Paired, Plenum-Type, Reader and Wiegand Keypad Cable:
   a. Three pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, individual aluminum foil-polypropylene tape shielded pairs each with No. 22 AWG, stranded tinned copper drain wire, 100 percent shield coverage, and fluorinated-ethylene-propylene jacket.
   b. NFPA 70, Type CMP.
   c. Flame Resistance: NFPA 262 Flame Test.
10. Multiconductor, Plenum-Type, Reader and Wiegand Keypad Cable:
    a. Six conductors, No. 20 AWG, stranded (7x28) tinned copper conductors, fluorinated-ethylene-propylene insulation, overall aluminum foil-polyester tape shield with 100 percent shield coverage plus tinned copper braid shield with 85 percent shield coverage, and fluorinated-ethylene-propylene jacket.
    b. NFPA 70, Type CMP.
    c. Flame Resistance: NFPA 262 Flame Test.
11. Paired Lock Cable:
    a. One pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.
    b. NFPA 70, Type CMG.
    c. Flame Resistance: UL 1581 Vertical Tray.

12. Paired, Plenum-Type, Lock Cable:
    a. One pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.
    b. NFPA 70, Type CMP.
    c. Flame Resistance: NFPA 262 Flame Test.
13. Paired Lock Cable:
    a. One pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.
    b. NFPA 70, Type CMG.
    c. Flame Resistance: UL 1581 Vertical Tray.
14. Paired, Plenum-Type, Lock Cable:
    a. One pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and plastic jacket.
    b. NFPA 70, Type CMP.
    c. Flame Resistance: NFPA 262 Flame Test.
15. Paired Input Cable:
    a. One pair, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, overall aluminum foil-polyester tape shield with No. 22 AWG, stranded (7x30) tinned copper drain wire, 100 percent shield coverage, and PVC jacket.
    b. NFPA 70, Type CMR.
    c. Flame Resistance: UL 1666 Riser Flame Test.
16. Paired, Plenum-Type, Input Cable:
    a. One pair, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, aluminum foil-polyester tape shield (foil side out), with No. 22 AWG drain wire, 100 percent shield coverage, and plastic jacket.
    b. NFPA 70, Type CMP.
    c. Flame Resistance: NFPA 262 Flame Test.
17. Paired AC Transformer Cable:
    a. One pair, twisted, No. 18 AWG, stranded (7x26) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.
    b. NFPA 70, Type CMG.
18. Paired, Plenum-Type, AC Transformer Cable:
    a. One pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and plastic jacket.
    b. NFPA 70, Type CMP.
    c. Flame Resistance: NFPA 262 Flame Test.
19. Elevator Travel Cable:
    a. Steel center core, with shielded, twisted pairs, No. 20 AWG conductor size.
    b. Steel center support shall be preformed, flexible, low-torsion, zinc-coated, steel wire rope; insulated with 60 deg C flame-resistant PVC and covered with a nylon or cotton braid.
    c. Shielded Pairs: Insulated copper conductors; color-coded, insulated with 60 deg C flame-resistant PVC; each pair shielded with bare copper braid for 85 percent coverage.
    d. Electrical grade, dry jute filler
    e. Helically wound synthetic fiber binder
    f. Rayon or cotton braid applied with 95 percent coverage.
    g. 60 deg C PVC jacket specifically compounded for flexibility and abrasion resistance and complying with UL VW-1 and CSA FT1 flame rated.
20. LAN Cabling:
    a. Comply with requirements in Division 16 Section "Conductors And Cables For Electronic Safety And Security".
    b. NFPA 262.

X. Transformers: NFPA 70, Class II control transformers, NRTL listed. Transformers for security access-control system shall not be shared with any other system.

Y. Cable And Asset Management Software

1. Computer-based cable and asset management system, with fully integrated database and graphic capabilities, complying with requirements in TIA/EIA-606.
    a. Document physical characteristics by recording the network, asset, user, TIA/EAI details, device configurations, and exact connections between equipment and cabling.
        1) Manage the physical layer of security system.
        2) List device configurations.
        3) List and display circuit connections.
        4) Record firestopping data.
        5) Record grounding and bonding connections and test data.
    b. Information shall be presented in database view, schematic plans, or technical drawings.
        1) Microsoft Visio Technical Drawing shall be used as drawing and schematic plans software. Drawing symbols, system layout, and design shall comply with SIA/IAPSC AG-01.
    c. System shall interface with the following testing and recording devices:
        1) Direct upload tests from circuit testing instrument into the PC.
        2) Direct download circuit labeling into labeling printer.
2. Software shall be designed for Microsoft Windows of same version as security access system's Central Station and workstations and shall be installed on the designated PC, using a hard drive dedicated only to this management function. Hard-drive capacity shall be not less than 50 GB.

1.3 EXECUTION

A. Examination
1. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.
2. Examine roughing-in for LAN and control cable conduit systems to PCs, controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Preparation
1. Comply with recommendations in SIA CP-01.
2. Comply with TIA/EIA 606-A, "Administration Standard for Commercial Telecommunications Infrastructure."
3. Obtain detailed Project planning forms from manufacturer of access-control system; develop custom forms to suit Project. Fill in all data available from Project plans and specifications and publish as Project planning documents for review and approval.
    a. Record setup data for control station and workstations.
    b. For each Location, record setup of controller features and access requirements.
    c. Propose start and stop times for time zones and holidays, and match up access levels for doors.
    d. Set up groups, facility codes, linking, and list inputs and outputs for each controller.
    e. Assign action message names and compose messages.
    f. Set up alarms. Establish interlocks between alarms, intruder detection, and video surveillance features.
    g. Prepare and install alarm graphic maps.
    h. Develop user-defined fields.
    i. Develop screen layout formats.
    j. Propose setups for guard tours and key control.
    k. Discuss badge layout options; design badges.
    l. Complete system diagnostics and operation verification.
    m. Prepare a specific plan for system testing, startup, and demonstration.
    n. Develop acceptance test concept and, on approval, develop specifics of the test.

4. Develop cable and asset-management system details; input data from construction documents. Include system schematics and Visio Technical Drawings in electronic format.
5. In meetings with the Owner, present Project planning documents and review, adjust, and prepare final setup documents. Use final documents to set up system software.

C. Cabling
1. Comply with NECA 1, "Good Workmanship in Electrical Contracting."
2. Install cables and wiring according to requirements in Division 16 Section "Conductors And Cables For Electronic Safety And Security".
3. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters. Conceal raceway and wiring except in unfinished spaces.
4. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use NRTL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.
5. Install LAN cables using techniques, practices, and methods that are consistent with Category 5E rating of components and fiber-optic rating of components, and that ensure Category 6 performance and fiber-optic performance of completed and linked signal paths, end to end.
6. Boxes and enclosures containing security system components or cabling, and which are easily accessible to employees or to the public, shall be provided with a lock. Boxes above ceiling level in occupied areas of the building shall not be considered to be accessible. Junction boxes and small device enclosures below ceiling level and easily accessible to employees or the public shall be covered with a suitable cover plate and secured with tamperproof screws.
7. Install end-of-line resistors at the field device location and not at the Controller or panel location.

D. Cable Application
1. Comply with TIA-569-B, "Commercial Building Standard for Telecommunications Pathways and Spaces."
2. Cable application requirements are minimum requirements and shall be exceeded if recommended or required by manufacturer of system hardware.
3. TIA 232-F Cabling: Install at a maximum distance of 50 feet (15 m).
4. TIA 485-A Cabling: Install at a maximum distance of 4000 feet (1220 m).
5. Card Readers and Keypads:
   a. Install number of conductor pairs recommended by manufacturer for the functions specified.
   b. Unless manufacturer recommends larger conductors, install No. 22 AWG wire if maximum distance from Controller to the reader is 250 feet (75 m), and install No. 20 AWG wire if maximum distance is 500 feet (150 m).
   c. For greater distances, install "extender" or "repeater" modules recommended by manufacturer of the Controller.
   d. Install minimum No. 18 AWG shielded cable to readers and keypads that draw 50 mA or more.
6. Install minimum No. 16 AWG cable from Controller to electrically powered locks. Do not exceed 250 feet (75 m) **OR** 500 feet (150 m), **as directed**.
7. Install minimum No. 18 AWG ac power wire from transformer to Controller, with a maximum distance of 25 feet (8 m).

E. Grounding
1. Comply with Division 16 Section "Grounding And Bonding".
2. Comply with IEEE 1100, "Recommended Practice for Power and Grounding Electronic Equipment."
3. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
4. Bond shields and drain conductors to ground at only one point in each circuit.
5. Signal Ground:

a. Terminal: Locate in each equipment room and wiring closet; isolate from power system and equipment grounding.
b. Bus: Mount on wall of main equipment room with standoff insulators.
c. Backbone Cable: Extend from signal ground bus to signal ground terminal in each equipment room and wiring closet.

F. Installation
1. Push Buttons: Where multiple push buttons are housed within a single switch enclosure, they shall be stacked vertically with each push-button switch labeled with 1/4-inch- (6.4-mm-) high text and symbols as required. Push-button switches shall be connected to the Controller associated with the portal to which they are applied, and shall operate the appropriate electric strike, electric bolt, or other facility release device.
2. Install card readers, keypads, push buttons, and biometric readers.

G. Identification
1. In addition to requirements in this Article, comply with applicable requirements in Division 16 Section "Electrical Identification" and with TIA/EIA-606.
2. Using software specified in "Cable and Asset Management Software" Article, develop cable administration drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable, and label cable and jacks, connectors, and terminals to which it connects with the same designation. Use logical and systematic designations for facility's architectural arrangement.
3. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
a. All wiring conductors connected to terminal strips shall be individually numbered, and each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with the name and number of the particular device as shown.
b. Each wire connected to building-mounted devices is not required to be numbered at the device if the color of the wire is consistent with the associated wire connected and numbered within the panel or cabinet.
4. At completion, cable and asset management software shall reflect as-built conditions.

H. System Software and Hardware
1. Develop, install, and test software and hardware, and perform database test for the complete and proper operation of systems involved. Assign software license to the Owner.

I. Field Quality Control
1. Perform tests and inspections.
a. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist testing.
2. Testing and Inspections:
a. LAN Cable Procedures: Inspect for physical damage and test each conductor signal path for continuity and shorts. Use Class 2, bidirectional, Category 5 tester. Test for faulty connectors, splices, and terminations. Test according to TIA/EIA-568-B.1, "Commercial Building Telecommunications Cabling Standards - Part 1 General Requirements." Link performance for UTP cables must comply with minimum criteria in TIA/EIA-568-B.
b. Test each circuit and component of each system. Tests shall include, but are not limited to, measurements of power supply output under maximum load, signal loop resistance, and leakage to ground where applicable. System components with battery backup shall be operated on battery power for a period of not less than 10 percent of the calculated battery operating time. Provide special equipment and software if testing requires special or dedicated equipment.
c. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end

performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.

3. Devices and circuits will be considered defective if they do not pass tests and inspections.
4. Prepare test and inspection reports.

J. Startup Service
1. Engage a factory-authorized service representative to supervise and assist with startup service.
   a. Complete installation and startup checks according to approved procedures that were developed in "Preparation" Article and with manufacturer's written instructions.
   b. Enroll and prepare badges and access cards for Owner's operators, management, and security personnel.

K. Protection
1. Maintain strict security during the installation of equipment and software. Rooms housing the control station, and workstations that have been powered up shall be locked and secured, with an activated burglar alarm and access-control system reporting to a Central Station complying with UL 1610, "Central-Station Burglar-Alarm Units," during periods when a qualified operator in the employ of Contractor is not present.

END OF SECTION 13700

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SECTION 13720 - PERIMETER SECURITY

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for perimeter security. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section Includes:
a. Perimeter detection and alarm system.
b. Integration of other electronic and electrical systems and equipment.

C. Definitions
1. CCTV: Closed-circuit television.
2. EMI: Electromagnetic interference.
3. PIR: Passive infrared.
4. RFI: Radio-frequency interference.
5. UPS: Uninterruptible power supply.
6. Control Unit: System component that monitors inputs and controls outputs through various circuits.
7. Master Control Unit: System component that accepts inputs from other control units and may also perform control-unit functions. The unit has limited capacity for the number of protected zones and is installed at an unattended location or at a location where it is not the attendant's primary function to monitor the security system.
8. Monitoring Station: Facility that receives signals and has personnel in attendance at all times to respond to signals. A central station is a monitoring station that is listed.
9. Protected Zone: A protected premises or an area within a protected premise that is provided with means to prevent an unwanted event.
10. Standard Intruder: A person who weighs 100 lb (45 kg) or less and whose height is 60 inches (1525 mm) or less; dressed in a long-sleeved shirt, slacks, and shoes unless environmental conditions at the site require protective clothing.
11. Standard-Intruder Movement: Any movement, such as walking, running, crawling, rolling, or jumping, of a "standard intruder" in a protected zone.
12. Systems Integration: The bringing together of components of several systems containing interacting components to achieve indicated functional operation of combined systems.
13. Zone. A defined area within a protected premise. It is a space or area for which an intrusion must be detected and uniquely identified. The sensor or group of sensors must then be assigned to perform the detection, and any interface equipment between sensors and communication must link to master control unit.

D. Action Submittals
1. Product Data: Components for sensing, detecting, systems integration, and control, including dimensions and data on features, performance, electrical characteristics, ratings, and finishes.
2. Shop Drawings: Detail assemblies of standard components that are custom assembled for specific application on this Project.
a. Functional Block Diagram: Show single-line interconnections between components including interconnections between components specified in this Section and those furnished under other Sections. Indicate methods used to achieve systems integration. Indicate control, signal, and data communication paths and identify programmable logic controllers **OR** networks, **as directed,** and control interface devices and media to be used. Describe characteristics of network and other data communication lines.

1) Indicate methods used to achieve systems integration.
2) Indicate control, signal, and data communication paths and identify PLCs, networks, control interface devices, and media to be used.
3) Describe characteristics of network and other data communication lines.
4) Describe methods used to protect against power outages and transient voltages including types and ratings of isolation and surge suppression devices used in data, communication, signal, control, and ac and dc power circuits.

b. Raceway Riser Diagrams: Detail raceway runs required for perimeter security and for systems integration. Include designation of devices connected by raceway, raceway type, and size, and type and size of wire and cable fill for each raceway run.
c. UPS: Sizing calculations.
d. Site and Floor Plans: Indicate final outlet and device locations, routing of raceways, and cables inside and outside the building. Include room layout for central-station control-unit console, terminal cabinet, racks, and UPS.
e. Master Control Unit Console Layout: Show required artwork and device identification.
f. Device Address List: Coordinate with final system programming.
g. System Wiring Diagrams: Include system diagrams unique to Project. Show connections for all devices, components, and auxiliary equipment. Include diagrams for equipment and for system with all terminals and interconnections identified.
h. Details of surge-protection devices and their installation.
i. Sensor detection patterns and adjustment ranges.

3. Equipment and System Operation Description: Include method of operation and supervision of each component and each type of circuit. Show sequence of operations for manually and automatically initiated system or equipment inputs. Description must cover this specific Project; manufacturer's standard descriptions for generic systems are not acceptable.
4. Samples for Initial Selection: For units with factory-applied color finishes.
5. Samples for Verification: For each type of exposed finish required.

E. Informational Submittals
1. Qualification Data: For Installer, security systems integrator, and testing agency.
2. Field quality-control test reports.
3. Warranty: Sample of special warranty.
4. Other Information Submittals:
a. Test Plan and Schedule: Test plan defining all tests required to ensure that system meets technical, operational, and performance specifications within 60 days of date of Contract award.
b. Examination reports documenting inspections of substrates, areas, and conditions.
c. Anchor inspection reports documenting inspections of built-in and cast-in anchors.

F. Closeout Submittals
1. Operation and Maintenance Data: For perimeter security system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation And Maintenance Data", include the following:
a. Data for each type of product, including features and operating sequences, both automatic and manual.
b. Master control-unit hardware and software data.

G. Maintenance Material Submittals
1. One spare control-unit board(s) for strain-sensitive cable system and one cable repair and splice kit(s).
2. One of each type of microwave sensor and one of each type of power supply for microwave perimeter security system.
3. One of each spare sensor and PIR unit and one alignment telescope(s) for long-range PIR system.
4. One spare control-unit board(s) for electrostatic-field system.

5. One spare control-unit board(s) for buried, ported coaxial cable system, 10 feet (3 m) of cable; and one cable repair and splice kit(s).
6. Fuses: Three of each kind and size.
7. Tool Kit: Provide six sets of tools for use with security fasteners, each packaged in a compartmented kit configured for easy handling and storage.
8. Security Fasteners: Furnish no fewer than 1 box for every 50 boxes or fraction thereof, of each type and size of security fastener installed.

H. Quality Assurance
1. Installer Qualifications:
   a. An employer of workers, at least one of whom is a technician certified by the National Burglar & Fire Alarm Association.
   b. Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
2. Security Systems Integrator Qualifications: An experienced perimeter security equipment supplier and Installer who has completed systems integration work for installations similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
3. Testing Agency Qualifications: Member company of NETA or an NRTL.
   a. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
4. 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.
5. FMG Compliance: FMG-approved and -labeled perimeter security devices and equipment.
6. Comply with NFPA 70.

I. Project Conditions
1. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
   a. Altitude: Sea level to 4000 feet (1220 m).
   b. Master Control Unit: Rated for continuous operation in an ambient of 60 to 85 deg F (16 to 29 deg C) and a relative humidity of 20 to 80 percent, noncondensing.
   c. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambients of minus 30 to plus 122 deg F (minus 34 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, condensing. Comply with UL 294 and UL 639 for outdoor-use equipment. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph (137 km/h) and snow cover up to 24 inches (610 mm) thick.
   d. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers or flyings shall be rated, listed, and installed according to NFPA 70.

J. Warranty:
1. Special Warranty: Manufacturer's standard form in which manufacturer and Installer agree to repair or replace components of perimeter security devices and equipment that fail in materials or workmanship within specified warranty period.
   a. Warranty Period: Two years from date of Substantial Completion.

1.2 PRODUCTS

A. Functional Description Of System
1. Description: Perimeter protection system with fence-mounted systems **OR** buried sensors **OR** volumetric detectors, **as directed,** integrated into a single perimeter detection and alarm system.
2. Supervision: System components shall be continuously monitored for normal, alarm, supervisory and trouble conditions. Indicate deviations from normal conditions at any location in

system. Indication includes identification of device or circuit in which deviation has occurred and whether deviation is an alarm or malfunction.

a. Alarm Signal: Display at central-station control unit and actuate audible and visual alarm devices.
b. Trouble Condition Signal: Distinct from other signals, indicating that system is not fully functional. Trouble signal shall indicate system problems such as battery failure, open or shorted transmission line conductors, or controller failure.
c. Supervisory Condition Signal: Distinct from other signals, indicating an abnormal condition as specified for the particular device or controller.

3. System Control: Central-station control unit shall directly monitor gate detection devices, perimeter detection units, and connecting wiring.

OR

System Control: One or more remote, addressable controllers operate under control of a central-station control-unit microcomputer in a multiplexed distributed control system or as part of a network. Controllers shall receive programming by multiplexed signal transmission from a central-station control-unit microprocessor or microcomputer and hold data in nonvolatile memory. System shall automatically reboot program without error or loss of status or alarm data after any system disturbance, **as directed**.

4. Operator Commands:
   a. Help with System Operation: Display all commands available to operator. Help command, followed by a specific command, shall produce a short explanation of the purpose, use, and system reaction to that command.
   b. Acknowledge Alarm: To indicate that alarm message has been observed by operator.
   c. Place Protected Zone in Access: Disable all intrusion-alarm circuits of a specific protected zone. Tamper circuits may not be disabled by operator.
   d. Place Protected Zone in Secure: Activate all intrusion-alarm circuits of a protected zone.
   e. Protected Zone Test: Initiate operational test of a specific protected zone.
   f. System Test: Initiate system-wide operational test.
   g. Print Reports.
5. Timed Control at Central-Station Control Unit: Allow automatically timed "secure" and "access" functions of selected protected zones.
6. Automatic Control of Related Systems: Alarm or supervisory signals from certain perimeter security devices control the following functions in related systems:
   a. Switch selected lights.
   b. Open a signal path between certain intercommunication stations.
   c. Shift sound system to "listening mode" and open a signal path to certain system speakers.
   d. Switch signal to selected monitor from closed-circuit television camera in vicinity of sensor signaling an alarm.
7. Printed Record of Events: Print a record of alarm, supervisory, and trouble events on system printer. Sort and report by protected zone, device, and function. When central-station control unit receives a signal, print a report of alarm, supervisory, or trouble condition. Report type of signal (alarm, supervisory, or trouble), protected zone description, date, and time of occurrence. Differentiate alarm signals from other indications. When system is reset, report reset event with the same information concerning device, location, date, and time. Commands shall initiate the reporting of a list of current alarm, supervisory, and trouble conditions in system or a log of past events.
8. Response Time: Two seconds between actuation of any alarm and its indication at central-station control unit.
9. Circuit Supervision: Supervise all signal and data transmission lines, links with other systems, controllers, and sensors from central-station control unit. Indicate circuit and detection device faults with both protected zone and trouble signals, sound a distinctive audible tone, and illuminate an LED. Maximum permissible elapsed time between occurrence of a trouble condition and indication at central-station control unit is 20 seconds. Initiate an alarm in response to opening, closing, shorting, or grounding of a signal or data transmission line.

10. Programmed Secure-Access Control: System shall be programmable to automatically change status of various combinations of protected zones between secure and access conditions at scheduled times. Status changes may be preset for repetitive, daily, and weekly; specially scheduled operations may be preset up to a year in advance. Manual secure-access control stations shall override programmed settings.
11. Manual Secure-Access Control: Coded entries at manual stations shall change status of associated protected zone between secure and access conditions.

B. System Component Requirements
1. Compatibility: Detection devices and their communication features, connecting wiring, and master control unit shall be selected and configured with accessories for full compatibility with the existing equipment.
2. Perimeter Security Units: Listed and labeled by a qualified testing agency for compliance with UL 639.
3. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor entry connection to components.
   a. Minimum Protection for Power Lines 120 V and More: Auxiliary panel suppressors complying with requirements in Division 16 Section "Transient Voltage Suppression".
   b. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Lines: Comply with requirements in Division 16 Section "Transient Voltage Suppression" as recommended by manufacturer for type of line being protected.
4. Interference Protection: Components shall be unaffected by radiated RFI and electrical induction of 15 V/m over a frequency range of 10 to 10,000 MHz and conducted interference signals up to 0.25-V RMS injected into power supply lines at 10 to 10,000 MHz.
5. Tamper Protection: Tamper switches on detection devices, controllers, annunciators, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled and when entering conductors are cut or disconnected. Central-station control-unit alarm display shall identify tamper alarms and indicate locations.
6. Self-Testing Devices: Automatically test themselves periodically, but not less than once per hour, to verify normal device functioning and alarm initiation capability. Devices transmit test failure to central-station control unit.
7. Antimasking Devices: Automatically check operation continuously or at intervals of a minute or less, and use signal-processing logic to detect blocking, masking, jamming, tampering, or other operational dysfunction. Devices transmit detection of operational dysfunction to central-station control unit as an alarm signal.
8. Addressable Devices: Transmitter and receivers shall communicate unique device identification and status reports to central-station control unit.
9. Remote-Controlled Devices: Individually and remotely adjustable for sensitivity and individually monitored at central-station control unit for calibration, sensitivity, and alarm condition.

C. Enclosures
1. Interior Sensors: Enclosures that protect against dust, falling dirt, and dripping noncorrosive liquids.
2. Interior Electronics: NEMA 250, Type 12.
3. Exterior Electronics: NEMA 250, Type 4X fiberglass **OR** stainless steel, **as directed**.
4. Corrosion Resistant: NEMA 250, Type 4X PVC **OR** stainless steel, **as directed**.
5. Terminal cabinets in handholes and manholes shall be NEMA 250, Type 6 **OR** 6P, **as directed**.
6. Screw Covers: Where enclosures are accessible to inmates, secure with security fasteners of type appropriate for enclosure.

D. Secure And Access Devices
1. Keypad and Display Module: Arranged for entering and executing commands for system-status changes and for displaying system-status and command-related data.
2. Key-Operated Switch: Change protected zone between secure and access conditions.

E. Strain-Sensitive Cable
1. Description: Strain-sensitive, coaxial transducer cable shall monitor chain-link-type and welded-mesh-type fence and generate an alarm when a standard intruder attempts to climb over, cut through, or lift fence fabric.
2. Environment: Suitable for exterior installation and the following conditions:
   a. Ambient Temperatures: Ranging from minus 22 to plus 158 deg F (minus 30 to plus 70 deg C).
3. Transducer Cable:
   a. Ultraviolet-resistant cable furnished by system manufacturer.
   b. Suitable for up to 1000 feet (300 m) of sensor cable per single-zone controller and up to 2000 feet (600 m) of sensor cable per dual-zone processor.
   c. Sensitivity shall be uniform throughout its entire length, requiring only one variable sensitivity adjustment throughout its entire length.
4. Control Unit:
   a. Field mounted, with tamper switch at controller board.
   b. Electronic circuitry shall discriminate between acceptable fence movement and intrusion-related disturbances.
   c. Sensitivity, count control, and climb-over processors shall be adjustable with a minimum of five individual count-control and climb-over adjustments.
   d. Controller output shall have adjustable pulse width to adjust the time the alarm relay will activate per detected intrusion attempt.
5. System Performance:
   a. Immune to RFI and EMI environments; interference shall have no effect on normal operational characteristics.
   b. Trouble and Tamper: Entire sensor system shall be fully supervised with individually monitored tamper and supervision alarms. Disconnecting, cutting, or shorting of strain-sensitive cable results in supervisory alarm.
   c. Intrusion Simulation: Each zone shall have a self-test feature that, when activated by a signal from central-station control unit, will produce an intrusion alarm and verify operation of sensor.

F. Microwave Intrusion Detectors
1. Description: Volumetric microwave detection system.
2. Device Performance: Microwave transmitter establishes an electromagnetic field in an adjustable detection pattern and detects intrusion by monitoring changes in that pattern.
   a. Movement Sensitivity: Adjustable, able to detect standard-intruder movement within sensor's detection pattern at any speed between 0.1 to 50 fps (0.03 to 15.2 m/s). Sensor sensitivity adjustments shall be accessible only when sensor housing is removed, and sensors shall comply with 47 CFR 15.
   b. Detection range: 15 to 600 feet (5 to 180 m).
   c. Range Sensitivity: Adjustable for setting area of protection between 15 to 500 feet (5 to 152 m) in range and from 2 to 40 feet (0.6 to 12 m) in beam diameter.
   d. Trouble and Tamper: Fully supervised with individually monitored tamper and supervision alarms. System failure shall result in tamper alarm. System jamming or wrong modulation shall result in supervisory alarm.
   e. Activation Indicator: LED indicator shall not be visible during normal operation. Indicator shall light when sensor detects a standard intruder. Locate test-enabling switch under sensor housing cover.
   f. Remote Test: When initiated by central-station control unit, start a test sequence for each detector element that simulates standard-intruder movement within sensor's detection patterns, causing an alarm.
3. Environment: Suitable for exterior installation and the following conditions:
   a. Ambient Temperatures: Ranging from minus 30 to plus 158 deg F (minus 34 to plus 70 deg C) and in rainfall up to 4 inches (100 mm).

G. Electrostatic Field
1. Description: Electronically balanced phase electrostatic-field detection system consisting of a field generator that generates an electrical field in one or more field wires and that has two or more sensing wires, a sense filter, amplifier, and a controller. Detection fields shall have a minimum of four different frequencies so adjacent zones cannot interfere with each other.
2. Environment: Suitable for exterior installation and the following conditions:
   a. Ambient Temperatures: Ranging from minus 22 to plus 158 deg F (minus 30 to plus 70 deg C).
3. System Performance:
   a. Detect, via sense wires, a compound signal form consisting of amplitude change, rate of change, and pre-set time disturbance that forms a "signature" of human movement. Generate an alarm when all exist simultaneously. Provide detection fields of not less than four different frequencies so adjacent zones do not interfere with each other.
   b. Control Units: Single or multiple zone, with sense filter. Front panel with calibration meter, status of alarm transmitter, sensitivity selector, test point selector, power indicator, and power control. Control unit shall reject signals due to wind and small objects striking the wires.
   c. Motion Detection: Sense standard-intruder movement at rates from 0.15 to 26 fps (0.045 to 8.0 m/s).
   d. Zone Length: Not to exceed 500 feet (152 m) **OR** 325 feet (100 m), **as directed**.
   e. Supervision: Generate trouble signal if field or sense wires are cut or shorted to ground or to each other. Generate supervisory alarm if received signal is substantially reduced.
4. Insulators, Wire-Tensioning Devices, and Brackets: Manufacturer's standard for mounting and tensioning of wires.
5. Field and Sensing Wires: Stainless steel.

H. Buried, Ported Coaxial Cable
1. Description: Buried electrostatic-field detection system consisting of parallel, ported coaxial cables that generate a detection field between cables.
2. Environment: Suitable for exterior installation and the following conditions:
   a. Ambient Temperatures: Ranging from minus 22 to plus 158 deg F (minus 30 to plus 70 deg C).
3. System Performance: One of two parallel cables receives a continuous wave signal from a transmitter module. Second cable, connected to a sensor module, detects, preamplifies, and analyzes variations in signal. When system senses "signature" of a standard intruder in the detection zone, based on mass, motion, and time of day, it generates an alarm.
   a. Transmitter: Locate at one end of zone, with standby battery.
   b. Preamplifier-Sensor: Locate at opposite end from transmitter, with standby battery.
   c. Front panel with sensitivity calibration meter, calibrated self-test potentiometer, power switch, and LED normal and malfunction indicators.
   d. Electromagnetic Radiation: Less than 50 mV per meter at 30 m.
   e. Motion Detection: Sense standard-intruder movement at rates from 0.17 to 26 fps (0.05 to 8.0 m/s).
   f. Zone Length: Not to exceed 500 feet (152 m) **OR** 325 feet (100 m), **as directed**.
   g. Zone Width: Not to exceed 15 feet (4.6 m), with an average width of 12 feet (3.7 m).
   h. Zone Height: Approximately 3.3 feet (1.0 m), depending on sensitivity setting.
   i. Supervision: Generate trouble signal if cable is cut or shorted to ground. Generate supervisory alarm if cabinets are tampered with.
4. Enclosures: Hinged cover with tamper switch and security fasteners.
5. Buried, Ported Coaxial Cable: Approximately 1/2-inch (1.3-mm) diameter, minimum 10 AWG center conductor, foam polyethylene dielectric, braided copper outer conductor, and polyethylene jacket.

I. Long-Range PIR Detectors
1. Description: Volumetric passive infrared detection system.
2. Listed and labeled by a qualified testing agency for compliance with SIA PIR-01.

3. Environment: Suitable for exterior installation and the following conditions:
   a. Ambient Temperatures: Ranging from minus 30 to plus 150 deg F (minus 34 to plus 65 deg C).
4. System Performance: Detect an interruption of dual-infrared light beams that link transmitters and receivers. Generate an alarm when signal is interrupted due to presence of an object that interrupts both beams.
   a. Sensitivity: Field adjustable to allow adjustment of range from 25 to 500 feet (7.6 to 152 m), generating an alarm within 20 to 50 ms when both beams are interrupted.
   b. Detection system shall adjust automatically to compensate for weather, including fog, rain, snow, blowing dust, and rapid temperature changes.
   c. Motion Detection: Detect standard-intruder movement at rates from 0.1 to 50 fps (0.03 to 15.2 m/s).
   d. Supervision: Generate supervisory alarm if any portion of system is tampered with.
   e. Remote Test: When initiated by central-station control unit, start a test sequence for each detector element that simulates standard-intruder movement within sensor's detection patterns, causing an alarm.

J. Geophone Fence Detection
1. Description: Fence-mounted system to detect attempts to cut or climb the protected fence, using geophone sensors that respond to specific shock or vibrations.
2. Environment: Suitable for exterior installation and the following conditions:
   a. Ambient Temperatures: Ranging from minus 30 to plus 150 deg F (minus 34 to plus 65 deg C).
3. System Performance:
   a. Controller: 10 zone capacity for processing geophone generated analog signals. Each zone shall consist of not more than 10 sensors.
      1) Adjustments: For each zone provide stepped gain control for sensitivity, and switches for geophone signal filters to minimize nuisance alarms. System shall adjust automatically to compensate for weather, including fog, rain, snow, blowing dust, and rapid temperature changes.
      2) Trouble Condition Signal: Generate when any zone fails.
      3) Supervisory Condition Signal: Generate on interference with controller operation or when detecting a break-in into a enclosure housing electronics.
   b. Sensors: Fence mounted 20 feet (6 m) o.c.
   c. Cable for Interconnection of System Components: Shielded, PVC jacketed and armored, as supplied by system manufacturer.
   d. Test each zone simulating an alarm condition. Test by command from central-station control **OR** test switch at controller inside the enclosure, **as directed**.

K. Video Motion Sensor
1. Description: Video-surveillance based detection system.
2. Device Performance: Detect changes in video signal within a user-defined protected zone. Provide an alarm output for each video input.
   a. Detect movement within protected zone of standard intruders wearing clothing with a reflectivity that differs from that of background scene by a factor of 2. Reject all other changes in video signal.
   b. Modular design that allows for expansion or modification of number of inputs.
   c. Adjustable Controls:
      1) Number of detection zones.
      2) Size of detection zones.
      3) Sensitivity of detection of each protected zone.
   d. Mounting: Standard 19-inch (480-mm) rack as described in EIA 310.
3. Environment: Suitable for installation in interior air-conditioned spaces.

L. Gate Units

1. Description: Fence mounted gate-movement detector, blanced-magnetic type, UL listed for outdoor locations. Units shall be designed for mounting on single- or double-leaf swinging or rolling gates and have armored jumper cables between switch and stationary junction box for wiring to central-station control unit and tamper switches in junction box.
2. Device Performance: Bias magnet and at least three encapsulated-reed switches that resist compromise from introduction of foreign magnetic fields, with integral overcurrent protective device to limit current to 80 percent of switch capacity.
3. Remote Test: Simulate movement of actuating magnet from central-station control unit.

M. Field-Mounted Control Units
1. Field-mounted control units shall include the power supply and detector specific functions, and provide for communications with the master control unit. Control unit shall include read-only resident software needed for startup, a time clock, and all automatic operations. Software shall be downloaded from the master control unit.
2. Battery Backup: UPS, providing 6 hours of run time during a power outage, with 2-rate automatic battery charger to fully recharge batteries within 12 hours after normal power is restored.
   a. Batteries: Rechargeable, valve-regulated, recombinant, sealed, lead-acid type with nominal 10-year life expectancy.
   b. Battery Charger: Solid-state, fully automatic, variable-charging-rate type. Charger shall recharge fully discharged battery within 24 hours.
3. Annunciation: Indicate a change in system condition and switching of system or component to backup power.

N. Master Control Unit
1. Description: Supervise sensors and detection subsystems and their connecting communication links, status control (secure or access) of sensors and detector subsystems, activation of alarms and supervisory and trouble signals, and other indicated functions.
   a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
   b. Include a real-time clock for time annotation of events on the event recorder and printer.
   c. Addressable initiation devices that communicate device identity and status.
   d. Control circuits for operation of mechanical equipment in response to an alarm.
2. Construction: Freestanding equipment rack **OR** Desk-mounted console, **as directed,** modular, with separate and independent alarm and supervisory system modules. Alarm-initiating protected zone boards shall be plug-in cards. Arrangements that require removal of field wiring for module replacement are unacceptable.
3. Comply with UL 609 **OR** UL 681 **OR** UL 1076, **as directed**.
4. Console Controls and Displays: Arranged for interface between human operator at master control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
   a. Annunciator and Display: LCD type, one **OR** two **OR** three line(s) of 40 **OR** 80 characters, minimum, **as directed**.
   b. Keypad: Arranged to permit entry and execution of programming, display, and control commands
   c. Control-Unit Network: Automatic communication of alarm, status changes, commands, and other communications required for system operation. Communication shall return to normal after partial or total network interruption such as power loss or transient event. Total or partial signaling network failures shall identify the failure and record the failure at the annunciator display and at the system printer.
   d. Field Device Network: Communicate between the control unit and field devices of the system. Communications shall consist of alarm, network status, and status and control of field-mounted processors. Each field-mounted device shall be interrogated during each interrogation cycle.

e. Operator Controls: Manual switches and push-to-test buttons that do not require a key to operate. Prevent resetting of alarm, supervisory, or trouble signals while alarm or trouble condition persists. Include the following:
   1) Acknowledge alarm.
   2) Silence alarm.
   3) System reset.
   4) LED test.

f. Timing Unit: Solid state, programmable, 365 days.

g. Confirmation: Relays, contactors, and other control devices shall have auxiliary contacts that provide confirmation signals to system for their on or off status. Software shall interpret such signals, display equipment status, and initiate failure signals.

h. Alarm Indication: An audible signal sounds and an LED lights at master control unit identifying the protected zone **OR** addressable detector, **as directed,** originating the alarm. Annunciator panel displays a common alarm light and sounds an audible tone.

i. Alarm Indication: An audible signal sounds and a plain-language identification of the protected zone **OR** addressable detector, **as directed** originating the alarm appears on LED or LCDdisplay at master control unit. Annunciator panel displays a common alarm light and sounds an audible tone.

j. Alarm Indication: An audible signal sounds and a plain-language identification of the protected zone **OR** addressable detector, **as directed** originating the alarm appears on LED, LCD or cathode-ray-tube display, **as directed** at master control unit. Annunciator panel alarm light and audible tone identify protected zone signaling an alarm.

k. Alarm activation sounds a bell **OR** siren **OR** strobe **OR** bell or siren and strobe, **as directed**.

5. Protected Zones: Quantity of alarm and supervisory zones as indicated, with capacity for expanding number of protected zones by a minimum of 25 percent.

6. Power Supply Circuits: Master control units shall provide power for remote power-consuming detection devices. Circuit capacity shall be adequate for at least a 25 percent increase in load.

7. UPS: Comply with Division 16 Section "Static Uninterruptible Power Supply". UPS shall be sized to provide a minimum of six hours of master control-unit operation.

8. Cabinet: Lockable, steel enclosure arranged so operations required for testing, normal operation, and maintenance are performed from front of enclosure. If more than a single cabinet is required to form a complete control unit, provide exactly matching modular enclosures. Accommodate all components and allow ample gutter space for field wiring. Identify each enclosure by an engraved, laminated, phenolic-resin nameplate. Lettering on enclosure nameplate shall not be less than 1 inch (25 mm) high. Identify, with permanent labels, individual components and modules within cabinets.

9. Transmission to Monitoring Station: A communications device to automatically transmit alarm, supervisory, and trouble signals to the monitoring station, operating over a standard voice grade telephone leased line. Comply with UL 1635.

10. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

O. Audible And Visual Alarm Devices

1. Bell: UL listed, 10 inches (254 mm) in diameter, rated to produce a minimum sound output of 84 dB at 10 feet (3 m) from central-station control unit.
   a. Enclosure: Weather-resistant steel box equipped with tamper switches on cover and on back of box.

2. Klaxon Weatherproof Motor-Driven Hooter: UL listed, rated to produce a minimum sound output of 120 dB at 3 feet (1 m), plus or minus 3 dB, at a frequency of 470 Hz. Rated for intermittent use - two minutes on, five minutes off.

a. Designed for use in industrial areas and in high noise, severe weather marine environments.

3. Siren: 30-W speaker with siren driver, rated to produce a minimum sound output of 103 dB at 10 feet (3 m) from central-station control unit.
   a. Enclosure: Weather-resistant steel box with tamper switches on cover and on back of box.
4. Strobe: Xenon light complying with UL 1638, with a clear polycarbonate lens.
   a. Light Output: 115 cd, minimum.
   b. Flash Rate: 60 per minute.

P. Security Fasteners
1. Operable only by tools produced for use on specific type of fastener by fastener manufacturer or other licensed fabricator. Drive system type, head style, material, and protective coating as required for assembly, installation, and strength.
2. Drive System Types: Pinned Torx-Plus, pinned Torx, or pinned hex (Allen).
3. Socket Flat Countersunk Head Fasteners:
   a. Heat-treated alloy steel, ASTM F 835 (ASTM F 835M).
   b. Stainless steel, ASTM F 879 (ASTM F 879M), Group 1 CW.
4. Socket Button Head Fasteners:
   a. Heat-treated alloy steel, ASTM F 835 (ASTM F 835M).
   b. Stainless steel, ASTM F 879 (ASTM F 879M), Group 1 CW.
5. Socket Head Cap Fasteners:
   a. Heat-treated alloy steel, ASTM A 574 (ASTM A 574M).
   b. Stainless steel, ASTM F 837 (ASTM F 837M), Group 1 CW.
6. Protective Coatings for Heat-Treated Alloy Steel:
   a. Zinc chromate, ASTM F 1135, Grade 3 or 4; for exterior applications and interior applications where indicated.
   b. Zinc phosphate with oil, ASTM F 1137, Grade I, or black oxide, unless otherwise indicated.

Q. Source Quality Control
1. Electrostatic-Field and Buried, Ported Coaxial Cable Systems Electronics: Precondition at factory by subjecting modules to at least 4 days' operational burn-in at temperatures not less than 140 deg F (60 deg C).

1.3 EXECUTION

A. Examination
1. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of perimeter security.
2. Examine roughing-in for embedded and built-in anchors to verify actual locations of perimeter security connections before perimeter security installation.
3. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of perimeter security.
4. Inspect built-in and cast-in anchor installations, before installing perimeter security, to verify that anchor installations comply with requirements. Prepare inspection reports.
   a. Remove and replace anchors where inspections indicate that they do not comply with requirements. Reinspect after repairs or replacements are made.
   b. Perform additional inspections to determine compliance of replaced or additional anchor installations. Prepare inspection reports.
5. For material whose orientation is critical for its performance as a ballistic barrier, verify installation orientation.
6. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Systems Integration
1. Integrate perimeter security system with the following systems and equipment:

a. Electronic door hardware.
b. Elevators.
c. Network lighting controls.
d. Intercommunications and program systems.
e. Public address and mass notification systems.
f. Access control.
g. Fire-alarm system.
h. Intrusion detection system.
i. Video surveillance.

C. System Installation
1. Comply with UL 681 and NFPA 731.
2. Equipment Mounting: Install master control unit on finished floor with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.
   a. Comply with requirements for seismic-restraint devices specified in Division 16 Section "Vibration And Seismic Controls For Electrical Systems".
3. Install wall-mounted equipment, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.
   a. Comply with requirements for seismic-restraint devices specified in Division 16 Section "Vibration And Seismic Controls For Electrical Systems".
4. Connecting to Existing Equipment: Verify that existing perimeter security system is operational before making changes or connections.
   a. Connect new equipment to existing control panel in existing part of the building.
   b. Connect new equipment to existing monitoring equipment at the Supervising Station.
   c. Expand, modify, and supplement existing **control** or **monitoring** equipment as necessary to extend existing **control** or **monitoring**] functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.
5. Security Fasteners: Where accessible to inmates, install perimeter security components using security fasteners with head style appropriate for fabrication requirements, strength, and finish of adjacent materials except that a maximum of two different sets of tools shall be required to operate security fasteners for Project. Provide stainless-steel security fasteners in stainless-steel materials.
6. Wiring Method: Install power, signal, and data transmission wire and cable in raceways according to Division 02 Section(s) "Underground Ducts And Utility Structures" AND Division 16 Section(s) "Raceways And Boxes". Minimum conduit size shall be 1/2 inch (13 mm). Control and data transmission wiring shall not share raceways with any other system.
7. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Use lacing bars and distribution spools. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with perimeter security system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
8. Wires and Cables:
   a. Conductors: Size as recommended in writing by system manufacturer, unless otherwise indicated.
   b. 120-V Power Wiring: Install according to Division 16 Section "Conductors And Cables", unless otherwise indicated.
   c. Cable for Low-Voltage Control and Signal Circuits: Install unshielded, twisted-pair cable, unless otherwise indicated or if manufacturer recommends shielded cable, according to Division 16 Section "Conductors And Cables For Electronic Safety And Security".
   d. Data and Television Signal Transmission Cables: Install according to Division 16 Section "Conductors And Cables For Electronic Safety And Security"

9. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
10. Install power supplies and other auxiliary components for detection devices at controllers, unless otherwise indicated or required by manufacturer. Do not install such items near devices they serve.
11. Stain-Sensitive Transducer Cable: Attached to fence at 12-inch (300-mm) intervals with tie wraps.
12. Electrostatic-Field System: Install field and sense wires on insulators and standoffs on a fence, wall, or roof. Provide intermediate supports recommended in writing by manufacturer as needed for specified performance.
13. Buried, Ported Coaxial Cable: Transmitters may be located at one end of parallel coaxial cables, and preamplifier-sensor module may be located at opposite end. Install cable so shield is uniform throughout the length, without twisting or distorting cable during installation. Field-cut cables to exact zone length at the site. To attach data transmission cable to sensing cable, use heat-shrink splice kits approved by manufacturer. Provide sufficient overlap of detector cables to eliminate the possibility of entry between zones.

D. Identification
1. Indentify system components wiring, cabling, and terminals. Comply with identification requirements in Division 16 Section "Electrical Identification".
2. Install instructions frame in a location visible from master control unit.

E. Grounding
1. Ground the master control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to master control unit.
2. Ground system components and conductor and cable shields to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
3. Signal Ground Terminal: Locate at main equipment rack or cabinet. Isolate from power system and equipment grounding. Provide 5-ohm ground. Measure, record, and report ground resistance.
4. Install grounding electrodes of type, size, location, and quantity indicated. Comply with installation requirements in Division 16 Section "Grounding And Bonding".

F. Field Quality Control
1. Pretesting: After installation, align, adjust, and balance system and perform complete pretesting to determine compliance of system with requirements in the Contract Documents. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.
   a. Report of Pretesting: After pretesting is complete, provide a letter certifying that installation is complete and fully operable; include names and titles of witnesses to preliminary tests.
2. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections.
3. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components and equipment installations, including connections.
4. Tests and Inspections: Comply with provisions in NFPA 731, Ch.9, “Testing and Insptections.”
   a. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.
   b. Operational Tests: Schedule tests after pretesting has been successfully completed. Test all modes of system operation and perimeter security at each detection device. Test for detection of intrusion and for false alarms in each protected zone. Test for false alarms by simulating activities outside indicated detection patterns.
   c. Electrical Tests: Comply with NFPA 72, Section A-7. Minimum required tests are as follows:
      1) Verify the absence of unwanted voltages between circuit conductors and ground.
      2) Test all conductors for short circuits using an insulation-testing device.

3) With each circuit pair, short circuit at the far end of circuit and measure circuit resistance with an ohmmeter. Record circuit resistance of each circuit on Record Drawings.
4) Verify that each controller is in normal condition as detailed in manufacturer's operation and maintenance manual.
5) Test signal and data transmission circuits complying with requirements in Division 16 Section "Conductors And Cables For Electronic Safety And Security" for proper signal transmission under open-circuit conditions. One connection each should be opened at not less than 10 percent of initiating and indicating devices. Observe proper signal transmission according to class of wiring used.
6) Verify that transient surge-protection devices are installed according to manufacturer's written instructions.
7) Test each initiating and indicating device for alarm operation and proper response at central-station control unit.
8) Test both primary and secondary power. Verify, by test, that UPS is capable of operating the system for period and in manner specified.

d. Geophone System Tests: Test each zone at a minimum of two different locations. Test each zone as follows:
1) Horizontal Movement: Adjust sensitivity to screen out alarms from wind.
2) Vertical Climb: 100 percent detection required. Set count at 3 occurrences within 90-second window.
3) Cut Test: 100 percent detection required. Set count at 2 occurrences within 120-second window.
4) Set sensitivity to value as low as possible, consistent with reliable detection.
5) If performance tests fail, make adjustments to sensors to comply with requirements. Retest failing and adjacent zones to comply with test.

e. Strain-Sensitive Cable System Tests: Adjust sensitivity and count control to value as low as possible, consistent with reliable detection.

f. Microwave Perimeter Security System Tests: Adjust sensitivity to value as low as possible, consistent with reliable detection.

g. Long-Range PIR System Tests: Adjust sensitivity and hold time between activity duration to value as low as possible, consistent with reliable detection.

5. Report of Tests and Inspections: Prepare a written record of tests, inspections, and detailed test results in the form of a test log.

6. Tag all equipment, stations, and other components at which tests have been satisfactorily completed.

G. Demonstration

1. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain perimeter security.

H. Adjusting

1. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose. Visits for this purpose shall be in addition to any required by warranty.

END OF SECTION 13720

SECTION 13720a - INTRUSION DETECTION

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for intrusion detection. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section includes:
a. Intrusion detection with communication links to perform monitoring, alarm, and control functions.
2. Integration of other electronic and electrical systems and equipment.

C. Definitions
1. CCTV: Closed-circuit television.
2. PIR: Passive infrared.
3. RFI: Radio-frequency interference.
4. UPS: Uninterruptible power supply.
5. Control Unit: System component that monitors inputs and controls outputs through various circuits.
6. Master Control Unit: System component that accepts inputs from other control units and may also perform control-unit functions. The unit has limited capacity for the number of protected zones and is installed at an unattended location or at a location where it is not the attendant's primary function to monitor the security system.
7. Monitoring Station: Facility that receives signals and has personnel in attendance at all times to respond to signals. A central station is a monitoring station that is listed.
8. Protected Zone: A protected premises or an area within a protected premises that is provided with means to prevent an unwanted event.
9. Standard Intruder: A person who weighs 100 lb (45 kg) or less and whose height is 60 inches (1525 mm) or less; dressed in a long-sleeved shirt, slacks, and shoes unless environmental conditions at the site require protective clothing.
10. Standard-Intruder Movement: Any movement, such as walking, running, crawling, rolling, or jumping, of a "standard intruder" in a protected zone.
11. Systems Integration: The bringing together of components of several systems containing interacting components to achieve indicated functional operation of combined systems.
12. Zone. A defined area within a protected premises. It is a space or area for which an intrusion must be detected and uniquely identified. The sensor or group of sensors must then be assigned to perform the detection, and any interface equipment between sensors and communication must link to master control unit.

D. Action Submittals
1. Product Data: Components for sensing, detecting, systems integration, and control, including dimensions and data on features, performance, electrical characteristics, ratings, and finishes.
2. Show Drawings: Detail assemblies of standard components that are custom assembled for specific application on the Project.
a. Functional Block Diagram: Show single-line interconnections between components including interconnections between components specified in this Section and those furnished under other Sections. Indicate methods used to achieve systems integration. Indicate control, signal, and data communication paths and identify programmable logic controllers **OR** networks, **as directed** and control interface devices and media to be used. Describe characteristics of network and other data communication lines.

1) Indicate methods used to achieve systems integration.
2) Indicate control, signal, and data communication paths and identify PLCs, networks, control interface devices, and media to be used.
3) Describe characteristics of network and other data communication lines.
4) Describe methods used to protect against power outages and transient voltages including types and ratings of isolation and surge suppression devices used in data, communication, signal, control, and ac and dc power circuits.

b. Raceway Riser Diagrams: Detail raceway runs required for intrusion detection and for systems integration. Include designation of devices connected by raceway, raceway type and size, and type and size of wire and cable fill for each raceway run.
c. UPS: Sizing calculations.
d. Site and Floor Plans: Indicate final outlet and device locations, routing of raceways, and cables inside and outside the building. Include room layout for master control-unit console, terminal cabinet, racks, and UPS.
e. Master Control-Unit Console Layout: Show required artwork and device identification.
f. Device Address List: Coordinate with final system programming.
g. System Wiring Diagrams: Include system diagrams unique to Project. Show connections for all devices, components, and auxiliary equipment. Include diagrams for equipment and for system with all terminals and interconnections identified.
h. Details of surge-protection devices and their installation.
i. Sensor detection patterns and adjustment ranges.

3. Equipment and System Operation Description: Include method of operation and supervision of each component and each type of circuit. Show sequence of operations for manually and automatically initiated system or equipment inputs. Description must cover this specific Project; manufacturer's standard descriptions for generic systems are unacceptable.
4. Samples for Initial Selection: For units with factory-applied color finishes.
5. Samples for Verification: For each type of exposed finish required.

E. Information Submittals
1. Qualification Data: For Installer **OR** intrusion detection systems integrator **OR** testing agency, **as directed**.
2. Field quality-control reports.
3. Warranty: Sample of special warranty.
4. Other Information Submittals:
a. Test Plan and Schedule: Test plan defining all tests required to ensure that system meets technical, operational, and performance specifications within 60 days of date of Contract award.
b. Examination reports documenting inspections of substrates, areas, and conditions.
c. Anchor inspection reports documenting inspections of built-in and cast-in anchors.

F. Closeout Submittals
1. Operation and Maintenance Data: For intrusion detection system to include in emergency, operation, and maintenance manuals," include the following:
a. Data for each type of product, including features and operating sequences, both automatic and manual.
b. Master control-unit hardware and software data.

G. Quality Assurance
1. Installer Qualifications:
a. An employer of workers, at least one of whom is a technician certified by the National Burglar & Fire Alarm Association.
b. Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
2. Intrusion Detection Systems Integrator Qualifications: An experienced intrusion detection equipment supplier and Installer who has completed systems integration work for installations

similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

3. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the testing indicated, that is a member company of the National Burglar & Fire Alarm Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to Owner's insurance underwriter.
   a. Testing Agency's Field Supervisor: Person currently certified as an advanced alarm technician by the National Burglar & Fire Alarm Association to supervise on-site testing specified in Part 3.
4. 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.
5. Control Units, Devices, and Communications with Monitoring Station: Listed and labeled by a qualified testing agency for compliance with SIA CP-01.
6. FM Global Compliance: FMG-Approved and -labeled intrusion detection devices and equipment.
7. Comply with NFPA 70.

H. Project Conditions
1. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
   a. Altitude: Sea level to 4000 feet (1220 m).
   b. Master Control Unit: Rated for continuous operation in an ambient of 60 to 85 deg F (16 to 29 deg C) and a relative humidity of 20 to 80 percent, noncondensing.
   c. Interior, Controlled Environment: System components, except master station control unit, installed in air-conditioned **OR** temperature-controlled, **as directed,** interior environments shall be rated for continuous operation in ambients of 36 to 122 deg F (2 to 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing.
   d. Interior, Uncontrolled Environment: System components installed in non-air-conditioned **OR** non-temperature-controlled, **as directed,** interior environments shall be rated for continuous operation in ambients of 0 to 122 deg F (minus 18 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing.
   e. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambients of minus 30 to plus 122 deg F (minus 34 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, condensing. Comply with UL 294 and UL 639 for outdoor-use equipment. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph (137 km/h) and snow cover up to 24 inches (610 mm) thick.
   f. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers or flyings shall be rated, listed, and installed according to NFPA 70.

I. Warranty
1. Special Warranty: Manufacturer's standard form in which manufacturer and Installer agree to repair or replace components of intrusion detection devices and equipment that fail in materials or workmanship within specified warranty period.
2. Warranty Period: Two years from date of Substantial Completion.

1.2 PRODUCTS

A. Functional Description Of System
1. Description: Hard-wired **OR** Multiplexed, modular, microprocessor-based controls, intrusion sensors and detection devices, and communication links to perform monitoring, alarm, and control functions.
2. Supervision: System components shall be continuously monitored for normal, alarm, supervisory, and trouble conditions. Indicate deviations from normal conditions at any location in

system. Indication includes identification of device or circuit in which deviation has occurred and whether deviation is an alarm or malfunction.

a. Alarm Signal: Display at master station control unit and actuate audible and visual alarm devices.
b. Trouble Condition Signal: Distinct from other signals, indicating that system is not fully functional. Trouble signal shall indicate system problems such as battery failure, open or shorted transmission line conductors, or controller failure.
c. Supervisory Condition Signal: Distinct from other signals, indicating an abnormal condition as specified for the particular device or controller.

3. System Control: Master station control unit shall directly monitor intrusion detection units and connecting wiring.

   OR

   System Control: Master station control unit shall directly monitor intrusion detection devices, perimeter detection units **OR** controllers associated with perimeter detection units, **as directed,** and connecting wiring in a multiplexed distributed control system or as part of a network.
4. System shall automatically reboot program without error or loss of status or alarm data after any system disturbance.
5. Operator Commands:
   a. Help with System Operation: Display all commands available to operator. Help command, followed by a specific command, shall produce a short explanation of the purpose, use, and system reaction to that command.
   b. Acknowledge Alarm: To indicate that alarm message has been observed by operator.
   c. Place Protected Zone in Access: Disable all intrusion-alarm circuits of a specific protected zone. Tamper circuits may not be disabled by operator.
   d. Place Protected Zone in Secure: Activate all intrusion-alarm circuits of a protected zone.
   e. Protected Zone Test: Initiate operational test of a specific protected zone.
   f. System Test: Initiate system-wide operational test.
   g. Print Reports.
6. Timed Control at Master station control unit: Allow automatically timed "secure" and "access" functions of selected protected zones.
7. Automatic Control of Related Systems: Alarm or supervisory signals from certain intrusion detection devices control the following functions in related systems:
   a. Switch selected lights.
   b. Shift elevator control to a different mode.
   c. Open a signal path between certain intercommunication stations.
   d. Shift sound system to "listening mode" and open a signal path to certain system speakers.
   e. Switch signal to selected monitor from closed-circuit television camera in vicinity of sensor signaling an alarm.
8. Printed Record of Events: Print a record of alarm, supervisory, and trouble events on system printer. Sort and report by protected zone, device, and function. When master station control unit receives a signal, print a report of alarm, supervisory, or trouble condition. Report type of signal (alarm, supervisory, or trouble), protected zone description, date, and time of occurrence. Differentiate alarm signals from other indications. When system is reset, report reset event with the same information concerning device, location, date, and time. Commands shall initiate the reporting of a list of current alarm, supervisory, and trouble conditions in system or a log of past events.
9. Response Time: Two seconds between actuation of any alarm and its indication at master station control unit.
10. Circuit Supervision: Supervise all signal and data transmission lines, links with other systems, and sensors from master station control unit. Indicate circuit and detection device faults with both protected zone and trouble signals, sound a distinctive audible tone, and illuminate an LED. Maximum permissible elapsed time between occurrence of a trouble condition and indication at master station control unit is 20 seconds. Initiate an alarm in response to opening, closing, shorting, or grounding of a signal or data transmission line.

11. Programmed Secure-Access Control: System shall be programmable to automatically change status of various combinations of protected zones between secure and access conditions at scheduled times. Status changes may be preset for repetitive, daily, and weekly; specially scheduled operations may be preset up to a year in advance. Manual secure-access control stations shall override programmed settings.
12. Manual Secure-Access Control: Coded entries at manual stations shall change status of associated protected zone between secure and access conditions.

B. System Component Requirements
1. Compatibility: Detection devices and their communication features, connecting wiring, and master station control unit shall be selected and configured with accessories for full compatibility with existing equipment:
2. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor entry connection to components.
   a. Minimum Protection for Power Lines 120 V and More: Auxiliary panel suppressors complying with requirements in Division 16 Section "Transient Voltage Suppression".
   b. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Lines: Comply with requirements in Division 16 Section "Transient Voltage Suppression" as recommended by manufacturer for type of line being protected.
3. Intrusion Detection Units: Listed and labeled by a qualified testing agency for compliance with UL 639.
4. Interference Protection: Components shall be unaffected by radiated RFI and electrical induction of 15 V/m over a frequency range of 10 to 10,000 MHz and conducted interference signals up to 0.25-V RMS injected into power supply lines at 10 to 10,000 MHz.
5. Tamper Protection: Tamper switches on detection devices, controllers, annunciators, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled and when entering conductors are cut or disconnected. Central-station control-unit alarm display shall identify tamper alarms and indicate locations.
6. Self-Testing Devices: Automatically test themselves periodically, but not less than once per hour, to verify normal device functioning and alarm initiation capability. Devices transmit test failure to master station control unit.
7. Antimasking Devices: Automatically check operation continuously or at intervals of a minute or less, and use signal-processing logic to detect blocking, masking, jamming, tampering, or other operational dysfunction. Devices transmit detection of operational dysfunction to master station control unit as an alarm signal.
8. Addressable Devices: Transmitter and receivers shall communicate unique device identification and status reports to master station control unit.
9. Remote-Controlled Devices: Individually and remotely adjustable for sensitivity and individually monitored at master station control unit for calibration, sensitivity, and alarm condition.

C. Enclosures
1. Interior Sensors: Enclosures that protect against dust, falling dirt, and dripping noncorrosive liquids.
2. Interior Electronics: NEMA 250, Type 12.
3. Exterior Electronics: NEMA 250, Type 4X fiberglass **OR** stainless steel, **as directed**.
4. Corrosion Resistant: NEMA 250, Type 4X PVC **OR** stainless steel, **as directed**.
5. Screw Covers: Where enclosures are accessible to inmates, secure with security fasteners of type appropriate for enclosure.

D. Secure And Access Devices
1. Keypad and Display Module: Arranged for entering and executing commands for system-status changes and for displaying system-status and command-related data.
2. Key-Operated Switch: Change protected zone between secure and access conditions.

E. Door And Window Switches

1. Description: Balanced-magnetic switch, complying with UL 634, installed on frame with integral overcurrent device to limit current to 80 percent of switch capacity. Bias magnet and minimum of two **OR** three, **as directed,** encapsulated reed switches shall resist compromise from introduction of foreign magnetic fields.
2. Flush-Mounted Switches: Unobtrusive and flush with surface of door and window frame.
3. Overhead Door Switch: Balanced-magnetic type, listed for outdoor locations, and having door-mounting magnet and floor-mounting switch unit.
4. Remote Test: Simulate movement of actuating magnet from master station control unit.

F. PIR Sensors
1. Listed and labeled by a qualified testing agency for compliance with SIA PIR-01.
2. Description: Sensors detect intrusion by monitoring infrared wavelengths emitted from a human body within their protected zone and by being insensitive to general thermal variations.
   a. Wall-Mounting Unit Maximum Detection Range: 125 percent of indicated distance for individual units and not less than 50 feet (15 m). Provide adjustable coverage pattern as indicated.
   b. Ceiling-Mounting Unit Spot-Detection Pattern: Full 360-degree conical.
   c. Ceiling-Mounting Unit Pattern Size: 84-inch (2135-mm) diameter at floor level for units mounted 96 inches (2440 mm) above floor; 18-foot (5.5-m) diameter at floor level for units mounted 25 feet (7.6 m) above floor.
3. Device Performance:
   a. Sensitivity: Adjustable pattern coverage to detect a change in temperature of 2 deg F (1deg C) or less, and standard-intruder movement within sensor's detection patterns at any speed between 0.3 to 7.5 fps (0.09 to 2.3 m/s) across 2 adjacent segments of detector's field of view.
   b. Test Indicator: LED test indicator that is not visible during normal operation. When visible, indicator shall light when sensor detects an intruder. Locate test enabling switch under sensor housing cover.
   c. Remote Test: When initiated by master station control unit, start a test sequence for each detector element that simulates standard-intruder movement within sensor's detection patterns, causing an alarm.

G. Microwave Intrusion Detectors (Interior)
1. Device Performance: Microwave transmitter establishes an electromagnetic field in an adjustable detection pattern and detects intrusion by monitoring changes in that pattern.
   a. Sensitivity: Adjustable, able to detect standard-intruder movement within sensor's detection pattern at any speed between 0.3 to 7.5 fps (0.09 to 2.3 m/s). Sensor sensitivity adjustments shall be accessible only when sensor housing is removed, and sensors shall comply with 47 CFR 15.
   b. Activation Indicator: LED indicator shall not be visible during normal operation. Indicator shall light when sensor detects a standard intruder. Locate test-enabling switch under sensor housing cover.
   c. Remote Test: When initiated by master station control unit, start a test sequence for each detector element that simulates standard-intruder movement within sensor's detection patterns, causing an alarm.

H. Acoustic-Type, Glass-Break Sensors
1. Listed and labeled by a qualified testing agency for compliance with SIA GB-01.
2. Device Performance: Detect unique, airborne acoustic energy spectrum caused by breaking glass.
   a. Sensor Element: Microprocessor-based, digital device to detect breakage of plate, laminate, tempered, and wired glass while rejecting common causes of false alarms. Detection pattern shall be at least a 20-foot (6-m) range.
   b. Hookup Cable: Factory installed, not less than 72 inches (1830 mm).

c. Activation Indicator: LED on sensor housing that lights when responding to vibrations, remaining on until manually reset at sensor controller or at master station control unit.
d. Controller: Integral with sensor housing or in a separate assembly, locally adjustable by control under housing cover.
e. Glass-Break Simulator: A device to induce frequencies into protected glass pane that simulate breaking glass without causing damage to glass.

I. Piezoelectric-Type, Glass-Break Sensors
1. Listed and labeled by a qualified testing agency for compliance with SIA GB-01.
2. Device Performance: Detect unique, high-frequency vibrations caused by breaking glass.
a. Sensor Element: Piezoelectric crystals in a housing designed to mount directly to glass surface with adhesive provided by element manufacturer. Circular detection pattern, with at least a 60-inch (1525-mm) radius on a continuous glass pane. Sensor element shall not be larger than 4 sq. in. (25.80 sq. cm).
b. Hookup Cable: Factory installed, not less than 72 inches (1830 mm).
c. Activation Indicator: LED on sensor housing that lights when responding to vibrations, remaining on until manually reset at sensor controller or at master station control unit.
d. Controller: Integral with sensor housing or in a separate assembly, locally adjustable by control under housing cover.
e. Glass-Break Simulator: A device to induce frequencies into protected glass pane that simulate breaking glass without causing damage to glass.

J. Vibration Sensors
1. Listed and labeled by a qualified testing agency for compliance with SIA GB-01.
2. Description: A sensor controller and piezoelectric crystal sensor elements that are designed to be rigidly mounted to structure being protected.
3. Device Performance: Detects high-frequency vibrations generated by use of such tools as oxyacetylene torches, oxygen lances, high-speed drills and saws, and explosives that penetrate a structure while not responding to any other mechanical vibration.
a. Circular detection pattern, with at least a 72-inch (1830-mm) radius on protected structure.
b. Hookup Cable: Factory installed, not less than 72 inches (1830 mm).
c. Controller: Integral with sensor housing or in a separate assembly, locally adjustable by control under housing cover.
d. Glass-Break Simulator: A device to induce frequencies to protected glass pane that simulate breaking glass without causing damage to glass.

K. Photoelectric Sensors
1. Device Performance: Detect an interruption of a pulsed, infrared, light beam that links transmitter and receiver.
a. Sensitivity: Detect standard-intruder movement within sensor's detection patterns at any speed of less than 7.5 fps (2.3 m/s) though the beam. Allow installation of multiple sensors within same protected zone that will not interfere with each other.
b. Activation Indicator: LED indicator shall not be visible during normal operation. Indicator shall light when sensor detects a standard intruder. Locate test enabling switch under sensor housing cover.
c. Remote Test: When initiated by master station control unit, start a test sequence for each detector element that simulates standard-intruder movement within sensor's detection patterns, causing an alarm.

L. Microwave-PIR Dual-Technology Motion Sensors
1. Description: Single unit combining a sensor that detects changes in microwave signals and a PIR sensor that detects changes in ambient level of infrared emissions caused by standard-intruder movement within detection pattern.
2. Device Performance: An alarm is transmitted when either sensor detects a standard intruder within a period of three to eight seconds from when the other sensor detects a standard intruder.
a. Minimum Detection Pattern: A room 20 by 30 feet (6 by 9 m).

b. PIR Sensor Sensitivity: Adjustable pattern coverage to detect a change in temperature of 2 deg F (1 deg C) or less, and standard-intruder movement within sensor's detection patterns at any speed between 0.3 to 7.5 fps (0.09 to 2.3 m/s) across 2 adjacent segments of detector's field of view.
c. Microwave Sensor Sensitivity: Adjustable, able to detect standard-intruder movement within sensor's detection pattern at any speed between 0.3 to 7.5 fps (0.09 to 2.3 m/s). Sensor sensitivity adjustments shall be accessible only when sensor housing is removed, and sensors shall comply with 47 CFR 15.
d. Activation Indicator: LED indicator shall not be visible during normal operation. Indicator shall light when sensor detects a standard intruder. Locate test enabling switch under sensor housing cover.
e. Remote Test: When initiated by master station control unit, start a test sequence for each detector element that simulates standard-intruder movement within sensor's detection patterns, causing an alarm.

M. Duress-Alarm Switches
1. Description: A switch with a shroud over the activating lever that allows an individual to covertly send a duress signal to master station control unit, with no visible or audible indication when activated. Switch shall lock in activated position until reset with a key.
a. Minimum Switch Rating: 50,000 operations.
b. Foot Rail: Foot activated, floor mounting.
c. Push Button: Finger activated, suitable for mounting on horizontal or vertical surface.

N. Video Motion Sensor (Interior)
1. Device Performance: Detect changes in video signal within a user-defined protected zone. Video inputs shall be composite video as defined in EIA 170. Provide an alarm output for each video input.
a. Detect movement within protected zone of standard intruders wearing clothing with a reflectivity that differs from that of background scene by a factor of 2. Reject all other changes in video signal.
b. Modular design that allows for expansion or modification of number of inputs.
c. Controls:
1) Number of detection zones.
2) Size of detection zones.
3) Sensitivity of detection of each protected zone.
d. Mounting: Standard 19-inch (480-mm) rack as described in EIA 310.

O. Master Control Units
1. Description: Supervise sensors and detection subsystems and their connecting communication links, status control (secure or access) of sensors and detector subsystems, activation of alarms and supervisory and trouble signals, and other indicated functions.
a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
b. Include a real-time clock for time annotation of events on the event recorder and printer.
c. Addressable initiation devices that communicate device identity and status.
d. Control circuits for operation of mechanical equipment in response to an alarm.
2. Construction: Freestanding equipment rack **OR** Desk-mounted console, **as directed** modular, with separate and independent alarm and supervisory system modules. Alarm-initiating protected zone boards shall be plug-in cards. Arrangements that require removal of field wiring for module replacement are unacceptable.
3. Comply with UL 609 **OR** UL 1023 **OR** UL 1076, **as directed**.
4. Console Controls and Displays: Arranged for interface between human operator at master control unit and addressable system components including annunciation and supervision.

Display alarm, supervisory, and component status messages and the programming and control menu.

a. Annunciator and Display: LCD, one **OR** two **OR** three line(s), as directed of 40 **OR** 80 characters, as directed, minimum.

b. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

c. Control-Unit Network: Automatic communication of alarm, status changes, commands, and other communications required for system operation. Communication shall return to normal after partial or total network interruption such as power loss or transient event. Total or partial signaling network failures shall identify the failure and record the failure at the annunciator display and at the system printer.

d. Field Device Network: Communicate between the control unit and field devices of the system. Communications shall consist of alarm, network status, and status and control of field-mounted processors. Each field-mounted device shall be interrogated during each interrogation cycle.

e. Operator Controls: Manual switches and push-to-test buttons that do not require a key to operate. Prevent resetting of alarm, supervisory, or trouble signals while alarm or trouble condition persists. Include the following:

1) Acknowledge alarm.
2) Silence alarm.
3) System reset.
4) LED test.

f. Timing Unit: Solid state, programmable, 365 days.

g. Confirmation: Relays, contactors, and other control devices shall have auxiliary contacts that provide confirmation signals to system for their on or off status. Software shall interpret such signals, display equipment status, and initiate failure signals.

h. Alarm Indication: Audible signal sounds and a plain-language identification **OR** LED **OR** LCD OR cathode ray-tube display at master control unit identifying the protected zone **OR** addressable detector**, as directed** originating the alarm. Annunciator panel displays a common alarm light and sounds an audible tone.

i. Alarm activation sounds a bell or siren or strobe **OR** bell or siren and strobe**, as directed**.

5. Protected Zones: Quantity of alarm and supervisory zones as indicated, with capacity for expanding number of protected zones by a minimum of 25 percent.

6. Power Supply Circuits: Master station control units shall provide power for remote power-consuming detection devices. Circuit capacity shall be adequate for at least a 25 percent increase in load.

7. UPS: Comply with Division 16 Section "Static Uninterruptible Power Supply". UPS shall be sized to provide a minimum of six hours of central-station control-unit operation.

8. Cabinet: Lockable, steel enclosure arranged so operations required for testing, normal operation, and maintenance are performed from front of enclosure. If more than a single cabinet is required to form a complete control unit, provide exactly matching modular enclosures. Accommodate all components and allow ample gutter space for field wiring. Identify each enclosure by an engraved, laminated, phenolic-resin nameplate. Lettering on enclosure nameplate shall not be less than 1 inch (25 mm) high. Identify, with permanent labels, individual components and modules within cabinets.

9. Transmission to Monitoring Station: A communications device to automatically transmit alarm, supervisory, and trouble signals to the monitoring station, operating over a standard voice grade telephone leased line. Comply with UL 1635.

10. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

P. Audible And Visual Alarm Devices

1. Bell: 10 inches (254 mm) in diameter, rated to produce a minimum sound output of 84 dB at 10 feet (3 m) from master control unit.
   a. Enclosure: Weather-resistant steel box equipped with tamper switches on cover and on back of box.
2. Klaxon Weatherproof Motor-Driven Hooter: UL listed, rated to produce a minimum sound output of 120 dB at 3 feet (1 m), plus or minus 3 dB, at a frequency of 470 Hz. Rated for intermittent use: two minutes on and five minutes off.
   a. Designed for use in industrial areas and in high-noise, severe-weather marine environments.
3. Siren: 30-W speaker with siren driver, rated to produce a minimum sound output of 103 dB at 10 feet (3 m) from master control unit.
   a. Enclosure: Weather-resistant steel box with tamper switches on cover and on back of box.
4. Strobe: Xenon light complying with UL 1638, with a clear polycarbonate lens.
   a. Light Output: 115 cd, minimum.
   b. Flash Rate: 60 per minute.

Q. Security Fasteners
1. Operable only by tools produced for use on specific type of fastener by fastener manufacturer or other licensed fabricator. Drive system type, head style, material, and protective coating as required for assembly, installation, and strength.
2. Drive System Types: Pinned Torx-Plus **OR** pinned Torx **OR** pinned hex (Allen)**, as directed**.
3. Socket Flat Countersunk Head Fasteners:
   a. Heat-treated alloy steel, ASTM F 835 (ASTM F 835M).
   b. Stainless steel, ASTM F 879 (ASTM F 879M), Group 1 CW.
4. Socket Button Head Fasteners:
   a. Heat-treated alloy steel, ASTM F 835 (ASTM F 835M).
   b. Stainless steel, ASTM F 879 (ASTM F 879M), Group 1 CW.
5. Socket Head Cap Fasteners:
   a. Heat-treated alloy steel, ASTM A 574 (ASTM A 574M).
   b. Stainless steel, ASTM F 837 (ASTM F 837M), Group 1 CW.
6. Protective Coatings for Heat-Treated Alloy Steel:
   a. Zinc chromate, ASTM F 1135, Grade 3 or Grade 4, for exterior applications and interior applications where indicated.
   b. Zinc phosphate with oil, ASTM F 1137, Grade I, or black oxide unless otherwise indicated.

1.3 EXECUTION

A. Examination
1. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of intrusion detection.
2. Examine roughing-in for embedded and built-in anchors to verify actual locations of intrusion detection connections before intrusion detection installation.
3. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of intrusion detection.
4. Inspect built-in and cast-in anchor installations, before installing intrusion detection, to verify that anchor installations comply with requirements. Prepare inspection reports.
   a. Remove and replace anchors where inspections indicate that they do not comply with requirements. Reinspect after repairs or replacements are made.
   b. Perform additional inspections to determine compliance of replaced or additional anchor installations. Prepare inspection reports.
5. For material whose orientation is critical for its performance as a ballistic barrier, verify installation orientation.
6. Proceed with installation only after unsatisfactory conditions have been corrected.

B. System Integration
   1. Electronic door hardware.
   2. Elevators.
   3. Network lighting controls.
   4. Intercommunications and program systems.
   5. Public address and mass notification systems.
   6. Access control.
   7. Fire-alarm system.
   8. Perimeter security system.
   9. Video surveillance.

C. System Installation
   1. Comply with UL 681 and NFPA 731.
   2. Equipment Mounting: Install master control unit on finished floor with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.
      a. Comply with requirements for seismic-restraint devices specified in Division 16 Section "Vibration And Seismic Controls For Electrical Systems".
   3. Install wall-mounted equipment, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.
      a. Comply with requirements for seismic-restraint devices specified in Division 16 Section "Vibration And Seismic Controls For Electrical Systems".
   4. Connecting to Existing Equipment: Verify that existing perimeter security system is operational before making changes or connections.
      a. Connect new equipment to existing control panel in existing part of the building.
      b. Connect new equipment to existing monitoring equipment at the Supervising Station.
      c. Expand, modify, and supplement existing control **OR** monitoring equipment**, as directed** as necessary to extend existing control **OR** monitoring functions**, as directed** to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.
   5. Security Fasteners: Where accessible to inmates, install intrusion detection components using security fasteners with head style appropriate for fabrication requirements, strength, and finish of adjacent materials except that a maximum of two different sets of tools shall be required to operate security fasteners for Project. Provide stainless-steel security fasteners in stainless-steel materials.

D. Wiring Installation
   1. Wiring Method: Install wiring in metal raceways according to Division 16 Section "Raceways And Boxes". Conceal raceway except in unfinished spaces and as indicated. Minimum conduit size shall be 1/2 inch (13 mm). Control and data transmission wiring shall not share conduit with other building wiring systems.
   2. Wiring Method: Install wiring in raceways except in accessible indoor ceiling spaces and in interior hollow gypsum board partitions where cable may be used. Conceal raceways and wiring except in unfinished spaces and as indicated. Minimum conduit size shall be 1/2 inch (13 mm). Control and data transmission wiring shall not share conduit with other building wiring systems.
   3. Wiring Method: Cable, concealed in accessible ceilings, walls, and floors when possible.
   4. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Use lacing bars and distribution spools. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
   5. Wires and Cables:
      a. Conductors: Size as recommended in writing by system manufacturer, unless otherwise indicated.

b. 120-V Power Wiring: Install according to Division 16 Section "Conductors And Cables", unless otherwise indicated.
c. Control and Signal Transmission Conductors: Install unshielded, twisted-pair cable, unless otherwise indicated or if manufacturer recommends shielded cable, according to Division 16 Section "Conductors And Cables For Electronic Safety And Security".
d. Data and Television Signal Transmission Cables: Install according to Division 16 Section "Conductors And Cables For Electronic Safety And Security".

6. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
7. Install power supplies and other auxiliary components for detection devices at controllers, unless otherwise indicated or required by manufacturer. Do not install such items near devices they serve.
8. Identify components with engraved, laminated-plastic or metal nameplate for master station control unit and each terminal cabinet, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 16 Section "Electrical Identification".

E. Identification
1. Identify system components, wiring, cabling, and terminals. Comply with identification requirements as specified in Division 16 Section "Electrical Identification".
2. Install instructions frame in a location visible from master control unit.

F. Grounding
1. Ground the master control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to master control unit.
2. Ground system components and conductor and cable shields to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
3. Signal Ground Terminal: Locate at main equipment rack or cabinet. Isolate from power system and equipment grounding. Provide 5-ohm ground. Measure, record, and report ground resistance.
4. Install grounding electrodes of type, size, location, and quantity indicated. Comply with installation requirements in Division 16 Section "Grounding And Bonding".

G. Field Quality Control
1. Pretesting: After installation, align, adjust, and balance system and perform complete pretesting to determine compliance of system with requirements in the Contract Documents. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.
a. Report of Pretesting: After pretesting is complete, provide a letter certifying that installation is complete and fully operable; include names and titles of witnesses to preliminary tests.
2. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections.
3. Manufacturer’s Field Service: Engage a factory-authorized service representative to inspect test, and adjust components, assemblies, and equipment installations connections.
4. Perform tests and inspections.
a. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
5. Test and Inspections: Comply with provisions in NFPA 731, Ch.9, “Testing and Inspections.”
a. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.
b. Test Methods: Intrusion detection systems and other systems and equipment that are associated with detection and accessory equipment shall be tested according to Table "Test Methods" and Table "Test Methods of Initiating Devices."
6. Documentation: Comply with provisions in NFPA 731, Ch. 4, "Documentation."

7. Tag all equipment, stations, and other components for which tests have been satisfactorily completed.
8.

H. Adjusting
1. Occupancy Adjustments: When requested within 12 months of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose. Visits for this purpose shall be in addition to any required by warranty.

I. Demonstration
1. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain intrusion detection system. Comply with documentation provisions in NFPA 731, Ch.4, “Documentation and User Training."

END OF SECTION 13720a

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Task	Specification	Specification Description
13720	13700	Security Access
13730	01352	No Specification Required

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SECTION 13740 - VIDEO SURVEILLANCE

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for video surveillance. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section includes a video surveillance system consisting of cameras, digital video recorder, data transmission wiring, and a control station with its associated equipment.
2. Video surveillance system shall be integrated with monitoring and control system specified in Division 13 Section "Perimeter Security", "Intrusion Detection", "Security Access", and PLC Electronic Detention Monitoring and Control Systems", which specifies systems integration.

C. Definitions
1. AGC: Automatic gain control.
2. BNC: Bayonet Neill-Concelman - type of connector.
3. B/W: Black and white.
4. CCD: Charge-coupled device.
5. FTP: File transfer protocol.
6. IP: Internet protocol.
7. LAN: Local area network.
8. MPEG: Moving picture experts group.
9. NTSC: National Television System Committee.
10. PC: Personal computer.
11. PTZ: Pan-tilt-zoom.
12. RAID: Redundant array of independent disks.
13. TCP: Transmission control protocol - connects hosts on the Internet.
14. UPS: Uninterruptible power supply.
15. WAN: Wide area network.

D. Performance Requirements
1. Seismic Performance: Video surveillance system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   a. 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."

E. Submittals
1. Product Data: For each type of product indicated. Include dimensions and data on features, performance, electrical characteristics, ratings, and finishes.
2. Shop Drawings: For video surveillance. Include plans, elevations, sections, details, and attachments to other work.
   a. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   b. Functional Block Diagram: Show single-line interconnections between components for signal transmission and control. Show cable types and sizes.
   c. Dimensioned plan and elevations of equipment racks, control panels, and consoles. Show access and workspace requirements.
   d. UPS: Sizing calculations.
   e. Wiring Diagrams: For power, signal, and control wiring.

3. Equipment List: Include every piece of equipment by model number, manufacturer, serial number, location, and date of original installation. Add pretesting record of each piece of equipment, listing name of person testing, date of test, set points of adjustments, name and description of the view of preset positions, description of alarms, and description of unit output responses to an alarm.
4. Seismic Qualification Certificates: For video surveillance, cameras, camera-supporting equipment, accessories, and components, from manufacturer.
   a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   b. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   c. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
   d. Field quality-control reports.
   e. Operation and Maintenance Data: For cameras, power supplies, infrared illuminators, monitors, videotape recorders, digital video recorders, video switches, and control-station components to include in emergency, operation, and maintenance manuals. Include the following:
      1) Lists of spare parts and replacement components recommended to be stored at the site for ready access.
5. Warranty: Sample of special warranty.

F. Quality Assurance
1. 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.
2. Comply with NECA 1.
3. Comply with NFPA 70.
4. Electronic data exchange between video surveillance system with an access-control system shall comply with SIA TVAC.

G. Project Conditions
1. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
   a. Control Station: Rated for continuous operation in ambient temperatures of 60 to 85 deg F (16 to 29 deg C) and a relative humidity of 20 to 80 percent, noncondensing.
   b. Interior, Controlled Environment: System components, except central-station control unit, installed in air-conditioned **OR** temperature-controlled, **as directed**, interior environments shall be rated for continuous operation in ambient temperatures of 36 to 122 deg F (2 to 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing. Use NEMA 250, Type 1 enclosures.
   c. Interior, Uncontrolled Environment: System components installed in non-air-conditioned **OR** non-temperature-controlled, **as directed**, interior environments shall be rated for continuous operation in ambient temperatures of 0 to 122 deg F (minus 18 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing. Use NEMA 250, Type 3R **OR** Type 4 **OR** Type 12 **OR** Type 12K, **as directed**, enclosures.
   d. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient temperatures of minus 30 to plus 122 deg F (minus 34 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph (137 km/h) and snow cover up to 24 inches (610 mm) thick, **as directed**. Use NEMA 250, Type 3 **OR** Type 3R **OR** Type 3S **OR** Type 4 **OR** Type 4X, **as directed**, enclosures.
   e. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers shall be rated, listed, and installed according to NFPA 70.

f. Corrosive Environment: System components subject to corrosive fumes, vapors, and wind-driven salt spray in coastal zones. Use NEMA 250, Type 4X **OR** Type 6P, **as directed**, enclosures.

g. Security Environment: Camera housing for use in high-risk areas where surveillance equipment may be subject to physical violence.

H. Warranty

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of cameras, equipment related to camera operation, and control-station equipment that fail in materials or workmanship within specified warranty period.

a. Warranty Period: Three years from date of Substantial Completion.

1.2 PRODUCTS

A. System Requirements

1. Video-signal format shall comply with NTSC standard, composite interlaced video. Composite video-signal termination shall be 75 ohms.

2. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor's entry connection to components.

a. Minimum Protection for Power Connections 120 V and More: Auxiliary panel suppressors complying with requirements in Division 16 Section "Transient Voltage Suppression."

b. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Connections: Comply with requirements in Division 16 Section "Transient Voltage Suppression" as recommended by manufacturer for type of line being protected.

3. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station, control-unit alarm display shall identify tamper alarms and indicate locations.

B. Standard Cameras

1. B/W Camera:

a. Comply with UL 639.

b. Pickup Device: CCD interline transfer, 252,000 512(H) by 492(V) pixels, **unless directed otherwise**.

c. Horizontal Resolution: 380 lines.

d. Signal-to-Noise Ratio: Not less than 46 dB.

e. With AGC, manually selectable on or off.

f. Sensitivity: Camera shall provide usable images in low-light conditions, delivering an image at a scene illumination, as directed by the Owner, with camera AGC off, **as directed**.

OR

Sensitivity: Camera shall deliver 1-V peak-to-peak video signal at the minimum specified light level. Illumination for the test shall be with lamps rated at approximately 2200-K color temperature, and with camera AGC off.

g. Manually selectable modes for backlight compensation or normal lighting.

h. Scanning Synchronization: Determined by external synch over the coaxial cable. Camera shall revert to internally generated synchronization on loss of external synch signal.

i. Motion Detector: Built-in digital.

2. Color Camera:

a. Comply with UL 639.

b. Pickup Device: CCD interline transfer, 380,000 771(H) by 492(V) pixels, **unless directed otherwise**.

c. Horizontal Resolution: 480 lines.

d. Signal-to-Noise Ratio: Not less than 50 dB, with camera AGC off.

e. With AGC, manually selectable on or off.
f. Sensitivity: Camera shall provide usable images in low-light conditions, delivering an image at a scene illumination, as directed by the Owner, with camera AGC off, **as directed**.
OR
Sensitivity: Camera shall deliver 1-V peak-to-peak video signal at the minimum specified light level. Illumination for the test shall be with lamps rated at approximately 2200-K color temperature, and with camera AGC off.
g. Manually selectable modes for backlight compensation or normal lighting.
h. Scanning Synchronization: Determined by external synch over the coaxial cable. Camera shall revert to internally generated synchronization on loss of external synch signal.
i. White Balance: Auto-tracing white balance, with manually settable fixed balance option.
j. Motion Detector: Built-in digital.

3. Automatic Color Dome Camera: Assembled and tested as a manufactured unit, containing dome assembly, color camera, motorized pan and tilt, zoom lens, and receiver/driver.
a. Comply with UL 639.
b. Pickup Device: CCD interline transfer, 380,000 768(H) by 494(V) pixels, **unless directed otherwise**.
c. Horizontal Resolution: 480 lines.
d. Signal-to-Noise Ratio: Not less than 50 dB, with camera AGC off.
e. With AGC, manually selectable on or off.
f. Sensitivity: Camera shall provide usable images in low-light conditions, delivering an image at a scene illumination, as directed by the Owner, with camera AGC off, **as directed**.
OR
Sensitivity: Camera shall deliver 1-V peak-to-peak video signal at the minimum specified light level. Illumination for the test shall be with lamps rated at approximately 2200-K color temperature, and with camera AGC off.
g. Manually selectable modes for backlight compensation or normal lighting.
h. Pan and Tilt: Direct-drive motor, 360-degree rotation angle, and 180-degree tilt angle. Pan-and-tilt speed shall be controlled by operator. Movement from preset positions shall be not less than 300 degrees per second.
i. Preset Positioning: Eight user-definable scenes, each allowing 16-character titles. Controls shall include the following:
1) In "sequence mode," camera shall continuously sequence through preset positions, with dwell time and sequencing under operator control.
2) Motion detection shall be available at each camera position.
3) Up to four preset positions may be selected to be activated by an alarm. Each of the alarm positions may be programmed to output a response signal.
j. Scanning Synchronization: Determined by external synch over the coaxial cable. Camera shall revert to internally generated synchronization on loss of external synch signal.
k. White Balance: Auto-tracing white balance, with manually settable fixed balance option.
l. Motion Detector: Built-in digital.
m. Dome shall support multiplexed control communications using coaxial cable recommended by manufacturer.

C. Submersible Cameras
1. Camera: Color, designed for underwater monitoring and for inspecting pipes and storm drains. Attributes as follows:
a. Infrared LEDs to provide illumination in zero-light conditions.
b. 60-foot (18.3-m) factory-installed cable with BNC connector for video and a 2.1-mm jack for 12-V dc power supply.
c. An adjustable swivel mount and attachment base.
d. Pickup Device: CCD interline transfer, 290,000 500(H) by 580(V) pixels, **unless directed otherwise**.

e. Horizontal Resolution: 380 lines.
f. Signal-to-Noise Ratio: Not less than 50 dB.
g. With AGC, from 4 to 39 dB.
h. Sensitivity: Camera shall provide usable images in low-light conditions, delivering an image at a scene illumination of 0.1 lux at f/2.0.
i. Scanning Synchronization: Internal.
j. White Balance: Auto-tracing white balance, for colors ranging from 2800 to 8200 deg K.

D. Reinforced Dome Cameras
1. Camera: Designed for high-abuse locations, with a weathertight semirecessed **OR** surface, **as directed**, mounting, impact-resistance polycarbonate dome, and heavy-gage, 6061 T6 aluminum body.
a. Suitable for exterior environment, rated for continuous operation in ambient temperatures of minus 40 to plus 122 deg F (minus 40 to plus 50 deg C) dry bulb and up to 85 percent relative humidity.
b. Pickup Device: CCD interline transfer, 290,000 510(H) by 492(V) pixels, **unless directed otherwise**.
c. Horizontal Resolution: 350 lines.
d. Signal-to-Noise Ratio: Not less than 46 dB.
e. With AGC and automatic backlight compensation.
f. Sensitivity: Camera shall provide usable images in low-light conditions, delivering an image at a scene illumination of 6 lux at f/2.0.
g. Scanning Synchronization: Determined by external synch over the coaxial cable. Camera shall revert to internally generated synchronization on loss of external synch signal.
h. White Balance: Auto-tracing white balance.

E. Lenses
1. Description: Optical-quality coated lens, designed specifically for video-surveillance applications and matched to specified camera. Provide color-corrected lenses with color cameras.
a. Auto-Iris Lens: Electrically controlled iris with circuit set to maintain a constant video level in varying lighting conditions.
b. Fixed Lens: With calibrated focus ring.
c. Zoom Lens: Motorized, remote-controlled unit, rated as "quiet operating." Features include the following:
1) Electrical Leads: Filtered to minimize video signal interference.
2) Motor Speed: Variable.
3) Lens shall be available with preset positioning capability to recall the position of specific scenes.

F. Power Supplies
1. Low-voltage power supplies matched for voltage and current requirements of cameras and accessories, and of type as recommended by manufacturer of camera, infrared illuminator, **as directed**, and lens.
a. Enclosure: NEMA 250, Type 1 **OR** Type 3 **OR** Type 4X, **as directed**.

G. Infrared Illuminators
1. Description: Lighting fixtures that emit light only in the infrared spectrum, suitable for use with cameras indicated, for nighttime surveillance, without emitting visible light.
a. Field-Selectable Beam Patterns: Narrow, medium, and wide.
b. Rated Lamp Life: More than 8000 hours.
c. Power Supply: 12-V ac/dc **OR** 120-V ac, **as directed**.
2. Area Coverage: Illumination to 150 feet (50 m) in a narrow beam pattern.
3. Exterior housings shall be suitable for same environmental conditions as the associated camera.

H. Camera-Supporting Equipment

1. Minimum Load Rating: Rated for load in excess of the total weight supported times a minimum safety factor of two.
2. Pan Units: Motorized automatic-scanning units arranged to provide remote-controlled manual and automatic camera panning action, and equipped with matching mounting brackets.
   a. Scanning Operation: Silent, smooth, and positive.
   b. Stops: Adjustable without disassembly, to limit the scanning arc.
3. Pan-and-Tilt Units: Motorized units arranged to provide remote-controlled aiming of cameras with smooth and silent operation, and equipped with matching mounting brackets.
   a. Panning Rotation: 0 to 355 degrees, with adjustable stops.
   b. Tilt Movement: 90 degrees, plus or minus 5 degrees, with adjustable stops.
   c. Speed: 12 degrees per second in both horizontal and vertical planes.
   d. Wiring: Factory prewired for camera and zoom lens functions and pan-and-tilt power and control.
   e. Built-in encoders or potentiometers for position feedback, and thermostat-controlled heater, **as directed**.
   f. Pan-and-tilt unit shall be available with preset positioning capability to recall the position of a specific scene.
4. Mounting Brackets for Fixed Cameras: Type matched to items supported and mounting conditions. Include manual pan-and-tilt adjustment.
5. Protective Housings for Fixed and Movable Cameras: Steel or 6061 T6 aluminum, **as directed**, enclosures with internal camera mounting and connecting provisions that are matched to camera/lens combination and mounting and installing arrangement of camera to be housed.
   a. Tamper switch on access cover sounds an alarm signal when unit is opened or partially disassembled. Central-control unit shall identify tamper alarms and indicate location in alarm display. Tamper switches and central-control unit are specified in Division 13 Section "Intrusion Detection."
   b. Camera Viewing Window: Polycarbonate **OR** Lexan, **as directed**, window, aligned with camera lens.
   c. Duplex Receptacle: Internally mounted.
   d. Alignment Provisions: Camera mounting shall provide for field aiming of camera and permit removal and reinstallation of camera lens without disturbing camera alignment.
   e. Built-in, thermostat-activated heater and blower units. Units shall be automatically controlled so the environmental limits of the camera equipment are not exceeded.
   f. Sun shield shall not interfere with normal airflow around the housing.
   g. Mounting bracket and hardware for wall or ceiling mounting of the housing. Bracket shall be of same material as the housing; mounting hardware shall be stainless steel.
   h. Finish: Housing and mounting bracket shall be factory finished using manufacturer's standard finishing process suitable for the environment.
   i. Enclosure Rating: as directed by the Owner.

I. Monitors
1. Monochrome:
   a. Metal cabinet units designed for continuous operation.
   b. Screen Size (Diagonal Dimension): as directed by the Owner.
   c. Horizontal Resolution: 600 lines, minimum, at center.
   d. Minimum Front Panel Devices and Controls: Power switch; power-on indicator; and brightness, horizontal-hold, vertical-hold, and contrast controls.
   e. Mounting: Adjustable tilting and training.
   f. Mounting: Single, 14-inch (356-mm) **OR** Dual, 9-inch (229-mm), **as directed**, vertical, EIA 19-inch (483-mm) electronic equipment rack or cabinet complying with CEA 310-E.
   g. Electrical: 120-V ac, 60 Hz.
2. Color:
   a. Metal cabinet units designed for continuous operation.
   b. Screen Size (Diagonal Dimension): as directed by the Owner.
   c. Horizontal Resolution: 300 lines.

d. Minimum Front Panel Devices and Controls: Power switch; power-on indicator; and brightness, contrast, color, and tint controls.
e. Degaussing: Automatic.
f. Mounting: Single, 14-inch (356-mm) **OR** Dual, 9-inch (229-mm), **as directed**, vertical, EIA 19-inch (483-mm) electronic equipment rack or cabinet complying with CEA 310-E.
g. Electrical: 120-V ac, 60 Hz.

J. Videotape Recorders
1. Description: Industrial, time-lapse type recorder, designed for continuous operation. Tape format is 1/2 inch (13 mm) using industrial-grade, T-120 cassettes.
a. Horizontal Resolution: 400 lines, minimum.
b. Recording Heads: Rotary-scan type.
c. Integral Timer: Permits programming of recording operation for adjustable daily and weekly periods.
d. Time-Lapse Operating Modes: Multiple, covering 24 to 240 hours, minimum.
e. Other Operating Modes:
1) Manual play and recording at two- and six-hour speeds.
2) Forward and reverse high-speed search.
3) Reverse, slow, and single-frame play.
f. Alarm Recording: Operating mode is automatically switched from time-lapse to two- or six-hour recording mode when an externally generated alarm signal is received.
g. Audio Recording: 70 to 7000 Hz. Phono and microphone input; phono output.
h. Time and Date Generator: Records time and date legend in corner of recorded scenes.
i. Tape Counter: Displays tape position.
j. Manual Recording Lock: Key or keypad operated. Prevents unauthorized tampering or control changes during preset operation.
k. Signal-to-Noise Ratio: 45 dB for video output in standard play mode.
l. Mounting: Standard 19-inch (483-mm) rack complying with CEA 310-E, or freestanding desktop.

K. Digital Video Recorders
1. Description: Digital, time-lapse type, full-frame and motion recorder, with removable hard drive.
a. Recording Time: 400 hours minimum.
b. Resolution: 720 by 480 lines, minimum.
c. Programming shall be from trackball and push buttons on face of the recorder, settings shall be displayed on any video monitor connected to the recorder. Programming shall include the following:
1) Motion analysis graph.
2) Password protection.
3) Alarm and timer controls.
4) Continuous recording option.
5) Time-lapse operating modes.
6) Search video by time, event, or motion.
d. Programming: SmartMedia card for software updating, image archiving, and image transfer to a PC.
e. Storage: 80-GB, **unless directed otherwise**, removable hard drive. Software shall permit hot-swapping drives.
f. Compression: MPEG-2.
g. Time and Date Generator: Records time (hr:min:sec) and date legend of each frame.
h. Audio Recording: 70 to 7000 Hz. Phono and microphone input; phono output.
i. Mounting: Standard 19-inch (483-mm) rack complying with CEA 310-E, or freestanding desktop.

L. Network Video Recorders
1. External storage or internal 250-1, 500-GB hard disk drive.
a. Video and audio recording over TCP/IP network.

b. Video recording of MPEG-2 and MPEG-4 streams.
c. Video recording up to 48 Mbps for internal storage and up to 100 Mbps for external storage.
d. Duplex Operation: Simultaneous recording and playback.
e. Continuous and alarm-based recording.
f. Full-Featured Search Capabilities: Search based on camera, time, or date.
g. Automatic data replenishment to ensure recording even if network is down.
h. Digital certification by watermarking.
i. Internal RAID storage or non-RAID storage of up to 1500 GB.
j. Capable of adding external RAID storage up to 7000 GB for models with no internal storage.
k. Full integration with LAN, Intranet, or Internet through standard Web browser or video management software.
l. Integrated Web server FTP server functionality.
m. Supports up to 16, 32, or 64 devices.

M. Digital Switchers
1. Quad Switch: For displaying images from four cameras on a single monitor. Provide color switcher if one or more cameras or monitors are in color.
   a. Controls: Unit-mounted front panel.
   b. Resolution: 720 by 480 lines, **unless directed otherwise**.
   c. Modes: Auto, manual, and alarm. In manual mode, each channel can also be viewed in single display mode. In the event of an alarm, alarming channel shall automatically switch to full screen. If several alarms are activated, channels in alarm shall be in auto-switching mode.
   d. Channel Loss Alarm: Audible buzzer; occurrence details shall be recorded.
   e. Time: Indicate date and time.
   f. Timing of Auto-Switcher: 1 to 30 seconds, selectable.
   g. Mounting: Standard 19-inch (483-mm) rack complying with CEA 310-E, or freestanding desktop.
2. Manual Switch Bank: Low-loss, high-isolation, multiple-video switch to allow manual switching of multiple quad switches and cameras to a single output. Switches shall be illuminated.
3. Sequential Switchers: Automatically sequence outputs of multiple cameras to single monitor and videotape recorder.
   a. Switching Time Interval: Continuously adjustable, 5 to 20 seconds minimum, with manual override.
   b. Skip-Sequential-Hold Switch: One for each camera, with LED to indicate active camera.
   c. Camera Identification Legend: Either on-screen message or label at skip-sequential switch.
   d. Alarm Switching: In the event of an alarm, alarming channel shall automatically switch the monitor to full screen.
   e. Mounting: Standard 19-inch (483-mm) rack complying with CEA 310-E.
4. PTZ Controls: Arranged for multiple-camera control, with switches to select camera to be controlled.
   a. Pan-and-Tilt Control: Joystick type.
   b. Zoom Control: Momentary-contact, "in-out" push button.
   c. Automatic-Scan Control: A push button for each camera with pan capability that places camera in automatic-scanning mode.

N. IP Video Systems
1. Description:
   a. System shall provide high-quality delivery and processing of IP-based video, audio, and control data using standard Ethernet-based networks.
   b. System shall have seamless integration of all video surveillance and control functions.

c. Graphical user interface software shall manage all IP-based video matrix switching and camera control functions, two-way audio communication, alarm monitoring and control, and recording and archive/retrieval management. IP system shall also be capable of integrating into larger system environments.
d. System design shall include all necessary compression software for high-performance, dual-stream, MPEG-2/MPEG-4 video. Unit shall provide connections for all video cameras, camera PTZ control data, bidirectional audio, discreet sensor inputs, and control system outputs.
e. All camera signals shall be compressed, encoded, and delivered onto the network for processing and control by the IP video-management software.
f. Camera system units shall be ruggedly built and designed for extreme adverse environments, complying with NEMA Type environmental standards.
g. Encoder/decoder combinations shall place video, audio, and data network stream that can be managed from multiple workstations on the user's LAN or WAN.
h. All system interconnect cables, workstation PCs, PTZ joysticks, and network intermediate devices shall be provided for full performance of specified system.

O. Video Motion Sensors (Interior)
1. Device Performance: Detect changes in video signal within a user-defined protected zone. Video inputs shall be composite video as defined in SMPTE 170M. Provide an alarm output for each video input.
a. Detect movement within protected zone of intruders wearing clothing with a reflectivity that differs from that of background scene by a factor of two. Reject all other changes in video signal.
b. Modular design that allows for expansion or modification of number of inputs.
c. Controls:
1) Size of detection zones.
2) Sensitivity of detection of each protected zone.
d. Mounting: Standard 19-inch (483-mm) rack complying with CEA 310-E.

P. Control Stations
1. Description: Heavy-duty, freestanding, modular, metal furniture units arranged to house electronic equipment. Coordinate component arrangement and wiring with components and wiring of other systems.
2. Equipment Mounting: Standard 19-inch (483-mm) rack complying with CEA 310-E.
3. Normal System Power Supply: 120 V, 60 Hz, through a locked disconnect device and an isolation transformer in central-station control unit. Central-station control unit shall supply power to all components connected to it unless otherwise indicated.
4. Power Continuity for Control Station: Batteries in power supplies of central-station control units and individual system components shall maintain continuous system operation during outages of both normal and backup ac system supply.
a. Batteries: Rechargeable, valve-regulated, recombinant, sealed, lead-acid type with nominal 10-year life expectancy. Capacity adequate to operate portions of system served including audible trouble signal devices for up to four hours and audible and visual alarm devices under alarm conditions for an additional 10 minutes.
b. Battery Charger: Solid-state, fully automatic, variable-charging-rate type. Charger shall recharge fully discharged battery within 24 hours.
5. Annunciation: Indicate change in system condition and switching of system or component to backup power.

Q. Signal Transmission Components
1. Cable: Coaxial cable elements have 75-ohm nominal impedance. Comply with requirements in Division 16 Section "Conductors and Cables for Electronic Safety and Security."
2. Video Surveillance Coaxial Cable Connectors: BNC type, 75 ohms. Comply with requirements in Division 16 Section "Conductors and Cables for Electronic Safety and Security."

1.3 EXECUTION

A. Examination
1. Examine pathway elements intended for cables. Check raceways and other elements for compliance with space allocations, installation tolerance, hazards to camera installation, and other conditions affecting installation.
2. Examine roughing-in for LAN, WAN, and IP network before device installation.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Wiring
1. Comply with requirements in Division 16 Section "Raceways and Boxes."
OR
Wiring Method: Install cables in raceways unless otherwise indicated.
a. Except raceways are not required in accessible indoor ceiling spaces and attics.
OR
Except raceways are not required in hollow gypsum board partitions.
b. Conceal raceways and wiring except in unfinished spaces.
2. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
3. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. 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-486B.
4. For LAN connection and fiber-optic and copper communication wiring, comply with Division 16 Sections "Communications Backbone Cabling" and "Communications Horizontal Cabling."
5. Grounding: Provide independent-signal circuit grounding recommended in writing by manufacturer.

C. Video Surveillance System Installation
1. Install cameras and infrared illuminators level and plumb.
2. Install cameras with 84-inch- (2134-mm-) minimum clear space below cameras and their mountings. Change type of mounting to achieve required clearance.
3. Set pan unit and pan-and-tilt unit stops to suit final camera position and to obtain the field of view required for camera. Connect all controls and alarms, and adjust.
4. Install power supplies and other auxiliary components at control stations unless otherwise indicated.
5. Install tamper switches on components indicated to receive tamper switches, arranged to detect unauthorized entry into system-component enclosures and mounted in self-protected, inconspicuous positions.
6. Avoid ground loops by making ground connections only at the control station.
a. For 12- and 24-V dc cameras, connect the coaxial cable shields only at the monitor end.
7. Identify system components, wiring, cabling, and terminals according to Division 16 Section "Electrical Identification."

D. Field Quality Control
1. Perform tests and inspections.
2. Tests and Inspections:
a. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.
b. Pretesting: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Conduct tests at varying lighting levels, including day and night scenes as applicable. Prepare video-surveillance equipment for acceptance and operational testing as follows:
1) Prepare equipment list described in "Submittals" Article.

2) Verify operation of auto-iris lenses.
3) Set back-focus of fixed focal length lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Adjust until image is in focus with and without the filter.
4) Set back-focus of zoom lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Additionally, set zoom to full wide angle and aim camera at an object 50 to 75 feet (17 to 23 m) away. Adjust until image is in focus from full wide angle to full telephoto, with the filter in place.
5) Set and name all preset positions; consult Owner's personnel.
6) Set sensitivity of motion detection.
7) Connect and verify responses to alarms.
8) Verify operation of control-station equipment.

c. Test Schedule: Schedule tests after pretesting has been successfully completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.

d. Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.

3. Video surveillance system will be considered defective if it does not pass tests and inspections.
4. Prepare test and inspection reports.

E. Adjusting

1. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Tasks shall include, but are not limited to, the following:
   a. Check cable connections.
   b. Check proper operation of cameras and lenses. Verify operation of auto-iris lenses and adjust back-focus as needed.
   c. Adjust all preset positions; consult Owner's personnel.
   d. Recommend changes to cameras, lenses, and associated equipment to improve Owner's use of video surveillance system.
   e. Provide a written report of adjustments and recommendations.

F. Cleaning

1. Clean installed items using methods and materials recommended in writing by manufacturer.
2. Clean video-surveillance-system components, including camera-housing windows, lenses, and monitor screens.

G. Demonstration

1. Train Owner's maintenance personnel to adjust, operate, and maintain video-surveillance equipment.

END OF SECTION 13740

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Task	Specification	Specification Description
13740	13700	Security Access
13743	13700	Security Access
13743	13740	Video Surveillance

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SECTION 13810 - CLOCK AND PROGRAM CONTROL

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for clock and program control. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section Includes:
2. Master clock and program control unit.
3. Secondary indicating clocks.
4. Program signal devices.
5. Clock circuit power boosters.
6. Interface with intercom and public-address system.
7. System wire and cable.

C. Definitions
1. NIST: The National Institute of Science and Technology.
2. PC: Personal computer.
3. UTC: Universal time coordinated. The precisely measured time at zero degrees longitude; a worldwide standard for time synchronization.

D. Performance Requirements
1. Seismic Performance: Master clock and housing shall withstand the effects of earthquake motions determined according to ASCE/SEI 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."

E. Submittals
1. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes (including available colors) for each product indicated and describe features and operating sequences, both automatic and manual.
2. Shop Drawings: For clock systems. Include plans, elevations, sections, details, and attachments to other work.
   a. Wiring Diagrams: For power, signal, and control wiring and correction circuits.
      1) Identify terminals and wiring color codes to facilitate installation, operation, and maintenance.
      2) Indicate recommended wire types and sizes, and circuiting arrangements for field-installed system wiring. Show protection from overcurrent, static discharge, and voltage surge.
   b. Details of seismic restraints including mounting, anchoring, and fastening devices for the following system components:
      1) Surface-mounted and semirecessed secondary indicating clocks.
      2) Master clock enclosures **OR** mounting racks, **as directed**.
      3) Clock circuit power boosters.
   c. Details of seismic strengthening of master clock enclosures **OR** mounting racks, **as directed**.

d. Dimensioned Outline Drawings of the Mounting Rack for the Master Clock: Show internal seismic bracing, and locate center of gravity of fully equipped and assembled unit. Locate and describe mounting and anchorage provisions.

3. Delegated-Design Submittal: For the master clock and housing indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   a. Detail fabrication and assembly of the master clock and housing.
   b. Design Calculations: Calculate requirements for selecting seismic restraints.
4. Seismic Qualification Certificates: For the master clock, accessories, and components, from manufacturer.
5. Field quality-control reports.
6. Operation and maintenance data.

F. Quality Assurance
1. 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.
2. Comply with NFPA 70.

1.2 PRODUCTS

A. Master And Secondary Clock System
1. System Functions and Features:
   a. Supply power to remote indicating clocks except those indicated to have correction signals applied through a data circuit.
   b. Maintain correct synchronized time and transmit time-correction signals over dedicated system wiring from a master clock to any one **OR** two, **as directed**, type(s) of secondary indicating clocks, including the following:
      1) Analog Synchronous Clocks: Correct for minute- and second-hand synchronization at least once each hour and for hour-hand synchronization at least once each day.
      2) Digital Clocks: Test clocks automatically for synchronization with master time control at least once every hour and automatically correct those not synchronized with the time reference unit. Automatically correct clocks immediately when power is restored after an outage of power to the master clock.
   c. Initiate and execute programs for scheduled automatic operation of remote devices. Include audible signal devices and visual signal devices, **as directed**, and on and off switching of equipment and circuits, **as directed**.
   d. Provide for manual control of programmed signal and equipment-switching circuits.
   e. Communicate with remote PC for access to UTC time base and to permit programming from remote location, **as directed**.
   f. Maintain system access security with a minimum of one level **OR** two levels **OR** three levels, **as directed**, of user-access control to restrict use of system controls to authorized personnel. Levels of access apply to both local access and access from a remote computer, **as directed**. Access to user programming and control functions is accomplished by entering a minimum three-digit code. Access levels include the following:
      1) Access to review existing programs only.
      2) Access to normal system operating controls.
      3) Access to all user-programming and control functions.
   g. Regulate system timing functions using power-line frequency, backed up for power outages by an internal battery-powered, crystal-controlled oscillator.
      OR
      Regulate system timing functions using power-line frequency, backed up for power outages by an internal battery-powered, crystal-controlled oscillator, and automated periodic reference to NIST or UTC time signals via internal telephone modem and automatic dialup connection **OR** internal modem and network or microcomputer Internet

access **OR** dedicated internal radio receiver tuned to NIST time signal broadcasts, **as directed**. Reference time signals shall be automatically accessed at programmable intervals.

h. Provide for programming multiple independent event schedules into memory and running them simultaneously for different output circuits.
   1) Quantity of Programmable Schedules: Three **OR** Four **OR** Eight **OR** 18 **OR** 250, **as directed**, minimum.
   2) Number of Weekly Events That Can Be Programmed for Each Schedule: 64 **OR** 128 **OR** 300 **OR** 600 **OR** 2500, **as directed**, minimum.
   3) Simultaneous operation of independent schedules shall be limited only by the number of signal-device and equipment-switching output circuits.
   4) Advance Programming for Automatic Holiday Schedule Changes: Number of schedule changes that can be programmed to suit holidays and vacations shall be 10 **OR** 16 **OR** 50 **OR** 100, **as directed**, and each change may be programmed up to a year in advance to occur on any day of the calendar year.

i. Automatically check functioning of LEDs, switches, input keys, central processor, read-only memory, random access memory, and output circuits. A display on the control panel or a remote computer with the proper access code, **as directed**, shall indicate failure by identifying faulty component or circuit and shall recommend corrective action.

j. Provide manually initiated **OR** programming for automatic, **as directed**, daylight savings time correction.

k. Provide for adjustments to master clock output signals. Duration of momentary signal shall be individually programmable for each signal and equipment-control output circuit from 1 to 99 seconds. Signals shall be programmable for either on or off switching to suit equipment-operation scheduling.

B. Master Clock
   1. Description: Microprocessor-based, software-controlled unit complying with Class A device requirements in 47 CFR 15.
      a. Programming and control switches.
      b. Informational Display: LED or backlit LCD type.
         1) Normally shows current time, date, and day of week, **as directed**, display.
         2) Provides programming cues when system is being programmed.
      c. Output Circuits for Power and Correction of Secondary Indicating Clocks:
         1) Wired Synchronous Clock Power-and-Correction Circuits: For analog and digital, **as directed**, clocks; a minimum of one **OR** two, **as directed**, required. Relay controlled.
            OR
            Wired Synchronous Digital Clock Power-and-Correction Circuits: One, **as directed**, required.
         2) Existing Clock Power-and-Correction Circuit: An output circuit suitable for the of existing power-and-correction circuit and number of clocks to be connected.
      d. Data Output Port for Digital, **as directed**, Secondary Clock Correction Circuit: RS485 or similar circuit for scheduled periodic correction signals.
      e. Modem and PC interface software suitable for remote programming and automatic NIST or UTC synchronization, **as directed**.
      f. Circuits for Audible and Visual, **as directed**, Signal Devices: Relay controlled, manually switchable, using controls on the master clock. Rated 120-V ac, five **OR** 10, **as directed,** A minimum. A minimum of two **OR** four **OR** six **OR** eight, **as directed**, circuits.
      g. Circuits for Programmable Switching of Remote Equipment and Circuits: Relay controlled, manually switchable, using controls on the master clock. Rated 120-V ac, 5 **OR** 10, **as directed**, A minimum. A minimum of two **OR** four **OR** six **OR** eight, **as directed**, circuits.
      h. Power Supplies: Capacity for internal loads and power-and correction circuits of connected clocks.

i. Enclosure: Metal cabinet with locking front panel. When cabinet is locked, display indication shall be visible on or through front panel face. Arrange cabinet for surface, semirecessed, or flush mounting as indicated.
OR
Housing: Rack-mounting metal enclosure with display indication visible on front panel face.
1) Reinforce mounting and attachment capable of resisting seismic forces described in Division 16 Section "Vibration And Seismic Controls For Electrical Systems".

j. Battery Backup for Time Base: Lithium battery to maintain the timekeeping function and retain the programs in memory during outage of normal ac power supply for up to 10 years.

k. Electrostatic Discharge Resistance: Master clock and secondary indicating clocks, **as directed**, shall be tested and certified according to IEC 61000-4-2 in both human-discharge and direct-injection modes.

C. Secondary Indicating Clocks

1. Analog Clock: Equipped with a sweep second hand. Movement shall be driven by self-starting, permanently lubricated, sealed synchronous motor equipped with a correcting solenoid actuator, or be a microprocessor-based, second impulse unit, compatible with the master clock.

2. Digital Clock: Microprocessor-controlled unit complying with Class A device requirements in 47 CFR 15, with red LED digital time display of hours and minutes **OR**, minutes, and seconds, **as directed**.

a. Display Height: 2-1/2-Inch (64-mm) Clock: Hour and minute numerals readable at 50 feet (15 m).
OR
Display Height: 4-Inch (102-mm) Clock: Hour and minute numerals readable at 100 feet (30 m).

b. Display Format: Selectable between 12-hour with "PM" LED display and 24-hour formats.

c. Connections for Power and Correction:

1) Wired synchronous connection to the master clock for both operating power and correction.

a) Time-Base Backup: Internal alkaline battery shall back up internal time base to maintain timekeeping during power outages of up to six days' duration.
OR
Time-Base Backup: Internal capacitor shall back up internal time base to maintain timekeeping during power outages of up to 12 hours' duration.

b) Correction by RS485, Ethernet, or similar data line with operating power supplied over a separate connection.

c) Power Connection for Secondary Indicating Clocks: Plug connector **OR** Wire pigtail or compression splice, **as directed**.

3. Interval-Timer Clock: Digital microprocessor-controlled, 4-inch (102-mm) unit with 2-1/2-inch (64-mm), red LED digital display for hours and minutes and 1-5/16-inch (33-mm) display for seconds; a separately mounted, mode-control switch; and the following features:

a. Display Visibility: Hour and minute numerals readable at 30 feet (10 m) in normal ambient light.

b. Operating Modes:

1) Normal: Clock operates as a regular secondary system clock, displaying corrected time in normal display configuration, selectable between 12- and 24-hour formats, with "PM" digital display for 12-hour format.

2) Count-Down or Count-Up Timer: Selected by mode-control switch count-up and count-down positions, and capable of being preset at the mode-control station.

3) Code Blue: Automatically selected by a signal through a wiring connection from the code-blue system. This signal captures control of the clock regardless of current mode or correction status and instantly initiates count-up operation, starting at time 00:00:00. While in this mode, other clock functions, including correction, shall run in

the background. Clock shall revert to normal operating mode when the initiating-signal system is reset.

c. Mode-Selector Switch: Push-button or rotary, multiposition type, flush mounted; with start, stop, and reset capability in both count-up and count-down modes.

d. Audible tone signal: Housed in clock or mode-selector-switch box. Sounds at end of preset up or down count.

4. Provision for Modular Panel Installation: Equip designated clock for panel mounting. Mount flush or semirecessed with arrangement and trim as indicated. Coordinate wiring with other modular panel components, including room lighting switches **OR** intercom devices **OR** convenience outlets **OR** data outlets **OR** speaker **OR** other similar devices, **as directed**.

5. Provision for Time-Tone-Unit Installation: Equip indicated clocks for housing or mounting in an acoustically treated and baffled speaker compartment specified in Division 16 Section "Public Address And Mass Notification Systems".

D. Secondary Indicating Clock Characteristics:

a. Clock Type: Analog **OR** Digital, **as directed**.

b. Face Configuration: Single **OR** Double, **as directed**.

c. Mounting: Recessed **OR** Semirecessed **OR** Pendant **OR** Surface **OR** Suspended **OR** Within time-tone unit **OR** Within modular panel, **as directed**.

d. Nominal Dimensions: as directed by the Owner.

e. Casing Finish: Types and colors, as directed by the Owner.

f. Special Environmental Conditions: Describe conditions such as corrosive, damp, or wet locations, as directed by the Owner.

g. For analog clocks.

1) Dial Face Color: as directed by the Owner.

2) Analog Clock Crystal: Clear glass **OR** acrylic **OR** polycarbonate, **as directed**.

h. For digital clocks.

1) Face Color: as directed by the Owner.

2) Display Height: as directed by the Owner.

3) Seconds Display: Yes **OR** No, **as directed**.

4) Digital Clock Lens: Antiglare acrylic material.

5) Battery Backup: Yes **OR** No, **as directed**.

6) Interval-Timer Display: Yes **OR** No, **as directed**.

E. Program Signal Devices

1. Bells: Heavy-duty, modular, vibrating type with the following sound-output ratings measured at 10 feet (3 m):

a. 4-Inch (100-mm) Bell: 90 dB.

b. 6-Inch (150-mm) Bell: 95 dB.

c. 10-Inch (250-mm) Bell: 104 dB.

2. Chimes: Heavy-duty, modular, vibrating chimes with polished-chrome tone bar and enamel-finished housing. Minimum sound-output rating measured at 10 feet (3 m) shall be 75 dB.

3. Clock Buzzers: Adjustable output signal device designed for mounting within clock housing or outlet box.

a. Sound-Output Rating Measured at 3 Feet (1 m): 75 dB.

b. Audible Tone Frequency: Manufacturer's standard between 120 Hz and 2 kHz.

4. Horns: Modular, adjustable-output, vibrating type with minimum full-intensity-rated sound output of 103 dB measured at 10 feet (3 m).

5. Projector Horns: Adjustable-output, vibrating type with single **OR** double, **as directed**, projector arranged to channel sound in the direction of the projector axis, and with minimum full-intensity-rated sound output of 104 dB measured at 10 feet (3 m).

6. Loudspeakers for Audible Tones: See Division 16 Section "Public Address And Mass Notification Systems".

7. Visible Signal Devices: Strobe lights with blue **OR** yellow, **as directed**, polycarbonate lens and xenon flash tube, with lens mounted on an aluminum faceplate and the word "Program" engraved

in letters at least 1 inch (25 mm) high on lens. Lamp unit shall have a minimum rated light output of 75 candela.

8. Combination Audible and Visible Signal Devices: Factory-integrated horn and strobe light in a single mounting assembly.
9. Outdoor Signal Equipment: Weatherproof models listed for outdoor use.
10. Mounting Arrangement for Signal Devices: Designed for attachment with screws on the mounting plate of a flush-mounted back box unless otherwise indicated.
11. Enclosures for Flush-Mounting Bells and Horns: Enclosure, mounting plate, and grille assembly shall be furnished by device manufacturer to match features of the device to be mounted. Enclosure shall be recessed in wall, completely enclosing the device, with grille mounting over the open side of the enclosure and flush with the wall.
12. Connection Provision for Signal-Indicating Devices: Plug connector **OR** Wire pigtail or compression splice, **as directed**.

F. Clock Circuit Power Booster
1. Description: Transformer power supply, mounted in steel cabinet with hinged door, and having fuse-protected input and output circuits.

G. Back Boxes For Secondary Indicating Clocks And Program Devices
1. Description: Box and cover-plate assembly shall be furnished by device manufacturer and be suitable for device to be mounted. Back boxes shall be equipped with knockouts and hanger straps or mounting adapters arranged for flush mounting the device unless otherwise indicated.

H. Guards
1. Description: Formed-steel wire, shaped to fit around guarded device, with 1-inch (25-mm) maximum clearance.
   a. Mounting Provisions: Fixed tabs, welded to guard and arranged for screw attachment to mounting surface.
   b. Finish for Indoor Devices: Clear epoxy lacquer over zinc plating.
   c. Finish for Outdoor Devices: Black powder coat over zinc plating and primer.

I. Rack-Mounting Provision For Master Clock
1. Equipment Cabinet: Floor **OR** Wall, **as directed**,-mounted, rack type. Comply with EIA-310-D and the following:
   a. Cabinet Housing: Constructed of steel, with front and rear, **as directed**, doors; with manufacturer's standard tumbler locks, keyed alike.
      1) Front door shall have a clear panel in front of the master clock display.
      2) Housing shall enclose master clock and auxiliary clock system components, plus a minimum of 20 percent spare capacity for future equipment.
   b. Forced Ventilation: Internal low-noise fan with a filtered intake vent, connected to operate from 105- to 130-V ac, 60 Hz; separately fused and switchable and arranged to be powered when main cabinet power switch is on.
      OR
      Natural Ventilation: Ventilated rear and sides with louvers and solid top.
   c. For freestanding, floor-mounting cabinet, arrange inputs, outputs, interconnections, and test points so they are accessible at rear of rack for maintenance and testing, with each item removable from rack without disturbing other items or connections.
   d. Blank Panels: Cover empty space in equipment racks so entire front of rack is occupied by equipment or panels.
   e. Finish: Uniform, baked-enamel, manufacturer's standard color finish over rust-inhibiting primer.
   f. Power-Control Panel: On front of equipment housing; with master power on-off switch and pilot light, and socket for a 5-A, indicating, cartridge fuse for rack equipment power.
   g. Vertical Plug Strip: Grounded receptacles, 12 inches (300 mm) o.c. the full height of rack, to supply rack-mounting equipment.

h. Maintenance Receptacles: Duplex convenience outlet with supply terminals separate from equipment plug strip and located in front of rack.

J. Conductors And Cables
1. Conductors: Jacketed, twisted pair and twisted multipair, untinned solid copper. Sizes as recommended by system manufacturer, but not smaller than No. 22 AWG. Voltage drop for signal, control, and clock correction circuits shall not exceed 10 percent under peak load conditions. Comply with requirements in Division 16 Section "Communications Horizontal Cabling".
2. 120-V AC and Class 1 Signal and Control Circuits: Stranded, single conductors of size and type recommended by system manufacturer. Materials and installation requirements are specified in Division 16 Section "Conductors And Cables".
3. Class 2 and Class 3 Signal and Control Circuits: Single conductor or twisted-pair cable, unshielded, unless manufacturer recommends shielded cable.
4. Data Circuits: Category 6 minimum, unshielded, twisted-pair cable, unless manufacturer recommends shielded cable.
5. Insulation: Thermoplastic, not less than 1/32 inch (0.8 mm) thick.
6. Plenum Cable: Listed and labeled for plenum installation.
7. Conductor Color-Coding: Uniformly identified and coordinated with wiring diagrams.
8. Shielding: For speaker-microphone leads and at other locations recommended by manufacturer; No. 34 AWG tinned, soft-copper strands formed into a braid or equivalent foil.
   a. Minimum Shielding Coverage on Conductors: 60 percent.

K. Pathways
1. Intercommunication and Program System Raceways and Boxes: Comply with requirements in Division 16 Section "Raceways And Boxes".
   OR
   Intercommunication and Program System Raceways and Boxes: Same as required for electrical branch circuits specified in Division 16 Section "Raceways And Boxes".
   OR
   Intercommunication and Program System Raceways and Boxes: Optical fiber/communications raceway and fittings **OR** Metal wireways **OR** Nonmetal wireways **OR** Surface metal raceways **OR** Surface nonmetal raceways, **as directed**.
2. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.
3. Flexible metal conduit is prohibited.

1.3 EXECUTION

A. Installation
1. Mount system components with fastening methods and devices designed to resist the seismic forces indicated in Division 16 Section "Vibration And Seismic Controls For Electrical Systems".

B. Wiring Methods
1. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
   a. Install plenum cable in environmental air spaces, including plenum ceilings.
   b. Comply with requirements for raceways and boxes specified in Division 16 Section "Raceways And Boxes".
   OR
   Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

2. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
3. Support cables not enclosed in raceways on J-Hooks. Install, size, and space J-Hooks to comply with TIA/EIA-568-B.

C. Electrical Connections
1. Make splices, taps, and terminations on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
2. Use plug connectors **OR** splices, **as directed**, for connections to clocks and signal devices.
3. Ground clocks, programming equipment, and conductor and cable shields to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

D. Identification
1. Comply with Division 16 Section "Electrical Identification".
2. Color-code wires, and apply wire and cable marking tape to designate wires and cables so they are uniformly identified and coordinated with wiring diagrams throughout the system.

E. Field Quality Control
1. Perform tests and inspections.
   a. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
2. Tests and Inspections:
   a. Perform operational-system tests to verify compliance with the Specifications and make adjustments to bring system into compliance. Include operation of all modes of clock correction and all programming and manually programmed signal and relay operating functions.
   b. Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.
3. Clock system will be considered defective if it does not pass tests and inspections.
4. Prepare test and inspection reports.

F. Adjusting
1. Program system according to Owner's requirements. Set system so signal devices operate on Owner-required schedules and are activated for durations selected by Owner. Program equipment-control output circuits to suit Owner's operating schedule for equipment controlled.
2. Adjust sound-output level of adjustable signal devices to suit Owner's requirements.
3. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

G. Demonstration
1. Train Owner's maintenance personnel to adjust, operate, and maintain clock-and-program-control system components.

END OF SECTION 13810

SECTION 13852 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for digital, addressable fire alarm system. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section Includes:
a. Fire-alarm control unit.
b. Manual fire-alarm boxes.
c. System smoke detectors.
d. Nonsystem smoke detectors.
e. Heat detectors.
f. Notification appliances.
g. Firefighters' two-way telephone communication service.
h. Magnetic door holders.
i. Remote annunciator.
j. Addressable interface device.
k. Digital alarm communicator transmitter.
l. Radio alarm transmitter.
m. System printer.

C. Definitions
1. LED: Light-emitting diode.
2. NICET: National Institute for Certification in Engineering Technologies.

D. System Description
1. Noncoded, UL-certified **OR** FMG-placarded, **as directed**, addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.
2. Noncoded addressable system, with automatic sensitivity control of certain smoke detectors and multiplexed signal transmission, dedicated to fire-alarm service only.

E. Performance Requirements
1. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
a. 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," **as directed.**

F. Submittals
1. General Submittal Requirements:
a. Submittals shall be approved by authorities having jurisdiction prior to submitting them to the Owner.
b. Shop Drawings shall be prepared by persons with the following qualifications:
1) Trained and certified by manufacturer in fire-alarm system design.
2) NICET-certified fire-alarm technician, Level III **OR** Level IV, **as directed**, minimum.
3) Licensed or certified by authorities having jurisdiction.
2. Product Data: For each type of product indicated.
3. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.

a. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
b. Include voltage drop calculations for notification appliance circuits.
c. Include battery-size calculations.
d. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
e. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
f. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
g. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

4. Delegated-Design Submittal: For smoke and heat detectors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   a. Drawings showing the location of each smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the detector.
   b. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72.
5. Qualification Data: For qualified Installer.
6. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.
   a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   b. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   c. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
7. Field quality-control reports.
8. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. Deliver copies to authorities having jurisdiction and include the following:
   a. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
   b. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
   c. Record copy of site-specific software.
   d. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
      1) Frequency of testing of installed components.
      2) Frequency of inspection of installed components.
      3) Requirements and recommendations related to results of maintenance.
      4) Manufacturer's user training manuals.
   e. Manufacturer's required maintenance related to system warranty requirements.
   f. Abbreviated operating instructions for mounting at fire-alarm control unit.
   g. Copy of NFPA 25.
9. Software and Firmware Operational Documentation:
   a. Software operating and upgrade manuals.
   b. Program Software Backup: On magnetic media or compact disk, complete with data files.
   c. Device address list.
   d. Printout of software application and graphic screens.

G. Quality Assurance
1. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
2. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II **OR** Level III **OR** Level IV, **as directed**, technician.
3. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.
4. 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.
5. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL.
6. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.
7. NFPA Certification: Obtain certification according to NFPA 72 in the form of a placard by an FMG-approved alarm company.
8. NFPA Certification: Obtain certification according to NFPA 72 by agency having jurisdiction.

H. Project Conditions
1. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:
   a. Notify the Owner no fewer than two days in advance of proposed interruption of fire-alarm service.
   b. Do not proceed with interruption of fire-alarm service without the Owner written permission.

I. Sequencing And Scheduling
1. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.
2. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

J. Software Service Agreement
1. Comply with UL 864.
2. Technical Support: Beginning with Substantial Completion, provide software support for two years.
3. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
   a. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.2 PRODUCTS

A. Systems Operational Description
1. Fire-alarm signal initiation shall be by one or more of the following devices and systems, **as directed**:
   a. Manual stations.
   b. Heat detectors.
   c. Flame detectors.
   d. Smoke detectors.
   e. Duct smoke detectors.
   f. Verified automatic alarm operation of smoke detectors.
   g. Automatic sprinkler system water flow.

h. Heat detectors in elevator shaft and pit.
i. Fire-extinguishing system operation.
j. Fire standpipe system.

2. Fire-alarm signal shall initiate the following actions:
   a. Continuously operate alarm notification appliances.
   b. Identify alarm at fire-alarm control unit and remote annunciators, **as directed**.
   c. Transmit an alarm signal to the remote alarm receiving station.
   d. Unlock electric door locks in designated egress paths.
   e. Release fire and smoke doors held open by magnetic door holders.
   f. Activate voice/alarm communication system.
   g. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
   h. Activate smoke-control system (smoke management) at firefighter smoke-control system panel.
   i. Activate stairwell and elevator-shaft pressurization systems.
   j. Close smoke dampers in air ducts of designated air-conditioning duct systems.
   k. Recall elevators to primary or alternate recall floors.
   l. Activate emergency lighting control.
   m. Activate emergency shutoffs for gas and fuel supplies.
   n. Record events in the system memory.
   o. Record events by the system printer.
3. Supervisory signal initiation shall be by one or more of the following devices and actions:
   a. Valve supervisory switch.
   b. Low-air-pressure switch of a dry-pipe sprinkler system.
   c. Elevator shunt-trip supervision.
4. System trouble signal initiation shall be by one or more of the following devices and actions:
   a. Open circuits, shorts, and grounds in designated circuits.
   b. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
   c. Loss of primary power at fire-alarm control unit.
   d. Ground or a single break in fire-alarm control unit internal circuits.
   e. Abnormal ac voltage at fire-alarm control unit.
   f. Break in standby battery circuitry.
   g. Failure of battery charging.
   h. Abnormal position of any switch at fire-alarm control unit or annunciator.
   i. Fire-pump power failure, including a dead-phase or phase-reversal condition.
   j. Low-air-pressure switch operation on a dry-pipe or preaction sprinkler system.
5. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators, **as directed**. Record the event on system printer.

B. Fire-Alarm Control Unit
1. General Requirements for Fire-Alarm Control Unit:
   a. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.
      1) System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
      2) Include a real-time clock for time annotation of events on the event recorder and printer.
   b. Addressable initiation devices that communicate device identity and status.
      1) Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire-alarm control unit, **as directed**.
      2) Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
   c. Addressable control circuits for operation of mechanical equipment.

2. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
   a. Annunciator and Display: Liquid-crystal type, 1 **OR** 2 **OR** 3, **as directed**, line(s) of 40 **OR** 80, **as directed**, characters, minimum.
   b. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters, **as directed**.
3. Circuits:
   a. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class A.
      1) Initiating Device Circuits: Style D **OR** Style E, **as directed**.
      2) Notification Appliance Circuits: Style Z.
      3) Signaling Line Circuits: Style 2 **OR** Style 5 **OR** Style 6 **OR** Style 7, **as directed**.
      4) Install no more than 50 addressable devices on each signaling line circuit.
   b. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class B.
      1) Initiating Device Circuits: Style A **OR** Style B **OR** Style C, **as directed**.
      2) Notification Appliance Circuits: Style W **OR** Style X **OR** Style Y, **as directed**.
      3) Signaling Line Circuits: Style 0.5 **OR** Style 1 **OR** Style 3 **OR** Style 3.5 **OR** Style 4 **OR** Style 4.5, **as directed**.
      4) Install no more than 50 addressable devices on each signaling line circuit.
   c. Serial Interfaces: Two RS-232 ports for printers.
4. Stairwell Pressurization: Provide an output signal using an addressable relay to start the stairwell pressurization system. Signal shall remain on until alarm conditions are cleared and fire-alarm system is reset. Signal shall not stop in response to alarm acknowledge or signal silence commands.
   a. Pressurization starts when any alarm is received at fire-alarm control unit.
   b. Alarm signals from smoke detectors at pressurization air supplies have a higher priority than other alarm signals that start the system.
5. Smoke-Alarm Verification:
   a. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
   b. Activate an NRTL-listed and -approved "alarm-verification" sequence at fire-alarm control unit and detector.
   c. Record events by the system printer.
   d. Sound general alarm if the alarm is verified.
   e. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.
6. Notification Appliance Circuit: Operation shall sound in a <**Insert pattern**>.
7. Elevator Recall:
   a. Smoke detectors at the following locations shall initiate automatic elevator recall. Alarm-initiating devices, except those listed, shall not start elevator recall, **as directed**.
      1) Elevator lobby detectors except the lobby detector on the designated floor.
      2) Smoke detector in elevator machine room.
      3) Smoke detectors in elevator hoistway.
   b. Elevator lobby detectors located on the designated recall floors shall be programmed to move the cars to the alternate recall floor.
   c. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.
      1) Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.
8. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be **OR** not be, **as directed**, connected to fire-alarm system.
9. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-

adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

10. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
11. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided in a separate cabinet located in the fire command center **OR** as a special module that is part of fire-alarm control unit, **as directed**.
    a. Indicated number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711 and be listed by an NRTL.
        1) Allow the application of and evacuation signal to indicated number of zones and, at same time, allow voice paging to the other zones selectively or in any combination.
        2) Programmable tone and message sequence selection.
        3) Standard digitally recorded messages for "Evacuation" and "All Clear."
        4) Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification appliance circuits of fire-alarm control unit.
    b. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
    c. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.
12. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.
13. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals **OR** supervisory and digital alarm communicator transmitters **OR** digital alarm radio transmitters, **as directed**, shall be powered by 24-V dc source.
    a. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.
14. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
    a. Batteries: Sealed lead calcium **OR** Sealed, valve-regulated, recombinant lead acid **OR** Vented, wet-cell pocket, plate nickel cadmium, **as directed**.
15. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

C. Manual Fire-Alarm Boxes
1. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
    a. Single-action mechanism, breaking-glass or plastic-rod **OR** pull-lever, **as directed**, type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
    b. Double-action mechanism requiring two actions to initiate an alarm, breaking-glass or plastic-rod **OR** pull-lever, **as directed**, type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.

c. Station Reset: Key- or wrench-operated switch.
d. Indoor Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
e. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

D. System Smoke Detectors
1. General Requirements for System Smoke Detectors:
a. Comply with UL 268; operating at 24-V dc, nominal.
b. Detectors shall be four **OR** two, **as directed**,-wire type.
c. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
d. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
e. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
f. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status, **as directed**.
g. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
1) Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
2) Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
3) Provide multiple levels of detection sensitivity for each sensor.
2. Photoelectric Smoke Detectors:
a. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
b. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
1) Primary status.
2) Device type.
3) Present average value.
4) Present sensitivity selected.
5) Sensor range (normal, dirty, etc.).
3. Ionization Smoke Detector:
a. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
b. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
1) Primary status.
2) Device type.
3) Present average value.
4) Present sensitivity selected.
5) Sensor range (normal, dirty, etc.).
4. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
a. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
b. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
1) Primary status.
2) Device type.
3) Present average value.

4) Present sensitivity selected.
5) Sensor range (normal, dirty, etc.).

c. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
d. Each sensor shall have multiple levels of detection sensitivity.
e. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
f. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

E. Nonsystem Smoke Detectors
1. Single-Station Smoke Detectors:
a. Comply with UL 217; suitable for NFPA 101, residential occupancies; operating at 120-V ac with 9-V dc battery as the secondary power source. Provide with "low" or "missing" battery chirping-sound device, **as directed**.
b. Auxiliary Relays: One Form C rated at 0.5 A **OR** Form A and one Form C, both rated at 0.5 A, **as directed**.
c. Audible Notification Appliance: Piezoelectric sounder rated at 90 dBA at 10 feet (3 m) according to UL 464.
d. Visible Notification Appliance: 177-cd strobe.
e. Heat sensor, 135 deg F (57 deg C) combination rate-of-rise, **as directed**, and fixed temperature.
f. Test Switch: Push to test; simulates smoke at rated obscuration.
g. Tandem Connection: Allow tandem connection of number of indicated detectors; alarm on one detector shall actuate notification on all connected detectors.
h. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
i. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
j. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status, **as directed**.
2. Single-Station Duct Smoke Detectors:
a. Comply with UL 268A; operating at 120-V ac.
b. Sensor: LED or infrared light source with matching silicon-cell receiver.
1) Detector Sensitivity: Smoke obscuration between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) when tested according to UL 268A.
c. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. The fixed base shall be designed for mounting directly to air duct. Provide terminals in the fixed base for connection to building wiring.
1) Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
d. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
e. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

F. Heat Detectors
1. General Requirements for Heat Detectors: Comply with UL 521.
2. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.
a. Mounting: Adapter plate for outlet box mounting **OR** Twist-lock base interchangeable with smoke-detector bases, **as directed**.
b. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

3. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F (88 deg C).
   a. Mounting: Adapter plate for outlet box mounting **OR** Twist-lock base interchangeable with smoke-detector bases, **as directed**.
   b. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Continuous Linear Heat-Detector System:
   a. Detector Cable: Rated detection temperature 155 deg F (68 deg C). NRTL listed for "regular" service and a standard environment. Cable includes two steel actuator wires twisted together with spring pressure, wrapped with protective tape, and finished with PVC outer sheath. Each actuator wire is insulated with heat-sensitive material that reacts with heat to allow the cable twist pressure to short- circuit wires at the location of elevated temperature.
   b. Control Unit: Two-zone or multizone unit as indicated. Provide same system power supply, supervision, and alarm features as specified for fire-alarm control unit.
   c. Signals to Fire-Alarm Control Unit: Any type of local system trouble shall be reported to fire-alarm control unit as a composite "trouble" signal. Alarms on each detection zone shall be individually reported to central fire-alarm control unit as separately identified zones.
   d. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

G. Notification Appliances
1. General Requirements for Notification Appliances: Individually addressed, connected to a signaling line circuit, equipped for mounting as indicated and with screw terminals for system connections.
2. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.
   a. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.
3. Chimes, Low-Level Output: Vibrating type, 75-dBA minimum rated output.
4. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.
5. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.
6. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.
   a. Rated Light Output:
      1) 15 **OR** 30 **OR** 75 **OR** 110 **OR** 177, **as directed**, cd.
         OR
         15/30/75/110 cd, selectable in the field.
   b. Mounting: Wall mounted unless otherwise indicated.
   c. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
   d. Flashing shall be in a temporal pattern, synchronized with other units.
   e. Strobe Leads: Factory connected to screw terminals.
   f. Mounting Faceplate: Factory finished, red **OR** white, **as directed**.
7. Voice/Tone Notification Appliances:
   a. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.
   b. High-Range Units: Rated 2 to 15 W.
   c. Low-Range Units: Rated 1 to 2 W.
   d. Mounting: Flush **OR** Semirecessed **OR** Surface mounted and bidirectional, **as directed**.

e. Matching Transformers: Tap range matched to acoustical environment of speaker location.

H. Firefighters' Two-Way Telephone Communication Service
1. Dedicated, two-way, supervised, telephone voice communication links between fire-alarm control unit, the fire command center, **as directed**, and remote firefighters' telephone stations. Supervised telephone lines shall be connected to talk circuits by controls in a control module. Provide the following:
   a. Common-talk type for firefighter use only.
   b. Selective-talk type for use by firefighters and fire wardens.
   c. Controls to disconnect phones from talk circuits if too many phones are in use simultaneously.
   d. Audible Pulse and Tone Generator, and High-Intensity Lamp: When a remote telephone is activated, it causes audible signal to sound and high-intensity lamp to flash.
   e. Selector panel controls shall provide for simultaneous operation of up to six telephones in selected zones. Indicate ground faults and open or shorted telephone lines on the panel front by individual LEDs.
   f. Display: Graphic **OR** Liquid-crystal digital, **as directed**, to indicate location of caller.
   g. Remote Telephone Cabinet: Flush- or surface-mounted cabinet as indicated, factory-standard red finish, with handset.
      1) Install one-piece handset to cabinet with vandal-resistant armored cord. Silk-screened or engraved label on cabinet door, designating "Fire Warden Phone" **OR** "Fire Emergency Phone", **as directed.**
      2) With "break-glass" type door access lock.
   h. Remote Telephone Jack Stations: Single-gang, stainless-steel-plate mounted plug, engraved "Fire Warden Phone" **OR** "Fire Emergency Phone", **as directed.**
   i. Handsets: <**Insert number**> push-to-talk-type sets with noise-canceling microphone, **as directed**, stored in a cabinet adjacent to fire-alarm control unit **OR** in the fire command center, **as directed**.

I. Magnetic Door Holders
1. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
   a. Electromagnet: Requires no more than 3 W to develop 25-lbf (111-N) holding force.
   b. Wall-Mounted Units: Flush mounted unless otherwise indicated.
   c. Rating: 24-V ac or dc.
   d. Rating: 120-V ac.
2. Material and Finish: Match door hardware.

J. Remote Annunciator
1. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
   a. Mounting: Flush **OR** Surface, **as directed**, cabinet, NEMA 250, Type 1.
2. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

K. Addressable Interface Device
1. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.
2. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall **OR** to circuit-breaker shunt trip for power shutdown, **as directed**.

L. Digital Alarm Communicator Transmitter

1. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.
2. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture one **OR** two, **as directed**, telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either, **as directed**, line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.
3. Local functions and display at the digital alarm communicator transmitter shall include the following:
   a. Verification that both telephone lines are available.
   b. Programming device.
   c. LED display.
   d. Manual test report function and manual transmission clear indication.
   e. Communications failure with the central station or fire-alarm control unit.
4. Digital data transmission shall include the following:
   a. Address of the alarm-initiating device.
   b. Address **OR** Zone, **as directed**, of the supervisory signal.
   c. Address **OR** Zone, **as directed**, of the trouble-initiating device.
   d. Loss of ac supply or loss of power.
   e. Low battery.
   f. Abnormal test signal.
   g. Communication bus failure.
5. Secondary Power: Integral rechargeable battery and automatic charger.
6. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

M. Radio Alarm Transmitter
1. Transmitter shall comply with NFPA 1221 and shall be listed and labeled by an NRTL.
2. Comply with 47 CFR 90.
3. Description: Manufacturer's standard commercial product; factory assembled, wired, tested, and ready for installation and operation.
   a. Packaging: A single, modular, NEMA 250, Type 1 metal enclosure with a tamper-resistant flush tumbler lock.
   b. Signal Transmission Mode and Frequency: VHF or UHF 2-W power output, coordinated with operating characteristics of the established remote alarm receiving station designated by Owner.
   c. Normal Power Input: 120-V ac.
   d. Secondary Power: Integral-sealed, rechargeable, 12-V battery and charger. Comply with NFPA 72 requirements for battery capacity; submit calculations.
   e. Antenna: Omnidirectional, coaxial half-wave, dipole type with driving point impedance matched to transmitter and antenna cable output impedance. Wind-load strength of antenna and mounting hardware and supports shall withstand 100 mph (160 km/h), **as directed**, with a gust factor of 1.3 without failure.
   f. Antenna Cable: Coaxial cable with impedance matched to the transmitter output impedance.
   g. Antenna-Cable Connectors: Weatherproof.
   h. Alarm Interface Devices: Circuit boards, modules, and other auxiliary devices, integral to the transmitter, matching fire-alarm and other system outputs to message-generating inputs of the transmitter that produce required message transmissions.
4. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit or from its own internal sensors or controls and shall automatically transmit signal along with a unique code that identifies the transmitting station to the remote alarm receiving station. Transmitted messages shall correspond to standard designations for fire-

reporting system to which the signal is being transmitted and shall include separately designated messages in response to the following events or conditions:

a. Transmitter Low-Battery Condition: Sent when battery voltage is below 85 percent of rated value.
b. System Test Message: Initiated manually by a test switch within the transmitter cabinet, or automatically at an optionally preselected time, once every 24 hours, with transmission time controlled by a programmed timing device integral to transmitter controls.
c. Transmitter Trouble Message: Actuated by failure, in excess of one-minute duration, of the transmitter normal power source, derangement of the wiring of the transmitter, or any alarm input interface circuit or device connected to it.
d. Local Fire-Alarm-System Trouble Message: Initiated by events or conditions that cause a trouble signal to be indicated on the building system.
e. Local Fire-Alarm-System Alarm Message: Actuated when the building system goes into an alarm state. Identifies device that initiated the alarm.
f. Local Fire-Alarm-System Supervisory-Alarm Message: Actuated when the building alarm system indicates a supervisory alarm, **as directed**.

N. System Printer
1. Printer shall be listed and labeled by an NRTL as an integral part of fire-alarm system.

O. Device Guards
1. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
   a. Factory fabricated and furnished by manufacturer of device.
   b. Finish: Paint of color to match the protected device.

1.3 EXECUTION

A. Equipment Installation
1. Comply with NFPA 72 for installation of fire-alarm equipment.
2. Equipment Mounting: Install fire-alarm control unit on concrete base with tops of cabinets not more than 72 inches (1830 mm) above the finished floor. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-place Concrete".
   a. Install seismic bracing. Comply with requirements in Division 16 Section "Vibration And Seismic Controls For Electrical Systems".
   b. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
   c. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   d. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   e. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Equipment Mounting: Install fire-alarm control unit on finished floor with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.
   a. Comply with requirements for seismic-restraint devices specified in Division 16 Section "Vibration And Seismic Controls For Electrical Systems".
4. Install wall-mounted equipment, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.
   a. Comply with requirements for seismic-restraint devices specified in Division 16 Section "Vibration And Seismic Controls For Electrical Systems".
5. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
   a. Connect new equipment to existing control panel in existing part of the building.
   b. Connect new equipment to existing monitoring equipment at the supervising station.

c. Expand, modify, and supplement existing control **OR** monitoring, **as directed**, equipment as necessary to extend existing control **OR** monitoring, **as directed**, functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

6. Smoke- or Heat-Detector Spacing:
   a. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
   b. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
   c. Smooth ceiling spacing shall not exceed 30 feet (9 m)
   d. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A or Appendix B in NFPA 72.
   e. HVAC: Locate detectors not closer than 3 feet (1 m) **OR** 5 feet (1.5 m), **as directed**, from air-supply diffuser or return-air opening.
   f. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture.
7. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.
8. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.
9. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.
10. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
11. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
12. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling.
13. Device Location-Indicating Lights: Locate in public space near the device they monitor.
14. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.
15. Annunciator: Install with top of panel not more than 72 inches (1830 mm) above the finished floor.
16. Antenna for Radio Alarm Transmitter: Mount to building structure where indicated. Use mounting arrangement and substrate connection that will resist 100-mph (160-km/h), **as directed**, wind load with a gust factor of 1.3 without damage.

B. Connections
1. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "Door Hardware". Connect hardware and devices to fire-alarm system.
   a. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.
2. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet (1 m) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
   a. Alarm-initiating connection to smoke-control system (smoke management) at firefighter smoke-control system panel.
   b. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
   c. Smoke dampers in air ducts of designated air-conditioning duct systems.
   d. Alarm-initiating connection to elevator recall system and components.
   e. Alarm-initiating connection to activate emergency lighting control.
   f. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.

g. Supervisory connections at valve supervisory switches.
h. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
i. Supervisory connections at elevator shunt trip breaker.
j. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
k. Supervisory connections at fire-pump engine control panel.

C. Identification
1. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 16 Section "Electrical Identification".
2. Install framed instructions in a location visible from fire-alarm control unit.

D. Grounding
1. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

E. Field Quality Control
1. Field tests shall be witnessed by authorities having jurisdiction.
2. Tests and Inspections:
a. Visual Inspection: Conduct visual inspection prior to testing.
1) Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
2) Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
b. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
c. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
d. Test audible appliances for the private operating mode according to manufacturer's written instructions.
e. Test visible appliances for the public operating mode according to manufacturer's written instructions.
f. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
3. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
4. Fire-alarm system will be considered defective if it does not pass tests and inspections.
5. Prepare test and inspection reports.
6. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
7. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

END OF SECTION 13852

SECTION 13852a - ZONED (DC LOOP) FIRE-ALARM SYSTEM

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for zoned (DC loop) fire alarm system. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section Includes:
a. Fire-alarm control unit.
b. Manual fire-alarm boxes.
c. System smoke detectors.
d. Nonsystem smoke detectors.
e. Heat detectors.
f. Notification appliances.
g. Magnetic door holders.
h. Remote annunciator.
i. Digital alarm communicator transmitter.
j. Radio alarm transmitter.

C. Definitions
1. LED: Light-emitting diode.
2. NICET: National Institute for Certification in Engineering Technologies.

D. System Description
1. Noncoded system, dedicated to fire-alarm service only.

E. Submittals
1. General Submittal Requirements:
a. Submittals shall be approved by authorities having jurisdiction prior to submitting them to the Owner.
b. Shop Drawings shall be prepared by persons with the following qualifications:
1) Trained and certified by manufacturer in fire-alarm system design.
2) NICET-certified fire-alarm technician, Level III **OR** Level IV, **as directed**, minimum.
3) Licensed or certified by authorities having jurisdiction.
2. Product Data: For each type of product indicated.
3. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.
a. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
b. Include voltage drop calculations for notification appliance circuits.
c. Include battery size calculations.
d. Include performance parameters and installation details for each detector, verifying that each detector is listed for the complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
e. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.

f. Include floor plans to indicate final outlet locations showing zone designation of each device. Show size and route of cable and conduits.

4. Delegated-Design Submittal: For smoke and heat detectors indicated to comply with performance requirements and design criteria, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.
   a. Drawings showing the location of each smoke and heat detector, the ratings of each, and installation details as needed to comply with the listing conditions of the detector.
   b. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72.
5. Qualification Data: For qualified Installer.
6. Field quality-control reports.
7. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. Deliver copies to authorities having jurisdiction, **as directed**, and include the following:
   a. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
   b. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
   c. Record copy of site-specific software.
   d. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
      1) Frequency of testing of installed components.
      2) Frequency of inspection of installed components.
      3) Requirements and recommendations related to results of maintenance.
      4) Manufacturer's user training manuals.
   e. Manufacturer's required maintenance related to system warranty requirements.
   f. Abbreviated operating instructions for mounting at fire-alarm control unit.
   g. Copy of NFPA 25.

F. Quality Assurance
1. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
2. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II **OR** Level III **OR** Level IV, **as directed**, technician.
3. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.
4. 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.

G. Project Conditions
1. Interruption of Existing Fire-alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:
   a. Notify the Owner no fewer than two days in advance of proposed interruption of fire-alarm service.
   b. Do not proceed with interruption of fire-alarm service without the Owner 's written permission.

H. Sequencing And Scheduling
1. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.

2. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

1.2 PRODUCTS

A. Systems Operational Description
1. Fire-alarm signal initiation shall be by one or more of the following devices and systems, **as directed**:
   a. Manual stations.
   b. Heat detectors.
   c. Smoke detectors.
   d. Duct smoke detectors.
   e. Automatic sprinkler system water flow.
   f. Fire-extinguishing system operation.
   g. Fire standpipe system.
2. Fire-alarm signal shall initiate the following actions:
   a. Continuously operate alarm notification appliances.
   b. Identify alarm zone at fire-alarm control unit and remote annunciators, **as directed**.
   c. Transmit an alarm signal to the remote alarm receiving station.
3. Supervisory signal initiation shall be by one or more of the following devices and systems:
   a. Valve supervisory switch.
4. System trouble signal initiation shall be by one or more of the following devices and actions:
   a. Open circuits, shorts, and grounds in designated circuits.
   b. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
   c. Loss of primary power at fire-alarm control unit.
   d. Ground or a single break in fire-alarm control unit internal circuits.
   e. Abnormal ac voltage at fire-alarm control unit.
   f. Break in standby battery circuitry.
   g. Failure of battery charging.
   h. Abnormal position of any switch at fire-alarm control unit or annunciator, **as directed**.
5. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators, **as directed**.

B. Fire-Alarm Control Unit
1. General Requirements for Fire-Alarm Control Unit:
   a. Modular, power-limited design with electronic modules, UL 864 listed.
      1) Include a real-time clock for time annotation of events.
2. Alphanumeric Display and System Controls: Display alarm, supervisory, and component status messages and the programming and control menu.
   a. Annunciator and Display: Liquid-crystal type, one line of 40 **OR** 80, **as directed**, characters, minimum.
3. Circuits:
   a. No Fewer Than Five Initiating Device Circuits:
      1) Four circuits, NFPA 72, Class B.
      2) One circuit(s), NFPA 72, Class A, Style 6
   b. No Fewer Than Two Notification Appliance Circuits: NFPA 72, Class B, Style Y.
4. Notification Appliance Circuit: Operation shall sound in a <**Insert pattern**>.
5. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be **OR** not be, **as directed**, connected to fire-alarm system.
6. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
7. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals **OR**

supervisory and digital alarm communicator transmitters **OR** digital alarm radio transmitters, **as directed**, shall be powered by the 24-V dc source.

a. Alarm current draw of the entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

8. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
   a. Batteries: Sealed lead calcium **OR** Sealed, valve-regulated, recombinant lead acid **OR** Vented, wet-cell pocket, plate nickel cadmium, **as directed**.
9. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

C. Manual Fire-Alarm Boxes
1. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
   a. Single-action mechanism, breaking-glass or plastic-rod **OR** pull-lever, **as directed**, type.
   b. Double-action mechanism requiring two actions to initiate an alarm, breaking-glass or plastic-rod **OR** pull-lever, **as directed**, type.
   c. Station Reset: Key- or wrench-operated switch.
   d. Indoor Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
   e. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

D. System Smoke Detectors
1. General Requirements for System Smoke Detectors:
   a. Operating at 24-V dc, nominal.
   b. Detectors shall be four **OR** two, **as directed**,-wire type.
   c. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
   d. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
   e. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status, **as directed**.
   f. Provide multiple levels of detection sensitivity for each sensor, with alarm-verification feature, **as directed**.
2. Photoelectric Smoke Detectors: Comply with UL 268.
3. Ionization Smoke Detector: Comply with UL 268.
4. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
   a. Remote indication and test, **as directed**, station. Operating key switch initiates an alarm test, **as directed**.
   b. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
   c. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
   d. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

E. Nonsystem Smoke Detectors
1. Single-Station Smoke Detectors:

a. Comply with UL 217; suitable for NFPA 101, residential occupancies; operating at 120-V ac with 9-V dc battery as the secondary power source. Provide with "low" or "missing" battery chirping-sound device, **as directed**.
b. Auxiliary Relays: One Form C rated at 0.5 A **OR** Form A and one Form C, both rated at 0.5 A, **as directed**.
c. Audible Notification Appliance: Piezoelectric sounder rated at 90 dBA at 10 feet (3 m) according to UL 464.
d. Visible Notification Appliance: 177-cd strobe.
e. Heat sensor, 135 deg F (57 deg C) combination rate-of-rise and fixed temperature, **as directed**.
f. Test Switch: Push-to-test; simulates smoke at rated obscuration.
g. Tandem Connection: Allow tandem connection of number of indicated detectors; alarm on one detector shall actuate notification on all connected detectors.
h. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
i. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
j. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status, **as directed**.

2. Single-Station Duct Smoke Detectors:
   a. Comply with UL 268A; operating at 120-V ac.
   b. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. The fixed base shall be designed for mounting directly to air duct. Provide terminals in the fixed base for connection to building wiring.
      1) Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
   c. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
   d. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

F. Heat Detectors
1. General Requirements for Heat Detectors: Comply with UL 521.
2. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.
   a. Mounting: Adapter plate for outlet box mounting **OR** Twist-lock base interchangeable with smoke-detector bases, **as directed**.
3. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F (88 deg C).
   a. Mounting: Adapter plate for outlet box mounting **OR** Twist-lock base interchangeable with smoke-detector bases, **as directed**.

G. Notification Appliances
1. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.
   a. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.
2. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.
3. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.

4. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.
   a. Rated Light Output:
      1) Indicated on Drawings.
      2) 15 **OR** 30 **OR** 75 **OR** 110 **OR** 177, **as directed**, cd.
         OR
         15/30/75/110 cd, selectable in the field.
   b. Mounting: Indicated on Drawings **OR** Wall mounted, **as directed**.
   c. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
   d. Flashing shall be in a temporal pattern, synchronized with other units.
   e. Strobe Leads: Factory connected to screw terminals.
   f. Mounting Faceplate: Factory finished, red **OR** white, **as directed**.

H. Magnetic Door Holders
1. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
   a. Electromagnet: Requires no more than 3 W to develop 25-lbf (111-N) holding force.
   b. Wall-Mounted Units: Flush mounted unless otherwise indicated.
   c. Rating: 24-V ac or dc.
   d. Rating: 120-V ac.
2. Material and Finish: Match door hardware.

I. Remote Annunciator
1. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
   a. Mounting: Flush **OR** Surface, **as directed**, cabinet, NEMA 250, Type 1.
2. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

J. Digital Alarm Communicator Transmitter
1. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.
2. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture one **OR** two, **as directed**, telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either, **as directed**, line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.
3. Local functions and display at the digital alarm communicator transmitter shall include the following:
   a. Verification that both telephone lines are available.
   b. Programming device.
   c. LED display.
   d. Manual test report function and manual transmission clear indication.
   e. Communications failure with the central station or fire-alarm control unit.
4. Digital data transmission shall include the following:
   a. Zone of the alarm initiating device.
   b. Zone of the supervisory signal.
   c. Zone of the trouble initiating device.

d. Loss of ac supply or loss of power.
e. Low battery.
f. Abnormal test signal.
g. Communication bus failure.

5. Secondary Power: Integral rechargeable battery and automatic charger.
6. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

K. Radio Alarm Transmitter

1. Transmitter shall comply with NFPA 1221 and shall be listed and labeled by an NRTL.
2. Comply with 47 CFR 90.
3. Description: Manufacturer's standard commercial product; factory assembled, wired, tested, and ready for installation and operation.
   a. Packaging: A single, modular, NEMA 250, Type 1 metal enclosure with a tamper-resistant flush tumbler lock.
   b. Signal Transmission Mode and Frequency: VHF or UHF 2-W power output, coordinated with operating characteristics of the established remote alarm receiving station designated by Owner.
   c. Normal Power Input: 120-V ac.
   d. Secondary Power: Integral-sealed, rechargeable, 12-V battery and charger. Comply with NFPA 72 requirements for battery capacity; submit calculations.
   e. Antenna: Omnidirectional, coaxial half-wave, dipole type with driving point impedance matched to transmitter and antenna cable output impedance. Wind-load strength of antenna and mounting hardware and supports shall withstand 100 mph (160 km/h) with a gust factor of 1.3 without failure.
   f. Antenna Cable: Coaxial cable with impedance matched to the transmitter output impedance.
   g. Antenna-Cable Connectors: Weatherproof.
   h. Alarm Interface Devices: Circuit boards, modules, and other auxiliary devices, integral to the transmitter, matching fire-alarm and other system outputs to message-generating inputs of the transmitter that produce required message transmissions.
4. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit or from its own internal sensors or controls and shall automatically transmit signal along with a unique code that identifies the transmitting station to the remote alarm receiving station. Transmitted messages shall correspond to standard designations for fire-reporting system to which the signal is being transmitted and shall include separately designated messages in response to the following events or conditions:
   a. Transmitter Low-Battery Condition: Sent when battery voltage is below 85 percent of rated value.
   b. System Test Message: Initiated manually by a test switch within the transmitter cabinet, or automatically at an optionally preselected time, once every 24 hours, with transmission time controlled by a programmed timing device integral to transmitter controls.
   c. Transmitter Trouble Message: Actuated by failure, in excess of one-minute duration, of the transmitter normal power source, derangement of the wiring of the transmitter, or any alarm input interface circuit or device connected to it.
   d. Local Fire-Alarm-System Trouble Message: Initiated by events or conditions that cause a trouble signal to be indicated on the building system.
   e. Local Fire-Alarm-System Alarm Message: Actuated when the building system goes into an alarm state. Identifies device that initiated the alarm.
   f. Local Fire-Alarm-System Supervisory-Alarm Message: Actuated when the building alarm system indicates a supervisory alarm, **as directed**.

L. Device Guards

1. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
   a. Factory fabricated and furnished by manufacturer of the device.
   b. Finish: Paint of color to match the protected device.

1.3 EXECUTION

A. Equipment Installation
1. Comply with NFPA 72 for installation of fire-alarm equipment.
2. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
   a. Connect new equipment to the existing control panel in the existing part of the building.
   b. Connect new equipment to the existing monitoring equipment at the supervising station.
   c. Expand, modify, and supplement the existing control **OR** monitoring, **as directed**, equipment as necessary to extend the existing control **OR** monitoring, **as directed**, functions to the new points. New components shall be capable of merging with the existing configuration without degrading the performance of either system.
3. Smoke- or Heat-Detector Spacing:
   a. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
   b. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
   c. Smooth ceiling spacing shall not exceed 30 feet (9 m), **as directed**.
   d. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A or Appendix B, **as directed**, in NFPA 72.
   e. HVAC: Locate detectors not closer than 3 feet (1 m) **OR** 5 feet (1.5 m), **as directed**, from air-supply diffuser or return-air opening.
   f. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture.
4. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.
5. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.
6. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.
7. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
8. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
9. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling.
10. Device Location-Indicating Lights: Locate in public space near the device they monitor.
11. Fire-Alarm Control Unit: Surface mounting, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.
12. Annunciator: Install with top of panel not more than 72 inches (1830 mm) above the finished floor.
13. Antenna for Radio Alarm Transmitter: Mount to building structure where indicated. Use mounting arrangement and substrate connection that will resist 100-mph (160-km/h), **as directed**, wind load with a gust factor of 1.3 without damage.

B. Connections
1. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "Door Hardware". Connect hardware and devices to fire-alarm system.
   a. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.

2. Connect supervised interface devices to the following devices and systems. Install the interface device less than 3 feet (1 m) from the device controlled.
   a. Smoke dampers in air ducts of designated air-conditioning duct systems.
   b. Supervisory connections at valve supervisory switches.
   c. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
   d. Supervisory connections at fire-pump engine control panel.

C. Identification
1. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 16 Section "Electrical Identification".
2. Install framed instructions in a location visible from fire-alarm control unit.

D. Grounding
1. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

E. Field Quality Control
1. Field tests shall be witnessed by authorities having jurisdiction.
2. Tests and Inspections:
   a. Visual Inspection: Conduct the visual inspection prior to testing.
      1) Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
      2) Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
   b. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing, and Maintenance" Chapter in NFPA 72.
   c. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
   d. Test visible appliances for the public operating mode according to manufacturer's written instructions.
   e. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
3. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
4. Fire-alarm system will be considered defective if it does not pass tests and inspections.
5. Prepare test and inspection reports.
6. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
7. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with the visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

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SECTION 13920 - ELECTRIC-DRIVE, CENTRIFUGAL FIRE PUMPS

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for electric-drive, centrifugal fire pumps. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section Includes:
a. End-suction, In-line, and Split-case fire pumps.
b. Fire-pump accessories and specialties.
c. Flowmeter systems.

C. Performance Requirements
1. Seismic Performance: Fire pumps shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
a. 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."
2. Pump Equipment, Accessory, and Specialty Pressure Rating: 175 psig (1200 kPa) minimum unless higher pressure rating is indicated.

D. Submittals
1. Product Data: For each type of product indicated.
2. Shop Drawings: For fire pumps, motor drivers, and fire-pump accessories and specialties. Include plans, elevations, sections, details, and attachments to other work.
a. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
b. Wiring Diagrams: For power, signal, and control wiring.
3. Seismic Qualification Certificates: For fire pumps, accessories, and components, from manufacturer.
a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
b. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
c. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
4. Product Certificates: For each fire pump, from manufacturer.
5. Source quality-control reports.
6. Field quality-control reports.
7. Operation and maintenance data.

E. Quality Assurance
1. 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.
2. NFPA Compliance: Comply with NFPA 20, "Installation of Stationary Pumps for Fire Protection."

1.2 PRODUCTS

A. General Requirements For Centrifugal Fire Pumps

1. Description: Factory-assembled and -tested fire-pump and driver unit.
2. Base: Fabricated and attached to fire-pump and driver unit with reinforcement to resist movement of pump during seismic events when base is anchored to building substrate.
3. Finish: Red paint applied to factory-assembled and -tested unit before shipping.

B. End-Suction Fire Pumps
1. Pump:
   a. Standard: UL 448, for end-suction pumps for fire service.
   b. Casing: Radially split case, cast iron with ASME B16.1 pipe-flange connections.
   c. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
   d. Wear Rings: Replaceable bronze.
   e. Shaft and Sleeve: Steel shaft with bronze sleeve.
      1) Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
      2) Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
   f. Mounting: Pump and driver shafts are horizontal, with pump and driver on same base.
2. Coupling: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.
3. Driver:
   a. Standard: UL 1004A.
   b. Type: Electric motor; NEMA MG 1, polyphase Design B.

C. In-Line Fire Pumps
1. Pump:
   a. Standard: UL 448, for in-line pumps for fire service.
   b. Casing: Radially split case, cast iron with ASME B16.1 pipe-flange connections.
   c. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
   d. Wear Rings: Replaceable bronze.
   e. Shaft and Sleeve: Steel shaft with bronze sleeve.
      1) Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
      2) Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
   f. Mounting: Pump and driver shaft is vertical, with motor above pump and pump on base.
2. Coupling: None or rigid.
3. Driver:
   a. Standard: UL 1004A.
   b. Type: Electric motor; NEMA MG 1, polyphase Design B.

D. Horizontally Mounted, Single-Stage, Split-Case Fire Pumps
1. Pump:
   a. Standard: UL 448, for split-case pumps for fire service.
   b. Casing: Axially split case, cast iron with ASME B16.1 pipe-flange connections.
   c. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
   d. Wear Rings: Replaceable bronze.
   e. Shaft and Sleeve: Steel shaft with bronze sleeve.
      1) Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
      2) Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
   f. Mounting: Pump and driver shafts are horizontal, with pump and driver on same base.
2. Coupling: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.
3. Driver:
   a. Standard: UL 1004A.
   b. Type: Electric motor; NEMA MG 1, polyphase Design B.

E. Horizontally Mounted, Multistage, Split-Case Fire Pumps
   1. Pump:
      a. Standard: UL 448, for split-case pumps for fire service.
      b. Number of Stages: Two.
      c. Casing: Axially split case, cast iron with ASME B16.1 pipe-flange connections.
      d. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
      e. Wear Rings: Replaceable bronze.
      f. Shaft and Sleeve: Steel shaft with bronze sleeve.
         1) Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
         2) Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
      g. Mounting: Pump and driver shafts are horizontal, with pump and driver on same base.
   2. Coupling: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.
   3. Driver:
      a. Standard: UL 1004A.
      b. Type: Electric motor; NEMA MG 1, polyphase Design B.

F. Vertically Mounted, Single-Stage, Split-Case Fire Pumps
   1. Pump:
      a. Standard: UL 448, for split-case pumps for fire service.
      b. Casing: Axially split case, cast iron with ASME B16.1 pipe-flange connections.
      c. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
      d. Wear Rings: Replaceable bronze.
      e. Shaft and Sleeve: Steel shaft with bronze sleeve.
         1) Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
         2) Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
      f. Mounting: Pump and driver shafts are vertical, with motor above pump and pump on base.
   2. Coupling: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.
   3. Driver:
      a. Standard: UL 1004A.
      b. Type: Electric motor; NEMA MG 1, polyphase Design B.

G. Fire-Pump Accessories And Specialties
   1. Automatic Air-Release Valves: Comply with NFPA 20 for installation in fire-pump casing.
   2. Circulation Relief Valves: UL 1478, brass, spring loaded; for installation in pump discharge piping.
   3. Relief Valves:
      a. Description: UL 1478, bronze or cast iron, spring loaded; for installation in fire-suppression water-supply piping.
   4. Inlet Fitting: Eccentric tapered reducer at pump suction inlet.
   5. Outlet Fitting: Concentric tapered reducer at pump discharge outlet.
   6. Discharge Cone: Closed **OR** Open, **as directed**, type.
   7. Hose Valve Manifold Assembly:
      a. Standard: Comply with requirements in NFPA 20.
      b. Header Pipe: ASTM A 53/A 53M, Schedule 40, galvanized steel with ends threaded according to ASME B1.20.1.
      c. Header Pipe Fittings: ASME B16.4, galvanized cast-iron threaded fittings.
      d. Automatic Drain Valve: UL 1726.
      e. Manifold:
         1) Test Connections: Comply with UL 405 except provide outlets without clappers instead of inlets.
         2) Body: Flush type, brass or ductile iron, with number of outlets required by NFPA 20.

3) Nipples: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe with ends threaded according to ASME B1.20.1.
4) Adapters and Caps with Chain: Brass or bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads.
5) Escutcheon Plate: Brass or bronze; rectangular.
6) Hose Valves: UL 668, bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads.
7) Exposed Parts Finish: Polished **OR** Rough, **as directed**, brass, chrome plated, **as directed**.
8) Escutcheon Plate Marking: Equivalent to "FIRE PUMP TEST."

OR

Manifold:

1) Test Connections: Comply with UL 405 except provide outlets without clappers instead of inlets.
2) Body: Exposed type, brass, with number of outlets required by NFPA 20.
3) Escutcheon Plate: Brass or bronze; round.
4) Hose Valves: UL 668, bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads. Include caps and chains.
5) Exposed Parts Finish: Polished **OR** Rough, **as directed**, brass, chrome plated, **as directed**.
6) Escutcheon Plate Marking: Equivalent to "FIRE PUMP TEST."

H. Flowmeter Systems
1. Description: UL-listed or FM-Approved, fire-pump flowmeter system with capability to indicate flow to not less than 175 percent of fire-pump rated capacity.
2. Pressure Rating: 175 psig (1200 kPa) minimum **OR** 250 psig (1725 kPa), **as directed**.
3. Sensor: Annubar probe, orifice plate, or venturi unless otherwise indicated. Sensor size shall match pipe, tubing, flowmeter, and fittings.
4. Permanently Mounted Flowmeter: Compatible with flow sensor; with dial not less than 4-1/2 inches (115 mm) in diameter. Include bracket or device for wall mounting.
   a. Tubing Package: NPS 1/8 or NPS 1/4 (DN 6 or DN 10) soft copper **OR** plastic, **as directed**, tubing with copper or brass fittings and valves.

   OR

   Portable Flowmeter: Compatible with flow sensor; with dial not less than 4-1/2 inches (115 mm) in diameter and with two 12-foot- (3.7-m-) long hoses in carrying case.

I. Grout
1. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
2. Characteristics: Nonshrink and recommended for interior and exterior applications.
3. Design Mix: 5000-psi (34-MPa), 28-day compressive strength.
4. Packaging: Premixed and factory packaged.

J. Source Quality Control
1. Testing: Test and inspect fire pumps according to UL 448 requirements for "Operation Test" and "Manufacturing and Production Tests."
   a. Verification of Performance: Rate fire pumps according to UL 448.
2. Fire pumps will be considered defective if they do not pass tests and inspections.
3. Prepare test and inspection reports.

1.3 EXECUTION

A. Installation

1. Fire-Pump Installation Standard: Comply with NFPA 20 for installation of fire pumps, relief valves, and related components.
2. Equipment Mounting: Install fire pumps on concrete bases. Comply with requirements for concrete bases specified in Division 03 Section "Cast-in-place Concrete".
   a. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
   b. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   c. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   d. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install fire-pump suction and discharge piping equal to or larger than sizes required by NFPA 20.
4. Support piping and pumps separately so weight of piping does not rest on pumps.
5. Install valves that are same size as connecting piping. Comply with requirements for fire-protection valves specified in Division 13 Section(s) "Fire-suppression Standpipes" OR "Wet-pipe Fire-suppression Sprinklers", **as directed**.
6. Install pressure gages on fire-pump suction and discharge flange pressure-gage tappings. Comply with requirements for pressure gages specified in Division 13 Section(s) "Fire-suppression Standpipes" OR "Wet-pipe Fire-suppression Sprinklers", **as directed**.
7. Install piping hangers and supports, anchors, valves, gages, and equipment supports according to NFPA 20.
8. Install flowmeters and sensors. Install flowmeter-system components and make connections according to NFPA 20 and manufacturer's written instructions.
9. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not factory mounted. Furnish copies of manufacturers' wiring diagram submittals to electrical Installer.
10. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

B. Alignment
1. Align end-suction and split-case pump and driver shafts after complete unit has been leveled on concrete base, grout has set, and anchor bolts have been tightened.
2. After alignment is correct, tighten anchor bolts evenly. Fill baseplate completely with grout, with metal blocks and shims or wedges in place. Tighten anchor bolts after grout has hardened. Check alignment and make required corrections.
3. Align piping connections.
4. Align pump and driver shafts for angular and parallel alignment according to HI 1.4 and to tolerances specified by manufacturer.

C. Connections
1. Comply with requirements for piping and valves specified in Division 13 Section(s) "Fire-suppression Standpipes" OR "Wet-pipe Fire-suppression Sprinklers", **as directed**. Drawings indicate general arrangement of piping, fittings, and specialties.
2. Install piping adjacent to pumps and equipment to allow service and maintenance.
3. Connect relief-valve discharge to drainage piping or point of discharge.
4. Connect flowmeter-system meters, sensors, and valves to tubing.
5. Connect fire pumps to their controllers.

D. Identification
1. Identify system components. Comply with requirements for fire-pump marking according to NFPA 20.

E. Field Quality Control
1. Test each fire pump with its controller as a unit. Comply with requirements for electric-motor-driver fire-pump controllers specified in Division 13 Section(s) "Electric-drive, Centrifugal Fire Pumps" OR "Diesel-drive, Centrifugal Fire Pumps" OR "Electric-drive, Vertical-turbine Fire Pumps" OR "Diesel-drive, Vertical-turbine Fire Pumps".

2. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
3. Perform tests and inspections.
   a. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
4. Tests and Inspections:
   a. After installing components, assemblies, and equipment including controller, test for compliance with requirements.
   b. Test according to NFPA 20 for acceptance and performance testing.
   c. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   d. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   e. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
5. Components, assemblies, and equipment will be considered defective if they do not pass tests and inspections.
6. Prepare test and inspection reports.
7. Furnish fire hoses in number, size, and length required to reach storm drain or other acceptable location to dispose of fire-pump test water. Hoses are for tests only and do not convey to Owner.

F. Demonstration
   1. Train Owner's maintenance personnel to adjust, operate, and maintain fire pumps.

END OF SECTION 13920

SECTION 13920a - DIESEL-DRIVE, CENTRIFUGAL FIRE PUMPS

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for diesel-drive, centrifugal fire pumps. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section Includes:
a. End-suction and Split-case fire pumps.
b. Fire-pump accessories and specialties.
c. Flowmeter systems.

C. Performance Requirements
1. Seismic Performance: Fire pumps shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
a. 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."
2. Pump Equipment, Accessory, and Specialty Pressure Rating: 175 psig (1200 kPa) minimum unless higher pressure rating is indicated.

D. Submittals
1. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, performance curves, electrical characteristics, and furnished specialties and accessories.
2. Shop Drawings: For fire pumps, engine drivers, and fire-pump accessories and specialties. Include plans, elevations, sections, details, and attachments to other work.
a. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
b. Wiring Diagrams: For power, signal, and control wiring.
3. Seismic Qualification Certificates: For fire pumps, accessories, and components, from manufacturer.
a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
b. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
c. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
4. Product Certificates: For each fire pump, from manufacturer.
5. Source quality-control reports.
6. Field quality-control reports.
7. Operation and maintenance data.

E. Quality Assurance
1. 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.
2. NFPA Compliance: Comply with NFPA 20, "Installation of Stationary Pumps for Fire Protection."

1.2 PRODUCTS

A. General Requirements For Centrifugal Fire Pumps
   1. Description: Factory-assembled and -tested fire-pump and driver unit.
   2. Base: Fabricated and attached to fire-pump and driver unit with reinforcement to resist movement of pump during seismic events when base is anchored to building substrate.
   3. Finish: Red paint applied to factory-assembled and -tested unit before shipping.

B. End-Suction Fire Pumps
   1. Pump:
      a. Standard: UL 448, for end-suction pumps for fire service.
      b. Casing: Radially split case, cast iron with ASME B16.1 pipe-flange connections.
      c. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
      d. Wear Rings: Replaceable bronze.
      e. Shaft and Sleeve: Steel shaft with bronze sleeve.
         1) Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
         2) Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
      f. Mounting: Pump and driver shafts are horizontal, with pump and driver on same base.
   2. Coupling: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.
   3. Driver:
      a. Standard: UL 1247.
      b. Type: Diesel engine.
      c. Emergency Manual Operator: Factory wired for starting and operating standby engine in case of malfunction in main controller or wiring.
      d. Engine Cooling System: Factory-installed radiator.
         1) Coolant: Type recommended by driver manufacturer.

         OR

         Engine Cooling System: Factory-installed water piping, valves, strainer, pressure regulator, heat exchanger, coolant pump, bypass piping, and fittings.
         1) Piping: ASTM B 88, Type L (ASTM B 88M, Type B), copper water tube; ASME B16.22, wrought-copper, solder-joint pressure fittings; AWS A5.8/A5.8M, BCuP Series brazing filler metal; and brazed joints.
      e. Engine-Jacket Water Heater: Factory-installed electric elements.
      f. Dual Batteries: Lead-acid-storage type with 100 percent standby reserve capacity.
      g. Fuel System: Comply with NFPA 20.
         1) Fuel Storage Tank: Size indicated but not less than required by NFPA 20. Include floor legs, direct-reading level gage, and secondary containment tank with capacity at least equal to fuel storage tank.
      h. Exhaust System: ASTM A 53/A 53M, Type E or S, Schedule 40, black steel pipe; ASME B16.9, weld-type pipe fittings; ASME B16.5, steel flanges; and ASME B16.21, nonmetallic gaskets. Fabricate double-wall, ventilated thimble from steel pipe.
         1) Exhaust Connector: Flexible type.
         2) Exhaust Silencer: Industrial **OR** Residential, **as directed**, type.

C. Single-Stage, Split-Case Fire Pumps
   1. Pump:
      a. Standard: UL 448, for split-case pumps for fire service.
      b. Casing: Axially split case, cast iron with ASME B16.1 pipe-flange connections.
      c. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
      d. Wear Rings: Replaceable bronze.
      e. Shaft and Sleeve: Steel shaft with bronze sleeve.
         1) Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
         2) Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
      f. Mounting: Pump and driver shafts are horizontal, with pump and driver on same base.

2. Coupling: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.
3. Driver:
   a. Standard: UL 1247.
   b. Type: Diesel engine.
   c. Emergency Manual Operator: Factory wired for starting and operating standby engine in case of malfunction in main controller or wiring.
   d. Engine Cooling System: Factory-installed radiator.
      1) Coolant: Type recommended by driver manufacturer.

      OR

      Engine Cooling System: Factory-installed water piping, valves, strainer, pressure regulator, heat exchanger, coolant pump, bypass piping, and fittings.
      1) Piping: ASTM B 88, Type L (ASTM B 88M, Type B), copper water tube; ASME B16.22, wrought-copper, solder-joint pressure fittings; AWS A5.8/A5.8M, BCuP Series brazing filler metal; and brazed joints.
   e. Engine-Jacket Water Heater: Factory-installed electric elements.
   f. Dual Batteries: Lead-acid-storage type with 100 percent standby reserve capacity.
   g. Fuel System: Comply with NFPA 20.
      1) Fuel Storage Tank: Size indicated but not less than required by NFPA 20. Include floor legs, direct-reading level gage, and secondary containment tank with capacity at least equal to fuel storage tank.
   h. Exhaust System: ASTM A 53/A 53M, Type E or S, Schedule 40, black steel pipe; ASME B16.9, weld-type pipe fittings; ASME B16.5, steel flanges; and ASME B16.21, nonmetallic gaskets. Fabricate double-wall, ventilated thimble from steel pipe.
      1) Exhaust Connector: Flexible type.
      2) Exhaust Silencer: Industrial **OR** Residential, **as directed**, type.

D. Multistage, Split-Case Fire Pumps
1. Pump:
   a. Standard: UL 448, for split-case pumps for fire service.
   b. Number Stages: Two.
   c. Casing: Axially split case, cast iron with ASME B16.1 pipe-flange connections.
   d. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
   e. Wear Rings: Replaceable bronze.
   f. Shaft and Sleeve: Steel shaft with bronze sleeve.
      1) Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
      2) Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
   g. Mounting: Pump and driver shafts are horizontal, with pump and driver on same base.
2. Coupling: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.
3. Driver:
   a. Standard: UL 1247.
   b. Type: Diesel engine.
   c. Emergency Manual Operator: Factory wired for starting and operating standby engine in case of malfunction in main controller or wiring.
   d. Engine Cooling System: Factory-installed radiator.
      1) Coolant: Type recommended by driver manufacturer.

      OR

      Engine Cooling System: Factory-installed water piping, valves, strainer, pressure regulator, heat exchanger, coolant pump, bypass piping, and fittings.
      1) Piping: ASTM B 88, Type L (ASTM B 88M, Type B), copper water tube; ASME B16.22, wrought-copper, solder-joint pressure fittings; AWS A5.8/A5.8M, BCuP Series brazing filler metal; and brazed joints.
   e. Engine-Jacket Water Heater: Factory-installed electric elements.
   f. Dual Batteries: Lead-acid-storage type with 100 percent standby reserve capacity.

g. Fuel System: Comply with NFPA 20.
   1) Fuel Storage Tank: Size indicated but not less than required by NFPA 20. Include floor legs, direct-reading level gage, and secondary containment tank with capacity at least equal to fuel storage tank.

h. Exhaust System: ASTM A 53/A 53M, Type E or S, Schedule 40, black steel pipe; ASME B16.9, weld-type pipe fittings; ASME B16.5, steel flanges; and ASME B16.21, nonmetallic gaskets. Fabricate double-wall, ventilated thimble from steel pipe.
   1) Exhaust Connector: Flexible type.
   2) Exhaust Silencer: Industrial **OR** Residential, **as directed**, type.

E. Fire-Pump Accessories And Specialties
1. Automatic Air-Release Valves: Comply with NFPA 20 for installation in fire-pump casing.
2. Circulation Relief Valves: UL 1478, brass, spring loaded; for installation in pump discharge piping.
3. Relief Valves:
   a. Description: UL 1478, bronze or cast iron, spring loaded; for installation in fire-suppression water-supply piping.
4. Inlet Fitting: Eccentric tapered reducer at pump suction inlet.
5. Outlet Fitting: Concentric tapered reducer at pump discharge outlet.
6. Discharge Cone: Closed **OR** Open, **as directed**, type.
7. Hose Valve Manifold Assembly:
   a. Standard: Comply with requirements in NFPA 20.
   b. Header Pipe: ASTM A 53/A 53M, Schedule 40, galvanized steel with ends threaded according to ASME B1.20.1.
   c. Header Pipe Fittings: ASME B16.4, galvanized cast-iron threaded fittings.
   d. Automatic Drain Valve: UL 1726.
   e. Manifold:
      1) Test Connections: Comply with UL 405 except provide outlets without clappers instead of inlets.
      2) Body: Flush type, brass or ductile iron, with number of outlets required by NFPA 20.
      3) Nipples: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe with ends threaded according to ASME B1.20.1.
      4) Adapters and Caps with Chain: Brass or bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads.
      5) Escutcheon Plate: Brass or bronze; rectangular.
      6) Hose Valves: UL 668, bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads.
      7) Exposed Parts Finish: Polished **OR** Rough, **as directed**, brass, **as directed**, chrome plated, **as directed**.
      8) Escutcheon Plate Marking: Equivalent to "FIRE PUMP TEST."

      OR

      Manifold:
      1) Test Connections: Comply with UL 405 except provide outlets without clappers instead of inlets.
      2) Body: Exposed type, brass, with number of outlets required by NFPA 20.
      3) Escutcheon Plate: Brass or bronze; round.
      4) Hose Valves: UL 668, bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads. Include caps and chains.
      5) Exposed Parts Finish: Polished **OR** Rough, **as directed**, brass, **as directed**, chrome plated, **as directed**.
      6) Escutcheon Plate Marking: Equivalent to "FIRE PUMP TEST."

F. Flowmeter Systems
1. Description: UL-listed or FM-Approved, fire-pump flowmeter system with capability to indicate flow to not less than 175 percent of fire-pump rated capacity.

2. Pressure Rating: 175 psig (1200 kPa) minimum **OR** 250 psig (1725 kPa), **as directed**.
3. Sensor: Annubar probe, orifice plate, or venturi unless otherwise indicated. Sensor size shall match pipe, tubing, flowmeter, and fittings.
4. Permanently Mounted Flowmeter: Compatible with flow sensor; with dial not less than 4-1/2 inches (115 mm) in diameter. Include bracket or device for wall mounting.
   a. Tubing Package: NPS 1/8 or NPS 1/4 (DN 6 or DN 10) soft copper **OR** plastic, **as directed**, tubing with copper or brass fittings and valves.

   OR

   Portable Flowmeter: Compatible with flow sensor; with dial not less than 4-1/2 inches (115 mm) in diameter and with two 12-foot- (3.7-m-) long hoses in carrying case.

G. Grout
1. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
2. Characteristics: Nonshrink and recommended for interior and exterior applications.
3. Design Mix: 5000-psi (34-MPa), 28-day compressive strength.
4. Packaging: Premixed and factory packaged.

H. Source Quality Control
1. Testing: Test and inspect fire pumps according to UL 448 requirements for "Operation Test" and "Manufacturing and Production Tests."
   a. Verification of Performance: Rate fire pumps according to UL 448.
2. Fire pumps will be considered defective if they do not pass tests and inspections.
3. Prepare test and inspection reports.

1.3 EXECUTION

A. Installation
1. Fire-Pump Installation Standard: Comply with NFPA 20 for installation of fire pumps, relief valves, and related components.
2. Equipment Mounting: Install fire pumps on concrete bases. Comply with requirements for concrete bases specified in Division 03 Section "Cast-in-place Concrete".
   a. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
   b. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   c. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   d. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install fire-pump suction and discharge piping equal to or larger than sizes required by NFPA 20.
4. Support piping and pumps separately so weight of piping does not rest on pumps.
5. Install valves that are same size as connecting piping. Comply with requirements for fire-protection valves specified in Division 13 Section(s) "Fire-suppression Standpipes" OR "Wet-pipe Fire-suppression Sprinklers", **as directed**.
6. Install pressure gages on fire-pump suction and discharge flange pressure-gage tappings. Comply with requirements for pressure gages specified in Division 13 Section(s) "Fire-suppression Standpipes" OR "Wet-pipe Fire-suppression Sprinklers", **as directed**.
7. Install piping hangers and supports, anchors, valves, gages, and equipment supports according to NFPA 20.
8. Install fuel system according to NFPA 20.
9. Install water supply and drain piping for diesel-engine heat exchangers. Extend drain piping from heat exchangers to point of disposal.
10. Install exhaust-system piping for diesel engines. Extend to point of termination outside structure. Install pipe and fittings with welded joints; install components having flanged connections with gasketed joints.

11. Install condensate-drain piping for diesel-engine exhaust system. Extend drain piping from low points of exhaust system to condensate traps and to point of disposal.
12. Install flowmeters and sensors. Install flowmeter-system components and make connections according to NFPA 20 and manufacturer's written instructions.
13. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not factory mounted. Furnish copies of manufacturers' wiring diagram submittals to electrical Installer.
14. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

B. Alignment
1. Align end-suction and split-case pump and driver shafts after complete unit has been leveled on concrete base, grout has set, and anchor bolts have been tightened.
2. After alignment is correct, tighten anchor bolts evenly. Fill baseplate completely with grout, with metal blocks and shims or wedges in place. Tighten anchor bolts after grout has hardened. Check alignment and make required corrections.
3. Align piping connections.
4. Align pump and driver shafts for angular and parallel alignment according to HI 1.4 and to tolerances specified by manufacturer.

C. Connections
1. Comply with requirements for piping and valves specified in Division 13 Section(s) "Fire-suppression Standpipes" OR "Wet-pipe Fire-suppression Sprinklers", **as directed**. Drawings indicate general arrangement of piping, fittings, and specialties.
2. Install piping adjacent to pumps and equipment to allow service and maintenance.
3. Connect relief-valve discharge to drainage piping or point of discharge.
4. Connect flowmeter-system meters, sensors, and valves to tubing.
5. Connect fire pumps to their controllers.

D. Identification
1. Identify system components. Comply with requirements for fire-pump marking according to NFPA 20.

E. Field Quality Control
1. Test each fire pump with its controller as a unit. Comply with requirements for diesel-engine-driver fire-pump controllers specified in Division 13 Section(s) "Electric-drive, Centrifugal Fire Pumps" OR "Diesel-drive, Centrifugal Fire Pumps" OR "Electric-drive, Vertical-turbine Fire Pumps" OR "Diesel-drive, Vertical-turbine Fire Pumps".
2. Perform tests and inspections.
   a. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
3. Tests and Inspections:
   a. After installing components, assemblies, and equipment including controller, test for compliance with requirements.
   b. Test according to NFPA 20 for acceptance and performance testing.
   c. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   d. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   e. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
4. Components, assemblies, and equipment will be considered defective if they do not pass tests and inspections.
5. Prepare test and inspection reports.

6. Furnish fire hoses in number, size, and length required to reach storm drain or other acceptable location to dispose of fire-pump test water. Hoses are for tests only and do not convey to Owner.

F. Startup Service
1. Perform startup service.
a. Complete installation and startup checks according to manufacturer's written instructions.

G. Demonstration
1. Train Owner's maintenance personnel to adjust, operate, and maintain fire pumps.

END OF SECTION 13920a

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SECTION 13920b - PRESSURE-MAINTENANCE PUMPS

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for pressure-maintenance pumps. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section Includes:
a. Multistage, pressure-maintenance pumps.
b. Regenerative-turbine, pressure-maintenance pumps.
c. Submersible, pressure-maintenance pumps.
d. Vertical-turbine, pressure-maintenance pumps.

C. Performance Requirements
1. Pump Equipment, Accessory, and Specialty Pressure Rating: 175 psig (1200 kPa) minimum unless higher pressure rating is indicated.

D. Submittals
1. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, performance curves, electrical characteristics, and furnished specialties and accessories.
2. Shop Drawings: For pumps, accessories, and specialties. Include plans, elevations, sections, details, and attachments to other work.
a. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
b. Wiring Diagrams: For power, signal, and control wiring.
3. Field quality-control reports.
4. Operation and maintenance data.

E. Quality Assurance
1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.2 PRODUCTS

A. Multistage, Pressure-Maintenance Pumps
1. Description: Factory-assembled and -tested, multistage, barrel-type vertical pump as defined in HI 2.1-2.2 and HI 2.3; designed for surface installation with pump and motor direct coupled and mounted vertically.
2. Pump Construction:
a. Barrel: Stainless steel.
b. Suction and Discharge Chamber: Cast iron with flanged inlet and outlet.
c. Pump Head/Motor Mount: Cast iron.
d. Impellers: Stainless steel, balanced, and keyed to shaft.
e. Pump Shaft: Stainless steel.
f. Seal: Mechanical type with carbon rotating face and silicon-carbide stationary seat.
g. Intermediate Chamber Bearings: Aluminum-oxide ceramic or bronze.
h. Chamber-Base Bearing: Tungsten carbide.
i. O-Rings: EPDM or NBR.

3. Motor: Single speed with permanently lubricated ball bearings and rigidly mounted to pump head. Comply with requirements in Division 15 Section "Common Motor Requirements for Fire Suppression Equipment."
   a. Power Cord: Factory-connected to motor for field connection to controller and at least 10 feet (3 m) long.
4. Nameplate: Permanently attached to pump and indicating capacity and characteristics.

B. Regenerative-Turbine, Pressure-Maintenance Pumps
1. Description: Factory-assembled and -tested, close-coupled, single-stage, regenerative-turbine centrifugal pump as defined in HI 1.1-1.2 and HI 1.3; with pump and motor mounted horizontally.
2. Pump Construction:
   a. Casing: Radially split, cast iron, with threaded inlet and outlet.
   b. Impeller: Bronze, balanced, and keyed to shaft.
   c. Pump Shaft: Stainless steel **OR** steel, **as directed**, with deflector.
   d. Shaft Sleeve: Bronze.
   e. Seal: Mechanical type with spring-loaded rotating head.
3. Motor: Single speed with permanently lubricated ball bearings. Comply with requirements in Division 15 Section "Common Motor Requirements for Fire Suppression Equipment."
   a. Power Cord: Factory-connected to motor for field connection to controller and at least 10 feet (3 m) long.
4. Nameplate: Permanently attached to pump and indicating capacity and characteristics.

C. Submersible, Pressure-Maintenance Pumps
1. Description: Factory-assembled and -tested, vertical, multistage, submersible pump as defined in HI 2.1-2.2 and HI 2.3; with pump motor mounted below pump.
2. Pump Construction:
   a. Pump Head or Elbow: Cast iron, for surface discharge, with flanged or threaded connections.
   b. Pump Shaft: Stainless steel.
   c. Bearings: Bronze.
   d. Bowl Section: Multiple cast-iron bowls with closed-type bronze or stainless-steel impellers.
   e. Column Pipe: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe with threaded ends and cast-iron or steel fittings, in sections 10 feet (3 m) or less, with strainer of cast or fabricated bronze or stainless steel between pump and bowl section.
3. Motor: Single speed with permanently lubricated ball bearings and capable of continuous operation under water. Comply with requirements in Division 15 Section "Common Motor Requirements for Fire Suppression Equipment."
   a. Power Cord: Capable of continuous under-water operation, factory-connected to motor for field connection to controller, and at least 10 feet (3 m) long.
4. Base: Cast iron or steel with hole for electrical cable.
5. Nameplate: Permanently attached to pump and indicating capacity and characteristics.

D. Vertical-Turbine, Pressure-Maintenance Pumps
1. Description: Factory-assembled and -tested, vertical, multistage, open-line-shaft turbine pump as defined in HI 2.1-2.2 and HI 2.3; with pump motor mounted above pump head.
2. Pump Construction:
   a. Pump Head: Cast iron, for surface discharge, with flange except connections may be threaded in sizes in which flanges are not available.
   b. Pump Head Seal: Stuffing box and stuffing.
   c. For static water levels of 50 feet (15 m) or less and for water-lubricated bearings.
      1) Line Shaft: Stainless steel or steel, with corrosion-resistant shaft sleeves.
      2) Line Shaft Bearings: Rubber sleeve, water lubricated.
   d. For static water levels between 50 and 200 feet (15 and 61 m) and for oil-lubricated bearings.
      1) Line Shaft: Steel.

2) Line Shaft Bearings: Corrosion resistant, oil lubricated.
e. Impeller Shaft: Monel metal or stainless steel.
f. Bowl Section: Multiple cast-iron bowls with closed-type bronze or stainless-steel impellers.
g. Column Pipe: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe with threaded ends and cast-iron or steel fittings, in sections 10 feet (3 m) or less, with strainer of cast or fabricated bronze or stainless steel at bottom.
3. Motor: Single speed with permanently lubricated ball bearings. Comply with requirements in Division 15 Section "Common Motor Requirements for Fire Suppression Equipment."
a. Power Cord: Factory-connected to motor for field connection to controller and at least 10 feet (3 m) long.
4. Base: Cast iron or steel with hole for electrical cable.
5. Nameplate: Permanently attached to pump and indicating capacity and characteristics.

E. Motors
1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 15 Section "Common Motor Requirements for Fire Suppression Equipment."
a. Motor Sizes: Minimum size as indicated; if not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
b. Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 16 Sections.

1.3 EXECUTION

A. Equipment Installation
1. NFPA Standard: Comply with NFPA 20 for installation of pressure-maintenance pumps.
2. Base-Mounted Pump Mounting: Install pumps on concrete bases. Comply with requirements for concrete bases specified in Division 3 Section "Cast-in-Place Concrete."
a. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
b. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
c. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
d. Install anchor bolts to elevations required for proper attachment to supported equipment.
e. Attach pumps to equipment base using anchor bolts.
3. Install multistage and regenerative-turbine, pressure-maintenance pumps according to HI 1.4.
4. Install submersible and vertical-turbine, pressure-maintenance pumps according to HI 2.4.

B. Field Quality Control
1. Perform tests and inspections.
a. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
2. Tests and Inspections:
a. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
b. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Pressure-maintenance pumps will be considered defective if they do not pass tests and inspections.
4. Prepare test and inspection reports.

C. Adjusting
1. Lubricate pumps as recommended by manufacturer.

2. Set field-adjustable pressure-switch ranges as indicated.

END OF SECTION 13920b

SECTION 13920c - CONTROLLERS FOR FIRE-PUMP DRIVERS

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for controllers for fire-pump drivers. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section Includes:
a. Full-service, full-voltage **OR** reduced-voltage, **as directed**, controllers rated 600 V and less.
b. Limited-service controllers rated 600 V and less.
c. Controllers for diesel-drive fire pumps.
d. Remote alarm panels.
e. Low-suction-shutdown panels.

C. Definitions
1. ATS: Automatic transfer switch(es).
2. ECM: Electronic control module.
3. MCCB: Molded-case circuit breaker.
4. N.O.: Normally open.

D. Performance Requirements
1. Seismic Performance: Fire-pump controllers and alarm panels shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
a. 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."

E. Submittals
1. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories**.**
2. Shop Drawings: For each type of product indicated. Include dimensioned plans, elevations, sections, details, and attachments to other work, including required clearances and service spaces around controller enclosures.
a. Show tabulations of the following:
1) Each installed unit's type and details.
2) Enclosure types and details for types other than NEMA 250, Type 2.
3) Factory-installed devices.
4) Nameplate legends.
5) Short-circuit current (withstand) rating of integrated unit.
6) Features, characteristics, ratings, and factory settings of individual overcurrent protective devices.
7) Specified modifications.
b. Detail equipment assemblies and indicate dimensions, weights, loads, method of field assembly, components, and location and size of each field connection.
c. Schematic and Connection Diagrams: For power, signal, alarm, and control wiring and for pressure-sensing tubing.
3. Qualification Data: For qualified testing agency.
4. Seismic Qualification Certificates: For each type of product indicated, from manufacturer.

a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
b. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
c. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

5. Product Certificates: For each type of product indicated, from manufacturer.
6. Manufacturer's factory test reports of fully assembled and tested equipment.
7. Source quality-control reports.
8. Field quality-control reports.
9. Operation and Maintenance Data: For each type of product indicated to include in emergency, operation, and maintenance manuals. Include the following:
   a. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
   b. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor-based logic controls.

F. Quality Assurance
1. Testing Agency Qualifications: Member company of an NRTL.
2. Source Limitations: Obtain fire-pump controllers and all associated equipment from single source or producer.
3. 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.
4. Comply with standards of authorities having jurisdiction pertaining to materials and installation.
5. Comply with NFPA 20 and NFPA 70.
6. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."

G. Delivery, Storage, And Handling
1. Store controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
2. If stored in areas subject to weather, protect controllers from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install temporary electric heating, with at least 250 W per controller **OR** connect factory-installed space heaters to temporary electrical service, **as directed**.

H. Project Conditions
1. Environmental Limitations:
   a. Ambient Temperature Rating: Not less than 40 deg F (5 deg C) and not exceeding 122 deg F (50 deg C) unless otherwise indicated.
   b. Altitude Rating: Not exceeding 6600 feet (2010 m) unless otherwise indicated.
2. Interruption of Existing Electric Service: Notify Owner no fewer than seven days in advance of proposed interruption of electric service, and comply with NFPA 70E.

I. Coordination
1. Coordinate layout and installation of controllers with other construction including conduit, piping, fire-pump equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels. Ensure that controllers are within sight of fire-pump drivers.
2. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.2 PRODUCTS

A. Full-Service Controllers
1. General Requirements for Full-Service Controllers:
   a. Comply with NFPA 20 and UL 218.
   b. Listed by an NRTL for electric-motor driver for fire-pump service.
   c. Combined automatic and nonautomatic **OR** Nonautomatic, **as directed**, operation.
   d. Factory assembled, wired, and tested; continuous-duty rated.
   e. Service Equipment Label: NRTL labeled for use as service equipment.
2. Method of Starting:
   a. Pressure **OR** Nonpressure, **as directed**,-switch actuated.
      1) Water-pressure-actuated switch and pressure transducer with independent high- and low-calibrated adjustments responsive to water pressure in fire-suppression piping.
      2) System pressure recorder, electric ac driven, with spring backup.
      3) Programmable minimum-run-time relay to prevent short cycling.
      4) Programmable timer for weekly tests.
   b. Magnetic Controller: Across-the-line **OR** Autotransformer **OR** Part-winding **OR** Primary-resistor **OR** Wye-delta (open transition) **OR** Wye-delta (closed transition), **as directed**, type.
      OR
      Solid-State Controller: Reduced-voltage type.
   c. Emergency Start: Mechanically operated start handle that closes and retains the motor RUN contactor independent of all electric or pressure actuators.
3. Method of Stopping: Automatic and nonautomatic shutdown after automatic starting **OR** Nonautomatic, **as directed**.
4. Capacity: Rated for fire-pump-driver horsepower and short-circuit-current (withstand) rating equal to or greater than short-circuit current available at controller location.
5. Method of Isolation and Overcurrent Protection: Interlocked isolating switch and nonthermal MCCB; with a common, externally mounted operating handle, and providing locked-rotor protection.
6. Door-Mounted Operator Interface and Controls:
   a. Monitor, display, and control the devices, alarms, functions, and operations listed in NFPA 20 as required for drivers and controller types used.
   b. Method of Control and Indication:
      1) Microprocessor-based logic controller, with multiline digital readout.
      2) Membrane keypad.
      3) LED alarm and status indicating lights.
   c. Local and Remote, **as directed**, Alarm and Status Indications:
      1) Controller power on.
      2) Motor running condition.
      3) Loss-of-line power.
      4) Line-power phase reversal.
      5) Line-power single-phase condition.
   d. Audible alarm, with silence push button.
   e. Nonautomatic START and STOP push buttons or switches.
7. Optional Features:
   a. Extra Output Contacts:
      1) One N.O. contact(s) for motor running condition.
      2) One set(s) of contacts for loss-of-line power.
      3) One each, Form C contacts for high and low reservoir level.
   b. Local alarm bell.
   c. Door-mounted thermal or impact printer for alarm and status logs.
   d. Operator Interface Communications Ports: USB, Ethernet, and RS485.
8. ATS:
   a. Complies with NFPA 20, UL 218, and UL 1008.

b. Integral with controller as a listed combination fire-pump controller and power transfer switch.
c. Automatically transfers fire-pump controller from normal power supply to alternate power supply in event of power failure.
d. Allows manual transfer from one source to the other.
e. Alternate-Source Isolating and Disconnecting Means: Integral molded-case switch, with an externally mounted operating handle.
OR
Alternate-Source Isolating and Disconnecting Means: Mechanically interlocked isolation switch and circuit breaker rated at a minimum of 115 percent of rated motor full-load current, with an externally mounted operating handle; circuit breaker shall be provided with nonthermal sensing, instantaneous-only short-circuit overcurrent protection to comply with available fault currents.
f. Local and Remote, **as directed**, Alarm and Status Indications:
1) Normal source available.
2) Alternate source available.
3) In normal position.
4) In alternate position.
5) Isolating means open.
g. Audible alarm, with silence push button.
h. Nonautomatic (manual, nonelectric) means of transfer.
i. Engine test push button.
j. Start generator output contacts.
k. Timer for weekly generator tests.

B. Limited-Service Controllers
1. General Requirements for Limited-Service Controllers:
a. Comply with NFPA 20 and UL 218.
b. Listed by an NRTL for electric-motor driver for fire-pump service.
c. Combined automatic and nonautomatic **OR** Nonautomatic, **as directed**, operation.
d. Factory assembled, wired, and tested; continuous-duty rated.
e. Service Equipment Label: NRTL labeled for use as service equipment.
2. Method of Starting:
a. Pressure **OR** Nonpressure, **as directed**,-switch actuated.
1) Water-pressure-actuated switch and pressure transducer with independent high- and low-calibrated adjustments responsive to water pressure in fire-suppression piping.
2) System pressure recorder, electric ac driven, with spring backup.
3) Programmable minimum-run-time relay to prevent short cycling.
4) Programmable timer for weekly tests.
b. Across-the-line magnetic controller.
c. Emergency Start: Mechanically operated start handle that closes and retains the motor RUN contactor independent of all electric or pressure actuators.
3. Method of Stopping: Automatic and nonautomatic shutdown after automatic starting **OR** Nonautomatic, **as directed**.
4. Capacity: Rated for fire-pump-driver horsepower and short-circuit-current (withstand) rating equal to or greater than short-circuit current available at controller location.
5. Method of Isolation and Overcurrent Protection: Inverse-time, nonadjustable MCCB, with an externally mounted operating handle.
6. Door-Mounted Operator Interface and Controls:
a. Monitor, display, and control the devices, alarms, functions, and operations listed in NFPA 20 as required for drivers and controller types used.
b. Method of Control and Indication:
1) Microprocessor-based logic controller, with multiline LCD digital readout.
2) Membrane keypad.

3) LED alarm and status indicating lights.

c. Local and Remote, **as directed** Alarm and Status Indications:
   1) Controller power on.
   2) Motor running condition.
   3) Loss-of-line power.
   4) Line-power phase reversal.
   5) Line-power single-phase condition.

d. Audible alarm, with silence push button.

e. Nonautomatic START and STOP push buttons.

7. Optional Features:
   a. Extra Output Contacts:
      1) One N.O. contact(s) for motor running condition.
      2) One set(s) of contacts for loss-of-line power.
      3) One each, Form C contacts for high and low reservoir level.
   b. Local alarm bell.
   c. Door-mounted thermal or impact printer for alarm and status logs.
   d. Operator Interface Communications Ports: USB, Ethernet, and RS485.

8. ATS:
   a. Complies with NFPA 20, UL 218, and UL 1008.
   b. Integral with controller as a listed combination fire-pump controller and power transfer switch.
   c. Automatically transfers fire-pump controller from normal power supply to alternate power supply in event of power failure.
   d. Allows manual transfer from one source to the other.
   e. Alternate-Source Isolating and Disconnecting Means: Integral molded-case switch, with an externally mounted operating handle.

      OR

      Alternate-Source Isolating and Disconnecting Means: Mechanically interlocked isolation switch and circuit breaker rated at a minimum of 115 percent of rated motor full-load current, with an externally mounted operating handle; circuit breaker shall be provided with nonthermal sensing, instantaneous-only short-circuit overcurrent protection to comply with available fault currents.
   f. Local and Remote, **as directed**, Alarm and Status Indications:
      1) Normal source available.
      2) Alternate source available.
      3) In normal position.
      4) In alternate position.
      5) Isolating means open.
   g. Audible alarm, with silence push button.
   h. Nonautomatic (manual, nonelectric) means of transfer.
   i. Engine test push button.
   j. Start generator output contacts.
   k. Timer for weekly generator tests.

C. Standalone ATS
   1. General Requirements for Standalone ATS:
      a. Complies with NFPA 20, UL 218, and UL 1008.
      b. Listed by an NRTL for fire-pump service.
      c. Automatic and nonautomatic operation.
      d. Separate from controller and individually listed as a fire-pump-controller power transfer switch.
      e. Automatically transfers fire-pump controller from normal power supply to alternate power supply in event of power failure.
      f. Allows manual transfer from one source to the other; factory assembled, wired, and tested.
   2. Capacity: Rated for fire-pump-driver horsepower and short-circuit-current (withstand) rating equal to or greater than short-circuit current available at ATS location.

3. Alternate-Source Isolating and Disconnecting Means: Integral molded-case switch, with an externally mounted operating handle.
4. Alternate-Source Isolating and Disconnecting Means:
   a. Mechanically interlocked isolation switch and circuit breaker rated at a minimum of 115 percent of rated motor full-load current.
   b. Externally mounted operating handle.
   c. Circuit breaker provided with nonthermal sensing, instantaneous-only, short-circuit overcurrent protection.
   d. Equipped with a voltage surge arrester.
5. Door-Mounted Operator Interface and Controls:
   a. Monitor, display, and control devices, alarms, functions, and operations listed in NFPA 20 as required for drivers and controller types used.
   b. Method of Control and Indication:
      1) Microprocessor-based logic controller, with multiline LCD readout.
      2) Membrane keypad.
      3) LED alarm and status indicating lights.
   c. Local and Remote, **as directed**, Alarm and Status Indications:
      1) Normal source available.
      2) Alternate source available.
      3) In normal position.
      4) In alternate position.
      5) Isolating means open.
   d. Audible alarm, with silence push button.
   e. Nonautomatic (manual, nonelectric) means of transfer.
   f. Engine test push button.
   g. Start generator output contacts.
   h. Timer for weekly generator tests
6. Optional Features:
   a. Extra Output Contacts:
      1) One each, Form A; isolating means open.
      2) One each, Form C; in normal or alternate position
   b. Door-mounted thermal or impact printer for alarm and status logs.
   c. Operator Interface Communications Ports: USB, Ethernet, and RS485.

D. Controllers For Diesel-Drive Fire Pumps
1. General Requirements for Controllers:
   a. Comply with NFPA 20 and UL 218.
   b. Listed by an NRTL for diesel-engine driver for fire-pump service.
   c. Combined automatic and nonautomatic **OR** Nonautomatic, ,**as directed** operation.
   d. Factory assembled, wired, and tested.
2. Method of Starting:
   a. Pressure **OR** Nonpressure, **as directed**,-switch actuated.
      1) Water-pressure-actuated switch and pressure transducer with independent high- and low-calibrated adjustments responsive to water pressure in fire-suppression piping.
      2) System pressure recorder, electric ac driven, with spring backup.
      3) Programmable minimum-run-time relay to prevent short cycling.
      4) Programmable timer for weekly tests.
   b. Dual, redundant dc-voltage battery units, with automatic changeover.
   c. Emergency Control: Bypasses all automatic control circuits during manual starting and running.
   d. Automatic engine start on loss of ac power to the controller.
3. Method of Stopping: Automatic and nonautomatic shutdown after automatic starting **OR** Nonautomatic, **as directed**.
4. Door-Mounted Operator Interface and Controls:

a. Monitor, display, and control devices, alarms, functions, and operations listed in NFPA 20 as required for drivers and controller types used.
b. Method of Control and Indication:
   1) Microprocessor-based logic controller, with multiline LCD readout.
   2) Membrane keypad.
   3) LED alarm and status indicating lights.
c. Local and Remote, **as directed**, Alarm and Status Indications:
   1) Controller power on.
   2) Engine-lubrication-system critically low oil pressure.
   3) Engine-jacket coolant high temperature.
   4) Engine fail-to-start.
   5) Engine overspeed shutdown.
   6) Low fuel level.
   7) Missing or failed battery.
   8) Battery charger failure.
   9) System overpressure.
   10) ECM selector switch in alternate ECM position.
   11) Fuel injector malfunction.
d. Audible alarm.
e. Nonautomatic START and STOP push buttons or switches.

5. Optional Features:
   a. Extra Output Contacts:
      1) One Form C contacts for low pump-room temperature.
      2) One each, Form C contacts for high and low fuel levels.
      3) One each, Form C contacts for high and low reservoir levels.
   b. Door-mounted thermal or impact printer for alarm and status logs.
   c. Operator Interface Communications Ports: USB, Ethernet, and RS485.
   d. Powered louver contacts.
   e. Powered engine-oil heater contacts.
6. Battery Charger System:
   a. Built-in, independent, dual battery chargers with automatic changeover; 12-V dc **OR** 24-V dc, **as directed**, for lead-acid **OR** nickel-cadmium, **as directed**, batteries.
   b. Standard: UL 1236.

E. Remote Alarm Panels
1. General Requirements for Remote Alarm Panels: Comply with NFPA 20 and UL 218; listed by an NRTL for fire-pump service.
2. General Requirements for Remote Alarm Panels: Factory assembled, wired, and tested.
3. Supervisory and Normal Control Voltage: 120-V ac **OR** 240-V ac, **as directed**; single **OR** dual, **as directed**, source.
4. Audible and Visual Alarm and Status Indications:
   a. Driver running.
   b. Loss of phase.
   c. Phase reversal.
   d. Supervised power on.
   e. Common **OR** Separate, **as directed**, trouble on the controller.
   f. Controller connected to alternate power source.
5. Audible and Visual Alarm and Status Indications: Manufacturer's standard indicating lights; push-to-test **OR** non-push-to-test, with separate test push button, **as directed**.
   a. Engine running.
   b. Controller main switch turned to the off or manual position.
   c. Supervised power on.
   d. Common **OR** Separate, **as directed**, trouble on the controller or engine.
   e. Common pump room trouble.
   f. Controller connected to alternate power source.
6. Audible alarm, with silence push button.

7. Pump REMOTE START push button.

F. Low-Suction-Shutdown Panels
1. General Requirements for Low-Suction-Shutdown Panels:
   a. Listed by an NRTL for fire-pump service.
   b. Factory assembled, wired, and tested.
   c. Prevents automatic start of fire pump, and shuts down automatically started fire pump, on low-suction pressure.
   d. Automatic **OR** Manual, **as directed**, reset.
2. Operation: External contact input **OR** Integral pressure switch, **as directed**.
3. Supervisory and Normal Control Voltage: 120-V ac **OR** 240-V ac, **as directed**; single **OR** dual, **as directed**, source.
4. Include audible and visual alarms and status indications, with silence push button, for the following conditions:
   a. Control power available.
   b. Low-suction pressure.
   c. Normal-suction pressure.

G. Enclosures
1. Fire-Pump Controllers, ATS, Remote Alarm Panels, and Low-Suction-Shutdown Panels: NEMA 250, to comply with environmental conditions at installed locations and NFPA 20.
   a. Indoor, Dry and Clean Locations: Type 1 (IEC IP10).
   b. Indoor Locations Subject to Dripping Noncorrosive Liquids: Type 2 (IEC IP11).
   c. Outdoor Locations: Type 3R (IEC IP14) **OR** Type 4 (IEC IP56) **OR** Type 4X (IEC IP56), **as directed**.
   d. Other Wet or Damp, Indoor Locations: Type 4 (IEC IP56) **OR** Type 4X (IEC IP56), **as directed**.
   e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12 (IEC IP12).
2. Enclosure Color: Manufacturer's standard "fire-pump-controller red".
3. Nameplates: Comply with NFPA 20; complete with capacity, characteristics, approvals, listings, and other pertinent data.
4. Optional Features:
   a. Floor stands, 12 inches (305 mm) high, for floor-mounted controllers.
   b. Space heater, 120-V ac **OR** 240-V ac, **as directed**, with humidistat, **as directed**, with thermostat, **as directed**.
   c. Tropicalization.

H. Source Quality Control
1. Testing: Test and inspect fire-pump controllers according to requirements in NFPA 20 and UL 218.
   a. Verification of Performance: Rate controllers according to operation of functions and features specified.
2. Fire-pump controllers will be considered defective if they do not pass tests and inspections.
3. Prepare test and inspection reports.

1.3 EXECUTION

A. Examination
1. Examine areas and surfaces to receive equipment, with Installer present, for compliance with requirements and other conditions affecting performance.
2. Examine equipment before installation. Reject equipment that is wet or damaged by moisture or mold.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Controller Installation
   1. Install controllers within sight of their respective drivers.
   2. Connect controllers to their dedicated pressure-sensing lines.
   3. Wall-Mounting Controllers: Install controllers on walls with disconnect operating handles not higher than 79 inches (2006 mm) above finished floor, and bottom of enclosure not less than 12 inches (305 mm) above finished floor unless otherwise indicated. Bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Division 16 Section "Hangers and Supports for Electrical Systems."
   4. Floor-Mounting Controllers: Install controllers on 4-inch (100-mm) nominal-thickness concrete bases, using floor stands high enough so that the bottom of enclosure cabinet is not less than 12 inches (305 mm) above finished floor. Comply with requirements for concrete bases specified in Division 3 Section "Cast-in-Place Concrete."
      a. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
      b. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete floor.
      c. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
      d. Install anchor bolts to elevations required for proper attachment to supported equipment.
   5. Seismic Bracing: Comply with requirements specified in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."
   6. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
   7. Comply with NEMA ICS 15.

C. Standalone ATS Installation
   1. Wall-Mounting ATS: Install ATS on walls with disconnect operating handles not higher than 79 inches (2006 mm) above finished floor, and bottom of enclosure not less than 12 inches (305 mm) above finished floor unless otherwise indicated. Bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For ATS not on walls, provide freestanding racks complying with Division 16 Section "Hangers and Supports for Electrical Systems."
   2. Floor-Mounting ATS: Install ATS on 4-inch (100-mm) nominal-thickness concrete bases, using floor stands high enough so that the bottom of enclosure cabinet is not less than 12 inches (305 mm) above finished floor. Comply with requirements for concrete bases specified in Division 3 Section "Cast-in-Place Concrete."
      a. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
      b. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete floor.
      c. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
      d. Install anchor bolts to elevations required for proper attachment to supported equipment.
   3. Seismic Bracing: Comply with requirements specified in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."
   4. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Remote Alarm And Low-Suction-Shutdown, **as directed**, Panel Installation
   1. Install panels on walls with tops not higher than 72 inches (1829 mm) above finished floor unless otherwise indicated. Bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For ATS not on walls, provide freestanding racks complying with Division 16 Section "Hangers and Supports for Electrical Systems."

E. Power Wiring Installation

1. Install power wiring between controllers and their services or sources, and between controllers and their drivers. Comply with requirements in NFPA 20, NFPA 70, and Division 16 Section "Conductors and Cables."
2. Comply with NECA 1.

F. Control And Alarm Wiring Installation
1. Install wiring between controllers and remote devices and facility's central monitoring system, **as directed**. Comply with requirements in NFPA 20, NFPA 70, and Division 16 Section "Control-Voltage Electrical Power Cables."
2. Install wiring between remote alarm and low-suction-shutdown, **as directed**, panels and controllers. Comply with requirements in NFPA 20, NFPA 70, and Division 16 Section "Control-Voltage Electrical Power Cables."
3. Install wiring between controllers and the building's fire-alarm system. Comply with requirements specified in Division 13 Section "Digital, Addressable Fire-Alarm System."
4. Bundle, train, and support wiring in enclosures.
5. Connect remote manual and automatic activation devices where applicable.

G. Identification
1. Comply with requirements in NFPA 20 for marking fire-pump controllers.
2. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification in NFPA 20 and as specified in Division 16 Section "Electrical Identification."

H. Field Quality Control
1. Perform tests and inspections.
2. Acceptance Testing Preparation:
   a. Inspect and Test Each Component:
      1) Inspect wiring, components, connections, and equipment installations. Test and adjust components and equipment.
      2) Test insulation resistance for each element, component, connecting supply, feeder, and control circuits.
      3) Test continuity of each circuit.
   b. Verify and Test Each Electric-Driver Controller:
      1) Verify that voltages at controller locations are within plus 10 or minus 1 percent of motor nameplate rated voltages, with motors off. If outside this range for any motor, notify Owner before starting the motor(s).
      2) Test each motor for proper phase rotation.
   c. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
   d. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Field Acceptance Tests:
   a. Do not begin field acceptance testing until suction piping has been flushed and hydrostatically tested and the certificate for flushing and testing has been submitted to Owner and authorities having jurisdiction.
   b. Prior to starting, notify authorities having jurisdiction of the time and place of the acceptance testing.
   c. Engage manufacturer's factory-authorized service representative to be present during the testing.
   d. Perform field acceptance tests as outlined in NFPA 20.
4. Controllers will be considered defective if they do not pass tests and inspections.
5. Prepare test and inspection reports.

I. Startup Service
1. Perform startup service.
   a. Complete installation and startup checks according to manufacturer's written instructions.

J. Adjusting
   1. Adjust controllers and battery charger systems, **as directed**, to function smoothly and as recommended by manufacturer.
   2. Set field-adjustable switches, auxiliary relays, time-delay relays, and timers.
   3. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.
   4. Set field-adjustable pressure switches.

K. Protection
   1. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.
   2. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

L. Demonstration
   1. Train Owner's maintenance personnel to adjust, operate, and maintain controllers, remote alarm panels, **as directed**, low-suction-shutdown panels, **as directed**, and to use and reprogram microprocessor-based controls within this equipment, **as directed**.

END OF SECTION 13920c

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SECTION 13930 - WET-PIPE FIRE-SUPPRESSION SPRINKLERS

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for wet-pipe fire-suppression sprinklers. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section Includes:
a. Pipes, fittings, and specialties.
b. Fire-protection valves.
c. Fire-department connections.
d. Sprinklers.
e. Excess-pressure pumps.
f. Alarm devices.
g. Manual control stations.
h. Control panels.
i. Pressure gages.

C. Definitions
1. High-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure higher than standard 175 psig (1200 kPa), but not higher than 250 psig (1725 kPa) **OR** 300 psig (2070 kPa), **as directed**.
2. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig (1200 kPa) maximum.

D. System Descriptions
1. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.
2. Deluge Sprinkler System: Open sprinklers are attached to piping connected to water supply through deluge valve. Fire-detection system, in same area as sprinklers, opens valve. Water flows into piping system and discharges from attached sprinklers when valve opens.

E. Performance Requirements
1. Standard-Pressure Piping System Component: Listed for 175-psig (1200-kPa) minimum working pressure.
2. High-Pressure Piping System Component: Listed for 250-psig (1725-kPa) minimum **OR** 300-psig (2070-kPa), **as directed**, working pressure.
3. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
4. Sprinkler system design shall be approved by authorities having jurisdiction.
a. Margin of Safety for Available Water Flow and Pressure: 10 **OR** 20, **as directed**, percent, including losses through water-service piping, valves, and backflow preventers.
b. Sprinkler Occupancy Hazard Classifications:
1) Automobile Parking Areas: Ordinary Hazard, Group 1.
2) Building Service Areas: Ordinary Hazard, Group 1.
3) Churches: Light Hazard.
4) Electrical Equipment Rooms: Ordinary Hazard, Group 1.
5) Dry Cleaners: Ordinary Hazard, Group 2.

6) General Storage Areas: Ordinary Hazard, Group 1.
7) Laundries: Ordinary Hazard, Group 1.
8) Libraries except Stack Areas: Light Hazard.
9) Library Stack Areas: Ordinary Hazard, Group 2.
10) Machine Shops: Ordinary Hazard, Group 2.
11) Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
12) Office and Public Areas: Light Hazard.
13) Plastics Processing Areas: Extra Hazard, Group 2.
14) Printing Plants: Extra Hazard, Group 1.
15) Repair Garages: Ordinary Hazard, Group 2.
16) Residential Living Areas: Light Hazard.
17) Restaurant Service Areas: Ordinary Hazard, Group 1.
18) Solvent Cleaning Areas: Extra Hazard, Group 2.
19) Upholstering Plants: Extra Hazard, Group 1.

c. Minimum Density for Automatic-Sprinkler Piping Design:
1) Residential (Dwelling) Occupancy: 0.05 gpm over 400-sq. ft. (2.04 mm/min. over 37.2-sq. m) area.
2) Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. (4.1 mm/min. over 139-sq. m) area.
3) Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. (6.1 mm/min. over 139-sq. m) area.
4) Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. (8.1 mm/min. over 139-sq. m) area.
5) Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq. ft. (12.2 mm/min. over 232-sq. m) area.
6) Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2500-sq. ft. (16.3 mm/min. over 232-sq. m) area.
7) Special Occupancy Hazard: As determined by authorities having jurisdiction.

d. Minimum Density for Deluge-Sprinkler Piping Design:
1) Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm (6.1 mm/min.) over entire area.
2) Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm (8.1 mm/min.) over entire area.
3) Extra-Hazard, Group 1 Occupancy: 0.30 gpm (12.2 mm/min.) over entire area.
4) Extra-Hazard, Group 2 Occupancy: 0.40 gpm (16.3 mm/min.) over entire area.
5) Special Occupancy Hazard: As determined by authorities having jurisdiction.

e. Maximum Protection Area per Sprinkler: Per UL listing.
OR
Maximum Protection Area per Sprinkler:
1) Residential Areas: 400 sq. ft. (37 sq. m).
2) Office Spaces: 120 sq. ft. (11.1 sq. m) **OR** 225 sq. ft. (20.9 sq. m), **as directed**.
3) Storage Areas: 130 sq. ft. (12.1 sq. m).
4) Mechanical Equipment Rooms: 130 sq. ft. (12.1 sq. m).
5) Electrical Equipment Rooms: 130 sq. ft. (12.1 sq. m).
6) Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

f. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
1) Light-Hazard Occupancies: 100 gpm (6.3 L/s) for 30 minutes.
2) Ordinary-Hazard Occupancies: 250 gpm (15.75 L/s) for 60 to 90 minutes.
3) Extra-Hazard Occupancies: 500 gpm (31.5 L/s) for 90 to 120 minutes.

5. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

F. Submittals
1. Product Data: For each type of product indicated.
2. LEED Submittal:

a. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content and chemical components.

3. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
   a. Wiring Diagrams: For power, signal, and control wiring.
4. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
5. Qualification Data: For qualified Installer and professional engineer, **as directed**.
6. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
7. Welding certificates.
8. Fire-hydrant flow test report.
9. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
10. Field quality-control reports.
11. Operation and maintenance data.

G. Quality Assurance
1. Installer Qualifications:
   a. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
      1) Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
2. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
3. 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.
4. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
   a. NFPA 13, "Installation of Sprinkler Systems."
   b. NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."
   c. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

H. Project Conditions
1. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
   a. Notify the Owner no fewer than two days in advance of proposed interruption of sprinkler service.
   b. Do not proceed with interruption of sprinkler service without the Owner's written permission.

1.2 PRODUCTS

A. Piping Materials
1. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

B. Steel Pipe And Fittings
1. Standard Weight, Galvanized- and Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

2. Schedule 30, Galvanized- and Black-Steel Pipe: ASTM A 135; ASTM A 795/A 795M, Type E; or ASME B36.10M, wrought steel; with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.
3. Thinwall Galvanized- and Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.
4. Schedule 10, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 10 in NPS 5 (DN 125) and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10 (DN 150 to DN 250), plain end.
5. Nonstandard OD, Thinwall Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, thinwall, with plain ends and wall thickness less than Schedule 10.
6. Hybrid Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, lightwall, with wall thickness less than Schedule 10 and greater than Schedule 5.
7. Schedule 5 Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, lightwall, with plain ends.
8. Galvanized- and Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
9. Galvanized and Uncoated, Steel Couplings: ASTM A 865, threaded.
10. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
11. Malleable- or Ductile-Iron Unions: UL 860.
12. Cast-Iron Flanges: ASME 16.1, Class 125.
13. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
14. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
15. Grooved-Joint, Steel-Pipe Appurtenances:
    a. Pressure Rating: 175 psig (1200 kPa) **OR** 250 psig (1725 kPa) **OR** 300 psig (2070 kPa), **as directed**, minimum.
    b. Galvanized and Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
    c. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.
16. Steel Pressure-Seal Fittings: UL 213, FM-approved, 175-psig (1200-kPa) pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

C. Copper Tube And Fittings
1. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) and ASTM B 88, Type M (ASTM B 88M, Type C) water tube, drawn temper.
2. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
3. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.
4. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
5. 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.
6. Copper Pressure-Seal Fittings:
    a. Standard: UL 213.
    b. NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
    c. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Cast-bronze fitting with EPDM-rubber O-ring seal in each end.
7. Grooved-Joint, Copper-Tube Appurtenances:
    a. Grooved-End, Copper Fittings: ASTM B 75 (ASTM B 75M), copper tube or ASTM B 584, bronze castings.

b. Grooved-End-Tube Couplings: To fit copper-tube dimensions, with design similar to AWWA C606. Include ferrous housing sections, EPDM-rubber gasket suitable for hot and cold water, and bolts and nuts.

8. Copper-Tube, Extruded-Tee Connections:
   a. Description: Tee formed in copper tube according to ASTM F 2014.

D. CPVC Pipe And Fittings
1. CPVC Pipe: ASTM F 442/F 442M and UL 1821, SDR 13.5, for 175-psig (1200-kPa) rated pressure at 150 deg F (62 deg C), with plain ends. Include "LISTED" and "CPVC SPRINKLER PIPE" markings.
2. CPVC Fittings: UL listed or FM approved, for 175-psig (1200-kPa) rated pressure at 150 deg F (62 deg C), socket type. Include "LISTED" and "CPVC SPRINKLER FITTING" markings.
   a. NPS 3/4 to NPS 1-1/2 (DN 20 to DN 40): ASTM F 438 and UL 1821, Schedule 40, socket type.
   b. NPS 2 to NPS 3 (DN 50 to DN 80): ASTM F 439 and UL 1821, Schedule 80, socket type.
   c. CPVC-to-Metal Transition Fittings: CPVC, one piece, with dimensions equivalent to pipe; one end with threaded brass insert, and one socket end.
   d. CPVC-to-Metal Transition Unions: CPVC, with dimensions equivalent to pipe; one end with threaded brass insert, and one socket end.
   e. Flanges: CPVC, one or two pieces.

E. Piping Joining Materials
1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free.
   a. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
   b. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.
2. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
3. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
4. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
5. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493, solvent cement recommended by pipe and fitting manufacturer, and made for joining CPVC sprinkler pipe and fittings. Include cleaner or primer recommended by pipe and fitting manufacturer.
   a. Use solvent cement that has a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   b. Use adhesive primer that has a VOC content of 650 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Plastic, Pipe-Flange Gasket, and Bolts and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

F. Cover System For Sprinkler Piping
1. Description: System of support brackets and covers made to protect sprinkler piping.
2. Brackets: Glass-reinforced nylon.
3. Covers: Extruded PVC sections of length, shape, and size required for size and routing of CPVC piping.

G. Listed Fire-Protection Valves
1. General Requirements:
   a. Valves shall be UL listed or FM approved.
   b. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig (1200 kPa).
   c. Minimum Pressure Rating for High-Pressure Piping: 250 psig (1725 kPa) **OR** 300 psig (2070 kPa), **as directed**.
2. Ball Valves:

a. Standard: UL 1091 except with ball instead of disc.
b. Valves NPS 1-1/2 (DN 40) and Smaller: Bronze body with threaded ends.
c. Valves NPS 2 and NPS 2-1/2 (DN 50 and DN 65): Bronze body with threaded ends or ductile-iron body with grooved ends.
d. Valves NPS 3 (DN 80): Ductile-iron body with grooved ends.

3. Bronze Butterfly Valves:
   a. Standard: UL 1091.
   b. Pressure Rating: 175 psig (1200 kPa).
   c. Body Material: Bronze.
   d. End Connections: Threaded.
4. Iron Butterfly Valves:
   a. Standard: UL 1091.
   b. Pressure Rating: 175 psig (1200 kPa).
   c. Body Material: Cast or ductile iron.
   d. Style: Lug or wafer.
      OR
      End Connections: Grooved.
5. Check Valves:
   a. Standard: UL 312.
   b. Pressure Rating: 250 psig (1725 kPa) minimum **OR** 300 psig (2070 kPa), **as directed**.
   c. Type: Swing check.
   d. Body Material: Cast iron.
   e. End Connections: Flanged or grooved.
6. Bronze OS&Y Gate Valves:
   a. Standard: UL 262.
   b. Pressure Rating: 175 psig (1200 kPa).
   c. Body Material: Bronze.
   d. End Connections: Threaded.
7. Iron OS&Y Gate Valves:
   a. Standard: UL 262.
   b. Pressure Rating: 250 psig (1725 kPa) minimum **OR** 300 psig (2070 kPa), **as directed**.
   c. Body Material: Cast or ductile iron.
   d. End Connections: Flanged or grooved.
8. Indicating-Type Butterfly Valves:
   a. Standard: UL 1091.
   b. Pressure Rating: 175 psig (1200 kPa) minimum.
   c. Valves NPS 2 (DN 50) and Smaller:
      1) Valve Type: Ball or butterfly.
      2) Body Material: Bronze.
      3) End Connections: Threaded.
   d. Valves NPS 2-1/2 (DN 65) and Larger:
      1) Valve Type: Butterfly.
      2) Body Material: Cast or ductile iron.
      3) End Connections: Flanged, grooved, or wafer.
   e. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch **OR** electrical, 115-V ac, prewired, two-circuit, supervisory switch **OR** visual, **as directed**, indicating device.
9. NRS Gate Valves:
   a. Standard: UL 262.
   b. Pressure Rating: 250 psig (1725 kPa) minimum **OR** 300 psig (2070 kPa), **as directed**.
   c. Body Material: Cast iron with indicator post flange.
   d. Stem: Nonrising.
   e. End Connections: Flanged or grooved.
10. Indicator Posts:
    a. Standard: UL 789.

b. Type: Horizontal for wall mounting.
c. Body Material: Cast iron with extension rod and locking device.
d. Operation: Wrench **OR** Hand wheel, **as directed**.

H. Trim And Drain Valves
1. General Requirements:
a. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
b. Pressure Rating: 175 psig (1200 kPa) minimum.
2. Angle Valves.
3. Ball Valves.
4. Globe Valves.
5. Plug Valves.

I. Specialty Valves
1. General Requirements:
a. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
b. Pressure Rating:
1) Standard-Pressure Piping Specialty Valves: 175 psig (1200 kPa) minimum.
2) High-Pressure Piping Specialty Valves: 250 psig (1725 kPa) minimum **OR** 300 psig (2070 kPa), **as directed**.
c. Body Material: Cast or ductile iron.
d. Size: Same as connected piping.
e. End Connections: Flanged or grooved.
2. Alarm Valves:
a. Standard: UL 193.
b. Design: For horizontal or vertical installation.
c. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, **as directed**, and fill-line attachment with strainer.
d. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
OR
Drip Cup Assembly: Pipe drain with check valve to main drain piping.
3. Deluge Valves:
a. Standard: UL 260.
b. Design: Hydraulically operated, differential-pressure type.
c. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, drip cup assembly piped without valves and separate from main drain line, fill-line attachment with strainer, and push-rod chamber supply connection.
d. Wet, Pilot-Line Trim Set: Include gage to read push-rod chamber pressure, globe valve for manual operation of deluge valve, and connection for actuation device.
4. Automatic (Ball Drip) Drain Valves:
a. Standard: UL 1726.
b. Pressure Rating: 175 psig (1200 kPa) minimum.
c. Type: Automatic draining, ball check.
d. Size: NPS 3/4 (DN 20).
e. End Connections: Threaded.

J. Fire-Department Connections
1. Exposed-Type, Fire-Department Connection:
a. Standard: UL 405.
b. Type: Exposed, projecting, for wall mounting.
c. Pressure Rating: 175 psig (1200 kPa) minimum.
d. Body Material: Corrosion-resistant metal.

e. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
f. Caps: Brass, lugged type, with gasket and chain.
g. Escutcheon Plate: Round, brass, wall type.
h. Outlet: Back, with pipe threads.
i. Number of Inlets: Two **OR** Three, **as directed**.
j. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE" **OR** "AUTO SPKR", **as directed**.
k. Finish: Polished chrome plated **OR** Rough brass or bronze **OR** Rough chrome plated, **as directed**.
l. Outlet Size: NPS 4 (DN 100) **OR** NPS 5 (DN 125) **OR** NPS 6 (DN 150), **as directed**.

2. Flush-Type, Fire-Department Connection:
   a. Standard: UL 405.
   b. Type: Flush, for wall mounting.
   c. Pressure Rating: 175 psig (1200 kPa) minimum.
   d. Body Material: Corrosion-resistant metal.
   e. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
   f. Caps: Brass, lugged type, with gasket and chain.
   g. Escutcheon Plate: Rectangular, brass, wall type.
   h. Outlet: With pipe threads.
   i. Body Style: Horizontal **OR** Square **OR** Vertical, **as directed**.
   j. Number of Inlets: Two **OR** Three **OR** Four **OR** Six, **as directed**.
   k. Outlet Location: Back **OR** Bottom **OR** Left side **OR** Right side **OR** Top, **as directed**.
   l. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE" **OR "**AUTO SPKR", **as directed**.
   m. Finish: Polished chrome plated **OR** Rough brass or bronze **OR** Rough chrome plated, **as directed**.
   n. Outlet Size: NPS 4 (DN 100) **OR** NPS 5 (DN 125) **OR** NPS 6 (DN 150) **OR** NPS 8 (DN 200), **as directed**.
3. Yard-Type, Fire-Department Connection:
   a. Standard: UL 405.
   b. Type: Exposed, freestanding.
   c. Pressure Rating: 175 psig (1200 kPa) minimum **OR** 300 psig (2070 kPa), **as directed**.
   d. Body Material: Corrosion-resistant metal.
   e. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
   f. Caps: Brass, lugged type, with gasket and chain.
   g. Escutcheon Plate: Round, brass, floor type.
   h. Outlet: Bottom, with pipe threads.
   i. Number of Inlets: Two **OR** Three **OR** Four, **as directed**.
   j. Sleeve: Brass **OR** Not required, **as directed**.
   k. Sleeve Height: 18 inches (460 mm).
   l. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE" **OR** "AUTO SPKR", **as directed**.
   m. Finish, Including Sleeve: Polished chrome plated **OR** Rough brass or bronze **OR** Rough chrome plated, **as directed**.
   n. Outlet Size: NPS 4 (DN 100) **OR** NPS 5 (DN 125) **OR** NPS 6 (DN 150), **as directed**.

K. Sprinkler Specialty Pipe Fittings
1. Branch Outlet Fittings:
   a. Standard: UL 213.

b. Pressure Rating: 175 psig (1200 kPa) minimum **OR** 300 psig (2070 kPa), **as directed**.
c. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
d. Type: Mechanical-T and -cross fittings.
e. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
f. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
g. Branch Outlets: Grooved, plain-end pipe, or threaded.

2. Flow Detection and Test Assemblies:
   a. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   b. Pressure Rating: 175 psig (1200 kPa) minimum **OR** 300 psig (2070 kPa), **as directed**.
   c. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
   d. Size: Same as connected piping.
   e. Inlet and Outlet: Threaded.
3. Branch Line Testers:
   a. Standard: UL 199.
   b. Pressure Rating: 175 psig (1200 kPa).
   c. Body Material: Brass.
   d. Size: Same as connected piping.
   e. Inlet: Threaded.
   f. Drain Outlet: Threaded and capped.
   g. Branch Outlet: Threaded, for sprinkler.
4. Sprinkler Inspector's Test Fittings:
   a. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   b. Pressure Rating: 175 psig (1200 kPa) minimum **OR** 300 psig (2070 kPa), **as directed**.
   c. Body Material: Cast- or ductile-iron housing with sight glass.
   d. Size: Same as connected piping.
   e. Inlet and Outlet: Threaded.
5. Adjustable Drop Nipples:
   a. Standard: UL 1474.
   b. Pressure Rating: 250 psig (1725 kPa) minimum **OR** 300 psig (2070 kPa), **as directed**.
   c. Body Material: Steel pipe with EPDM-rubber O-ring seals.
   d. Size: Same as connected piping.
   e. Length: Adjustable.
   f. Inlet and Outlet: Threaded.
6. Flexible, Sprinkler Hose Fittings:
   a. Standard: UL 1474.
   b. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
   c. Pressure Rating: 175 psig (1200 kPa) minimum **OR** 300 psig (2070 kPa), **as directed**.
   d. Size: Same as connected piping, for sprinkler.

L. Sprinklers
1. General Requirements:
   a. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   b. Pressure Rating for Residential Sprinklers: 175 psig (1200 kPa) maximum.
   c. Pressure Rating for Automatic Sprinklers: 175 psig (1200 kPa) minimum.
   d. Pressure Rating for High-Pressure Automatic Sprinklers: 250 psig (1725 kPa) minimum **OR** 300 psig (2070 kPa), **as directed**.
2. Automatic Sprinklers with Heat-Responsive Element:
   a. Early-Suppression, Fast-Response Applications: UL 1767.
   b. Nonresidential Applications: UL 199.
   c. Residential Applications: UL 1626.

d. Characteristics: Nominal 1/2-inch (12.7-mm) orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

3. Open Sprinklers with Heat-Responsive Element Removed: UL 199.
   a. Characteristics:
      1) Nominal 1/2-inch (12.7-mm) Orifice: With Discharge Coefficient K between 5.3 and 5.8.
      2) Nominal 17/32-inch (13.5-mm) Orifice: With Discharge Coefficient K between 7.4 and 8.2.
4. Sprinkler Finishes:
   a. Chrome plated.
   b. Bronze.
   c. Painted.
5. Special Coatings:
   a. Wax.
   b. Lead.
   c. Corrosion-resistant paint.
6. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
   a. Ceiling Mounting: Chrome-plated steel, one piece, flat **OR** Chrome-plated steel, two piece, with 1-inch (25-mm) vertical adjustment **OR** Plastic, white finish, one piece, flat, **as directed**.
   b. Sidewall Mounting: Chrome-plated steel **OR** Plastic, white finish, **as directed**, one piece, flat.
7. Sprinkler Guards:
   a. Standard: UL 199.
   b. Type: Wire cage with fastening device for attaching to sprinkler.

M. Excess-Pressure Pumps
1. Pump: Factory-fabricated, positive-displacement, gear type.
   a. Pump and Motor: Directly connected.
   b. Motor: Comply with requirements in Division 15 Section "Common Work Results For Fire Suppression".
2. Miscellaneous Components: Wet-pipe kit of switches, fittings, valves, mounting brackets, and connections for power, hydraulic piping, and wiring from alarm devices.
3. Motor Control: Differential-pressure switch.
4. Lights: To indicate sprinkler system's operating condition.
   a. White Light: Pressure is normal.
   b. Red Light: Pressure is low.
5. Capacity: 2.0 gpm at 75-psig (0.13 L/s at 520-kPa) differential pressure and 1/3 hp **OR** 1.85 gpm at 100-psig (0.12 L/s at 690-kPa) differential pressure and 1/2 hp **OR** 3.5 gpm at 100-psig (0.22 L/s at 690-kPa) differential pressure and 1/2 hp, **as directed**.

N. Alarm Devices
1. Alarm-device types shall match piping and equipment connections.
2. Water-Motor-Operated Alarm:
   a. Standard: UL 753.
   b. Type: Mechanically operated, with Pelton wheel.
   c. Alarm Gong: Cast aluminum with red-enamel factory finish.
   d. Size: 10-inch (250-mm) diameter.
   e. Components: Shaft length, bearings, and sleeve to suit wall construction.
   f. Inlet: NPS 3/4 (DN 20).
   g. Outlet: NPS 1 (DN 25) drain connection.
3. Electrically Operated Alarm Bell:

a. Standard: UL 464.
b. Type: Vibrating, metal alarm bell.
c. Size: 6-inch (150-mm) minimum-diameter **OR** 8-inch (200-mm) minimum-diameter **OR** 10-inch (250-mm) diameter, **as directed**.
d. Finish: Red-enamel factory finish, suitable for outdoor use.

4. Water-Flow Indicators:
   a. Standard: UL 346.
   b. Water-Flow Detector: Electrically supervised.
   c. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
   d. Type: Paddle operated.
   e. Pressure Rating: 250 psig (1725 kPa).
   f. Design Installation: Horizontal or vertical.
5. Pressure Switches:
   a. Standard: UL 346.
   b. Type: Electrically supervised water-flow switch with retard feature.
   c. Components: Single-pole, double-throw switch with normally closed contacts.
   d. Design Operation: Rising pressure signals water flow.
6. Valve Supervisory Switches:
   a. Standard: UL 346.
   b. Type: Electrically supervised.
   c. Components: Single-pole, double-throw switch with normally closed contacts.
   d. Design: Signals that controlled valve is in other than fully open position.
7. Indicator-Post Supervisory Switches:
   a. Standard: UL 346.
   b. Type: Electrically supervised.
   c. Components: Single-pole, double-throw switch with normally closed contacts.
   d. Design: Signals that controlled indicator-post valve is in other than fully open position.

O. Manual Control Stations
1. Description: UL listed or FM approved, hydraulic operation, with union, NPS 1/2 (DN 15) pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

P. Control Panels
1. Description: Single-area, two-area, or single-area cross-zoned control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves. Panels contain power supply; battery charger; standby batteries; field-wiring terminal strip; electrically supervised solenoid valves and polarized fire-alarm bell; lamp test facility; single-pole, double-throw auxiliary alarm contacts; and rectifier.
   a. Panels: UL listed and FM approved when used with thermal detectors and Class A detector circuit wiring. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
   b. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.
      OR
      Manual Control Stations: Hydraulic operation, with union, NPS 1/2 (DN 15) pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

Q. Pressure Gages

1. Standard: UL 393.
2. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.
3. Pressure Gage Range: 0 to 250 psig (0 to 1725 kPa) minimum **OR** 0 to 300 psig (0 to 2070 kPa), **as directed**.
4. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
5. Air System Piping Gage: Include retard feature, **directed**, and "AIR" or "AIR/WATER" label on dial face.

R. Escutcheons
1. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
2. One-Piece, Cast-Brass Escutcheons: Polished chrome-plated **OR** rough-brass, **as directed**, finish with set-screws.
3. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with chrome-plated finish.
4. One-Piece, Stamped-Steel Escutcheons: Chrome-plated finish with set-screw **OR** spring clips, **as directed**.
5. Split-Casting, Cast-Brass Escutcheons: Polished chrome-plated **OR** rough-brass, **as directed**, finish with concealed hinge and set-screw.
6. Split-Plate, Stamped-Steel Escutcheons: Chrome-plated finish with concealed **OR** exposed-rivet, **as directed**, hinge, set-screw **OR** spring clips, **as directed**.
7. One-Piece Floor Plates: Cast-iron flange with holes for fasteners, **as directed**.
8. Split-Casting Floor Plates: Cast brass with concealed hinge.

S. Sleeves
1. Cast-Iron Wall Pipe Sleeves: Cast or fabricated of cast iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
2. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
3. Molded-PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
4. Molded-PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.
5. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
6. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, standard weight, zinc coated, plain ends.
7. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
   a. Underdeck Clamp: Clamping ring with set-screws.

T. Sleeve Seals
1. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
   a. Sealing Elements: EPDM-rubber or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   b. Pressure Plates: Carbon steel **OR** Plastic **OR** Stainless steel, **as directed**.
   c. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating **OR** Stainless steel, **as directed**, of length required to secure pressure plates to sealing elements.

U. Grout
1. Standard: ASTM C 1107, Grade B, posthardening and volume adjusting, dry, hydraulic-cement grout.
2. Characteristics: Nonshrink, and recommended for interior and exterior applications.
3. Design Mix: 5000-psi (34-MPa), 28-day compressive strength.
4. Packaging: Premixed and factory packaged.

1.3 EXECUTION

A. Preparation
1. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
2. Report test results promptly and in writing.

B. Service-Entrance Piping
1. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Division 02 Section "Facility Fire-suppression Water-service Piping".
2. Install shutoff valve, backflow preventer, **as directed**, pressure gage, drain, and other accessories indicated at connection to water-service piping. Comply with requirements for backflow preventers in Division 02 Section "Facility Fire-suppression Water-service Piping", **as directed**.
OR
Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

C. Water-Supply Connections
1. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements for interior piping in Division 15 Section "Domestic Water Piping".
2. Install shutoff valve, backflow preventer, **as directed**, pressure gage, drain, and other accessories indicated at connection to water-distribution piping. Comply with requirements for backflow preventers in Division 15 Section "Domestic Water Piping Specialties", **as directed**.
OR
Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

D. Piping Installation
1. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
   a. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with the Owner before deviating from approved working plans.
2. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
3. Install seismic restraints on piping. Comply with requirements for seismic-restraint device materials and installation in NFPA 13.
4. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
5. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.
6. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
7. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
8. Install sprinkler piping with drains for complete system drainage.
9. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
10. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
11. Install alarm devices in piping systems.
12. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
13. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

14. Pressurize and check preaction sprinkler system piping and air-pressure maintenance devices **OR** air compressors, **as directed**.
15. Fill sprinkler system piping with water.
16. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing. Comply with requirements for heating cables in Division 15 Section "Heat Tracing For Fire-suppression Piping" and for piping insulation in Division 15 Section "Fire-suppression Systems Insulation".

E. Joint Construction
1. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
2. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.
3. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
4. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
5. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
6. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
7. 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:
   a. Apply appropriate tape or thread compound to external pipe threads.
   b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
8. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
9. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
10. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
    a. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
11. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
12. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
13. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
14. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
15. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
16. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and copper pressure-seal fittings with tools recommended by fitting manufacturer.
17. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
18. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

19. Plastic-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
    a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
    b. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

F. Installation Of Cover System For Sprinkler Piping
1. Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and with NFPA 13 or NFPA 13R for supports.

G. Valve And Specialties Installation
1. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
2. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
3. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
4. Specialty Valves:
    a. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
    b. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.
    c. Deluge Valves: Install in vertical position, in proper direction of flow, and in main supply to deluge system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

H. Excess-Pressure Pump Installation
1. Assemble components and mount on wood backing. Comply with requirements in Division 06 Section "Rough Carpentry" for wood backing material and installation.
2. Install excess-pressure pumps, controls, devices, and supports for sprinkler piping application.
    a. Mounting: Install on wall, where indicated **OR** attached to water-supply pipe, **as directed**.

I. Sprinkler Installation
1. Install sprinklers in suspended ceilings in center of narrow dimension of, **as directed**, acoustical ceiling panels.
2. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
3. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

J. Fire-Department Connection Installation
1. Install wall-type, fire-department connections.
2. Install yard-type, fire-department connections in concrete slab support. Comply with requirements for concrete in Division 03 Section "Cast-in-place Concrete".
    a. Install two **OR** three, **as directed**, protective pipe bollards around **OR** on sides of, **as directed**, each fire-department connection. Comply with requirements for bollards in Division 05 Section "Metal Fabrications".
3. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

K. Escutcheon Installation
1. Install escutcheons for penetrations of walls, ceilings, and floors.
2. Escutcheons for New Piping:
    a. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
    b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish **OR** stamped steel with set-screw **OR** stamped steel with set-screw or spring clips **OR** stamped steel with spring clips, **as directed**.

c. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish **OR** One piece or split casting, cast brass with polished chrome-plated finish **OR** Split casting, cast brass with polished chrome-plated finish **OR** One piece, stamped steel with set-screw **OR** One piece or split plate, stamped steel with set-screw **OR** Split plate, stamped steel with set-screw, **as directed**.

d. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish **OR** cast brass with rough-brass finish **OR** stamped steel with set-screw **OR** stamped steel with spring clips **OR** stamped steel with set-screw or spring clips, **as directed**.

e. Bare Piping in Equipment Rooms: One piece, cast brass **OR** stamped steel with set-screw **OR** stamped steel with spring clips **OR** stamped steel with set-screw or spring clips, **as directed**.

f. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3. Escutcheons for Existing Piping:

a. Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.

b. Insulated Piping: Split plate, stamped steel with concealed or exposed-rivet hinge and spring clips.

c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish **OR** plate, stamped steel with concealed hinge and spring clips, **as directed**.

d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish **OR** plate, stamped steel with concealed hinge and set-screw, **as directed**.

e. Bare Piping in Unfinished Service Spaces: Split casting, cast brass with polished chrome-plated finish **OR** casting, cast brass with rough-brass finish **OR** plate, stamped steel with concealed hinge and set-screw or spring clips **OR** plate, stamped steel with concealed or exposed-rivet hinge and set-screw or spring clips **OR** plate, stamped steel with exposed-rivet hinge and set-screw or spring clips, **as directed**.

f. Bare Piping in Equipment Rooms: Split casting, cast brass **OR** plate, stamped steel with set-screw or spring clips, **as directed**.

g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.

L. Sleeve Installation

1. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
2. Sleeves are not required for core-drilled holes.
3. Permanent sleeves are not required for holes formed by removable PE sleeves.
4. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
5. Install sleeves in new partitions, slabs, and walls as they are built.
6. 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 for joint sealants in Division 07 Section "Joint Sealants".
7. 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 for joint sealants in Division 07 Section "Joint Sealants".
8. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals.
9. Seal space outside of sleeves in concrete slabs and walls with grout.
10. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
11. Install sleeve materials according to the following applications:

a. Sleeves for Piping Passing through Concrete Floor Slabs: Molded PE **OR** Molded PVC **OR** Galvanized-steel pipe, **as directed**.

b. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Galvanized-steel pipe **OR** Stack sleeve fittings, **as directed**.

1) Extend sleeves 2 inches (50 mm) above finished floor level.
2) For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Comply with requirements for flashing in Division 07 Section "Sheet Metal Flashing And Trim".

c. Sleeves for Piping Passing through Gypsum-Board Partitions:
1) PVC-pipe **OR** Galvanized-steel-pipe, **as directed**, sleeves for pipes smaller than NPS 6 (DN 150).
2) Galvanized-steel-sheet sleeves for pipes NPS 6 (DN 150) and larger.
3) Exception: Sleeves are not required for water-supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.

d. Sleeves for Piping Passing through Concrete Roof Slabs: Molded PE **OR** Molded PVC **OR** Galvanized-steel pipe, **as directed**.

e. Sleeves for Piping Passing through Exterior Concrete Walls:
1) Galvanized-steel-pipe sleeves for pipes smaller than NPS 6 (DN 150).
2) Cast-iron wall-pipe sleeves for pipes NPS 6 (DN 150) and larger.
3) Install sleeves that are large enough to provide 1-inch (25-mm) annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.

f. Sleeves for Piping Passing through Interior Concrete Walls:
1) PVC-pipe **OR** Galvanized-steel-pipe, **as directed**, sleeves for pipes smaller than NPS 6 (DN 150).
2) Galvanized-steel-sheet sleeves for pipes NPS 6 (DN 150) and larger.

12. 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 for firestop materials and installations in Division 07 Section "Through-penetration Firestop Systems".

M. Sleeve Seal Installation
1. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
2. 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.

N. Identification
1. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
2. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 16 Section "Electrical Identification".

O. Field Quality Control
1. Perform tests and inspections.
2. Tests and Inspections:
a. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
b. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
c. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
d. Energize circuits to electrical equipment and devices.
e. Start and run excess-pressure pumps.
f. Coordinate with fire-alarm tests. Operate as required.
g. Coordinate with fire-pump tests. Operate as required.
h. Verify that equipment hose threads are same as local fire-department equipment.
3. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

4. Prepare test and inspection reports.

P. Cleaning
1. Clean dirt and debris from sprinklers.
2. Remove and replace sprinklers with paint other than factory finish.

Q. Piping Schedule
1. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded **OR** grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved, **as directed**, joints.
2. Sprinkler specialty fittings may be used, downstream of control vales, instead of specified fittings.
3. Copper-tube, extruded-tee connections may be used for tee branches in copper tubing instead of specified copper fittings. Branch-connection joints must be brazed.
4. CPVC pipe; Schedule 40 **OR** Schedule 80, **as directed**, CPVC fittings; and solvent-cemented joints may be used for light-hazard and residential occupancies.
5. Standard-pressure, wet-pipe sprinkler system, NPS 2 (DN 50) and smaller, shall be one of the following:
   a. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
   b. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
   c. Standard-weight or Schedule 30, black-steel pipe with plain ends; uncoated, plain-end-pipe fittings; and twist-locked joints.
   d. Standard-weight or Schedule 30, galvanized-steel pipe with plain ends; galvanized, plain-end-pipe fittings; and twist-locked joints.
   e. Standard-weight or Schedule 30, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
   f. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
   g. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
   h. Thinwall **OR** Schedule 10, **as directed**, nonstandard OD, thinwall or hybrid black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
   i. Thinwall **OR** Schedule 10, **as directed**, or hybrid black-steel pipe with plain ends; uncoated, plain-end-pipe fittings; and twist-locked joints.
   j. Thinwall **OR** Schedule 10, **as directed**, nonstandard OD, thinwall or hybrid black-steel pipe with plain ends; welding fittings; and welded joints.
   k. Schedule 5 steel pipe; steel pressure-seal fittings; and pressure-sealed joints.
   l. Type L (Type B) **OR** Type M (Type C), **as directed**, hard copper tube with plain ends; cast- or wrought-copper solder-joint fittings; and brazed joints.
   m. Type L (Type B) **OR** Type M (Type C), **as directed**, hard copper tube with plain ends; copper pressure-seal fittings; and pressure-sealed joints.
   n. NPS 2 (DN 50), Type L (Type B) **OR** Type M (Type C), **as directed**, hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.
6. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4 (DN 65 to DN 100), shall be one of the following:
   a. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
   b. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.

c. Standard-weight or Schedule 30, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
d. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
e. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
f. Thinwall **OR** Schedule 10, **as directed**, nonstandard OD, thinwall or hybrid black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
g. Thinwall **OR** Schedule 10, **as directed**, nonstandard OD, thinwall or hybrid black-steel pipe with plain ends; welding fittings; and welded joints.
h. Type L (Type B) **OR** Type M (Type C), **as directed**, hard copper tube with plain ends; cast- or wrought-copper solder-joint fittings; and brazed joints.
i. Type L (Type B) **OR** Type M (Type C), **as directed**, hard copper tube with plain ends; copper pressure-seal fittings; and pressure-sealed joints.
j. Type L (Type B) **OR** Type M (Type C), **as directed**, hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.

7. Standard-pressure, wet-pipe sprinkler system, NPS 5 (DN 125) and larger, shall be one of the following:
   a. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
   b. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
   c. Standard-weight or Schedule 30, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
   d. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
   e. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
   f. Thinwall **OR** Schedule 10, **as directed**, or hybrid black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
   g. Thinwall **OR** Schedule 10, **as directed**, or hybrid black-steel pipe with plain ends; welding fittings; and welded joints.
   h. Type L (Type B) **OR** Type M (Type C), **as directed**, hard copper tube with plain ends; cast- or wrought-copper solder-joint fittings; and brazed joints.
   i. Type L (Type B) **OR** Type M (Type C), **as directed**, hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.
8. High-pressure, wet-pipe sprinkler system, NPS 4 (DN 100) and smaller, shall be one of the following:
   a. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
   b. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
   c. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
   d. Thinwall **OR** Schedule 10, **as directed**, or hybrid black-steel pipe with plain ends; welding fittings; and welded joints.
9. High-pressure, wet-pipe sprinkler system, NPS 5 (DN 125) and larger, shall be one of the following:

a. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
b. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
c. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
d. Thinwall **OR** Schedule 10, **as directed**, or hybrid black-steel pipe with plain ends; welding fittings; and welded joints.

R. Sprinkler Schedule
1. Use sprinkler types in subparagraphs below for the following applications:
a. Rooms without Ceilings: Upright sprinklers.
b. Rooms with Suspended Ceilings: Pendent sprinklers **OR** Recessed sprinklers **OR** Flush sprinklers **OR** Concealed sprinklers, **as directed**.
c. Wall Mounting: Sidewall sprinklers.
d. Spaces Subject to Freezing: Upright sprinklers **OR** Pendent, dry sprinklers **OR** Sidewall, dry sprinklers, **as directed**.
e. Deluge-Sprinkler Systems: Upright and pendent, open sprinklers.
f. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where indicated.
2. Provide sprinkler types in subparagraphs below with finishes indicated.
a. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
b. Flush Sprinklers: Bright chrome, with painted white escutcheon.
c. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
d. Residential Sprinklers: Dull chrome.
e. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 13930

SECTION 13935 - DRY-PIPE FIRE-SUPPRESSION SPRINKLERS

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for dry-pipe fire-suppression sprinklers. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section Includes:
a. Pipes, fittings, and specialties.
b. Fire-protection valves.
c. Fire-department connections.
d. Sprinkler specialty pipe fittings.
e. Sprinklers.
f. Alarm devices.
g. Manual control stations.
h. Control panels.
i. Pressure gages.

C. Definitions
1. Standard-Pressure Sprinkler Piping: Dry-pipe sprinkler system piping designed to operate at working pressure 175 psig (1200 kPa) maximum.

D. System Descriptions
1. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from sprinklers that are open.
2. Combined Dry-Pipe and Preaction Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Fire-detection system in same area as sprinklers actuates tripping devices that open dry-pipe valve without loss of air pressure and actuates fire alarm. Water discharges from sprinklers that have opened.
3. Single-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of fire-detection system in same area as sprinklers opens deluge valve, permitting water to flow into piping and to discharge from sprinklers that have opened.
4. Double-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of a fire-detection system in the same area as sprinklers opens the deluge valve permitting water to flow into the sprinkler piping; a closed solenoid valve in the sprinkler piping is opened by another fire-detection device; then water will discharge from sprinklers that have opened.

E. Performance Requirements
1. Standard-Pressure Piping System Component: Listed for 175-psig (1200-kPa) minimum working pressure.
2. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
3. Sprinkler system design shall be approved by authorities having jurisdiction.
a. Margin of Safety for Available Water Flow and Pressure: 10 **OR** 20, **as directed**, percent, including losses through water-service piping, valves, and backflow preventers.
b. Sprinkler Occupancy Hazard Classifications:
1) Automobile Parking Areas: Ordinary Hazard, Group 1.

2) Building Service Areas: Ordinary Hazard, Group 1.
3) Churches: Light Hazard.
4) Electrical Equipment Rooms: Ordinary Hazard, Group 1.
5) Dry Cleaners: Ordinary Hazard, Group 2.
6) General Storage Areas: Ordinary Hazard, Group 1.
7) Laundries: Ordinary Hazard, Group 1.
8) Libraries Except Stack Areas: Light Hazard.
9) Library Stack Areas: Ordinary Hazard, Group 2.
10) Machine Shops: Ordinary Hazard, Group 2.
11) Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
12) Office and Public Areas: Light Hazard.
13) Plastics Processing Areas: Extra Hazard, Group 2.
14) Printing Plants: Extra Hazard, Group 1.
15) Repair Garages: Ordinary Hazard, Group 2.
16) Restaurant Service Areas: Ordinary Hazard, Group 1.
17) Solvent Cleaning Areas: Extra Hazard, Group 2.
18) Upholstering Plants: Extra Hazard, Group 1.

c. Minimum Density for Automatic-Sprinkler Piping Design:
1) Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. (4.1 mm/min. over 139-sq. m) area.
2) Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. (6.1 mm/min. over 139-sq. m) area.
3) Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. (8.1 mm/min. over 139-sq. m) area.
4) Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq. ft. (12.2 mm/min. over 232-sq. m) area.
5) Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2500-sq. ft. (16.3 mm/min. over 232-sq. m) area.
6) Special Occupancy Hazard: As determined by authorities having jurisdiction.

d. Maximum Protection Area per Sprinkler: Per UL listing.
OR
Maximum Protection Area per Sprinkler:
1) Office Spaces: 120 sq. ft. (11.1 sq. m) **OR** 225 sq. ft. (20.9 sq. m), **as directed**.
2) Storage Areas: 130 sq. ft. (12.1 sq. m).
3) Mechanical Equipment Rooms: 130 sq. ft. (12.1 sq. m).
4) Electrical Equipment Rooms: 130 sq. ft. (12.1 sq. m).
5) Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

e. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
1) Light-Hazard Occupancies: 100 gpm (6.3 L/s) for 30 minutes.
2) Ordinary-Hazard Occupancies: 250 gpm (15.75 L/s) for 60 to 90 minutes.
3) Extra-Hazard Occupancies: 500 gpm (31.5 L/s) for 90 to 120 minutes.

4. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

F. Submittals
1. Product Data: For each type of product indicated.
2. Shop Drawings: For dry-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
a. Wiring Diagrams: For power, signal, and control wiring.
3. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
4. Qualification Data: For qualified Installer and professional engineer, **as directed**.

5. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
6. Fire-hydrant flow test report.
7. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
8. Field quality-control reports.
9. Operation and maintenance data.

G. Quality Assurance
1. Installer Qualifications:
   a. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
      1) Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
2. 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.
3. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
   a. NFPA 13, "Installation of Sprinkler Systems."
   b. NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."
   c. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

H. Project Conditions
1. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
   a. Notify the Owner no fewer than two days in advance of proposed interruption of sprinkler service.
   b. Do not proceed with interruption of sprinkler service without the Owner's written permission.

1.2 PRODUCTS

A. Piping Materials
1. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Steel Pipe And Fittings
1. Standard Weight, Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.
2. Schedule 30, Galvanized-Steel Pipe: ASTM A 135; ASTM A 795/A 795M, Type E; or ASME B36.10M, wrought steel; with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.
3. Thinwall Galvanized-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.
4. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
5. Galvanized, Steel Couplings: ASTM A 865, threaded.
6. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
7. Malleable- or Ductile-Iron Unions: UL 860.
8. Cast-Iron Flanges: ASME B16.1, Class 125.

9. Plain-End-Pipe Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn or screwed retainer pin to secure pipe in fitting.
10. Grooved-Joint, Steel-Pipe Appurtenances:
    a. Pressure Rating: 175 psig (1200 kPa) **OR** 250 psig (1725 kPa) **OR** 300 psig (2070 kPa), **as directed**, minimum.
    b. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
    c. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

C. Copper Tube And Fittings
1. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) and ASTM B 88, Type M (ASTM B 88M, Type C) water tube, drawn temper.
2. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
3. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.
4. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
5. 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.
6. Copper Pressure-Seal Fittings:
    a. Standard: UL 213.
    b. NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
    c. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Cast-bronze fitting with EPDM-rubber O-ring seal in each end.
7. Grooved-Joint, Copper-Tube Appurtenances:
    a. Grooved-End, Copper Fittings: ASTM B 75 (ASTM B 75M), copper tube or ASTM B 584, bronze castings.
    b. Grooved-End-Tube Couplings: To fit copper tube, with dimensions and design similar to AWWA C606. Include ferrous housing sections, EPDM-rubber gasket suitable for hot and cold water, and bolts and nuts.
8. Copper-Tube, Extruded-Tee Connections:
    a. Description: Tee formed in copper tube according to ASTM F 2014.

D. Piping Joining Materials
1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free.
    a. Class 125, Cast-Iron and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
    b. Class 250, Cast-Iron and Class 300, Raised-Face Flanges: Ring-type gaskets.
2. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
3. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

E. Listed Fire-Protection Valves
1. General Requirements:
    a. Valves shall be UL listed or FM approved.
    b. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig (1200 kPa).
2. Ball Valves:
    a. Standard: UL 1091 except with ball instead of disc.
    b. Valves NPS 1-1/2 (DN 40) and Smaller: Bronze body with threaded ends.
    c. Valves NPS 2 and NPS 2-1/2 (DN 50 and DN 65): Bronze body with threaded ends or ductile-iron body with grooved ends.
    d. Valves NPS 3 (DN 80): Ductile-iron body with grooved ends.

F. Bronze Butterfly Valves:

a. Standard: UL 1091.
b. Pressure Rating: 175 psig (1200 kPa).
c. Body Material: Bronze.
d. End Connections: Threaded.

G. Iron Butterfly Valves:
a. Standard: UL 1091.
b. Pressure Rating: 175 psig (1200 kPa).
c. Body Material: Cast or ductile iron.
d. Style: Lug or wafer.
OR
End Connections: Grooved.

H. Check Valves:
a. Standard: UL 312
b. Pressure Rating: 250 psig (1725 kPa) minimum **OR** 300 psig (2070 kPa), **as directed**.
c. Type: Swing check.
d. Body Material: Cast iron.
e. End Connections: Flanged or grooved.

2. Bronze OS&Y Gate Valves:
a. Standard: UL 262.
b. Pressure Rating: 175 psig (1200 kPa).
c. Body Material: Bronze.
d. End Connections: Threaded.

3. Iron OS&Y Gate Valves:
a. Standard: UL 262.
b. Pressure Rating: 250 psig (1725 kPa) minimum **OR** 300 psig (2070 kPa), **as directed**.
c. Body Material: Cast or ductile iron.
d. End Connections: Flanged or grooved.

4. Indicating-Type Butterfly Valves:
a. Standard: UL 1091.
b. Pressure Rating: 175 psig (1200 kPa) minimum.
c. Valves NPS 2 (DN 50) and Smaller:
1) Valve Type: Ball or butterfly.
2) Body Material: Bronze.
3) End Connections: Threaded.
d. Valves NPS 2-1/2 (DN 65) and Larger:
1) Valve Type: Butterfly.
2) Body Material: Cast or ductile iron.
3) End Connections: Flanged, grooved, or wafer.
e. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch **OR** electrical, 115-V ac, prewired, two-circuit, supervisory switch **OR** visual, **as directed**, indicating device.

5. NRS Gate Valves:
a. Standard: UL 262.
b. Pressure Rating: 250 psig (1725 kPa) minimum **OR** 300 psig (2070 kPa), **as directed**.
c. Body Material: Cast iron with indicator post flange.
d. Stem: Nonrising.
e. End Connections: Flanged or grooved.

6. Indicator Posts:
a. Standard: UL 789.
b. Type: Horizontal for wall mounting.
c. Body Material: Cast iron with extension rod and locking device.
d. Operation: Wrench **OR** Hand wheel, **as directed**.

I. Trim And Drain Valves

1. General Requirements:
   a. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   b. Pressure Rating: 175 psig (1200 kPa) minimum.
2. Angle Valves.
3. Ball Valves.
4. Globe Valves.
5. Plug Valves.

J. Specialty Valves
1. General Requirements:
   a. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   b. Pressure Rating:
      1) Standard-Pressure Piping Specialty Valves: 175 psig (1200 kPa) minimum.
      2) High-Pressure Piping Specialty Valves: 250 psig (1725 kPa) minimum **OR** 300 psig (2070 kPa), **as directed**.
   c. Body Material: Cast or ductile iron.
   d. Size: Same as connected piping.
   e. End Connections: Flanged or grooved.
2. Dry-Pipe Valves:
   a. Standard: UL 260
   b. Design: Differential-pressure type.
   c. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
   d. Air-Pressure Maintenance Device:
      1) Standard: UL 260.
      2) Type: Automatic device to maintain minimum air pressure in piping.
      3) Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig (95- to 410-kPa) adjustable range, and 175-psig (1200-kPa) **OR** 300-psig (2070-kPa), **as directed**, outlet pressure.
   e. Air Compressor:
      1) Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
      2) Motor Horsepower: Fractional.
      3) Power: 120-V ac, 60 Hz, single phase.
3. Deluge Valves:
   a. Standard: UL 260.
   b. Design: Hydraulically operated, differential-pressure type.
   c. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, drip cup assembly piped without valves and separate from main drain line, fill-line attachment with strainer, and push-rod chamber supply connection.
   d. Dry, Pilot-Line Trim Set: Include dry, pilot-line actuator; air- and water-pressure gages; low-air-pressure warning switch; air relief valve; and actuation device. Dry, pilot-line actuator includes cast-iron, operated, diaphragm-type valve with resilient facing plate, resilient diaphragm, and replaceable bronze seat. Valve includes threaded water and air inlets and water outlet. Loss of air pressure on dry, pilot-line side allows pilot-line actuator to open and causes deluge valve to open immediately.
   e. Air-Pressure Maintenance Device:
      1) Standard: UL 260.
      2) Type: Automatic device to maintain minimum air pressure in piping.
      3) Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure,

strainer, pressure ratings with 14- to 60-psig (95- to 410-kPa) adjustable range, and 175-psig (1200-kPa) **OR** 300-psig (2070-kPa), **as directed**, outlet pressure.

f. Air Compressor:
   1) Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   2) Motor Horsepower: Fractional.
   3) Power: 120-V ac, 60 Hz, single phase.

4. Automatic (Ball Drip) Drain Valves:
   a. Standard: UL 1726.
   b. Pressure Rating: 175 psig (1200 kPa) minimum.
   c. Type: Automatic draining, ball check.
   d. Size: NPS 3/4 (DN 20).
   e. End Connections: Threaded.

K. Fire-Department Connections
1. Exposed-Type, Fire-Department Connection:
   a. Standard: UL 405.
   b. Type: Exposed, projecting, for wall mounting.
   c. Pressure Rating: 175 psig (1200 kPa) minimum.
   d. Body Material: Corrosion-resistant metal.
   e. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
   f. Caps: Brass, lugged type, with gasket and chain.
   g. Escutcheon Plate: Round, brass, wall type.
   h. Outlet: Back, with pipe threads.
   i. Number of Inlets: Two **OR** Three, **as directed**.
   j. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE" **OR** "AUTO SPKR", **as directed**.
   k. Finish: Polished chrome plated **OR** Rough brass or bronze **OR** Rough chrome plated, **as directed**.
   l. Outlet Size: NPS 4 (DN 100) **OR** NPS 5 (DN 125) **OR** NPS 6 (DN 150), **as directed**.
2. Flush-Type, Fire-Department Connection:
   a. Standard: UL 405.
   b. Type: Flush, for wall mounting.
   c. Pressure Rating: 175 psig (1200 kPa) minimum.
   d. Body Material: Corrosion-resistant metal.
   e. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
   f. Caps: Brass, lugged type, with gasket and chain.
   g. Escutcheon Plate: Rectangular, brass, wall type.
   h. Outlet: With pipe threads.
   i. Body Style: Horizontal **OR** Square **OR** Vertical, **as directed**.
   j. Number of Inlets: Two **OR** Three **OR** Four **OR** Six, **as directed**.
   k. Outlet Location: Back **OR** Bottom **OR** Left side **OR** Right side **OR** Top, **as directed**.
   l. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE" **OR** "AUTO SPKR", **as directed**.
   m. Finish: Polished chrome plated **OR** Rough brass or bronze **OR** Rough chrome plated, **as directed**.
   n. Outlet Size: NPS 4 (DN 100) **OR** NPS 5 (DN 125) **OR** NPS 6 (DN 150) **OR** NPS 8 (DN 200), **as directed**.
3. Yard-Type, Fire-Department Connection:
   a. Standard: UL 405.
   b. Type: Exposed, freestanding.
   c. Pressure Rating: 175 psig (1200 kPa) minimum **OR** 300 psig (2070 kPa), **as directed**.

d. Body Material: Corrosion-resistant metal.
e. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
f. Caps: Brass, lugged type, with gasket and chain.
g. Escutcheon Plate: Round, brass, floor type.
h. Outlet: Bottom, with pipe threads.
i. Number of Inlets: Two **OR** Three **OR** Four, **as directed**.
j. Sleeve: Brass **OR** Not required, **as directed**.
k. Sleeve Height: 18 inches (460 mm).
l. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE" **OR** "AUTO SPKR", **as directed**.
m. Finish, Including Sleeve: Polished chrome plated **OR** Rough brass or bronze **OR** Rough chrome plated, **as directed**.
n. Outlet Size: NPS 4 (DN 100) **OR** NPS 5 (DN 125) **OR** NPS 6 (DN 150), **as directed**.

L. Sprinkler Specialty Pipe Fittings
1. General Requirements for Dry-Pipe-System Fittings: UL listed for dry-pipe service.
2. Branch Outlet Fittings:
a. Standard: UL 213.
b. Pressure Rating: 175 psig (1200 kPa) minimum **OR** 300 psig (2070 kPa), **as directed**.
c. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
d. Type: Mechanical-T and -cross fittings.
e. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
f. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
g. Branch Outlets: Grooved, plain-end pipe, or threaded.
3. Flow Detection and Test Assemblies:
a. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
b. Pressure Rating: 175 psig (1200 kPa) minimum **OR** 300 psig (2070 kPa), **as directed**.
c. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
d. Size: Same as connected piping.
e. Inlet and Outlet: Threaded.
4. Branch Line Testers:
a. Standard: UL 199.
b. Pressure Rating: 175 psig (1200 kPa) minimum.
c. Body Material: Brass.
d. Size: Same as connected piping.
e. Inlet: Threaded.
f. Drain Outlet: Threaded and capped.
g. Branch Outlet: Threaded, for sprinkler.
5. Sprinkler Inspector's Test Fittings:
a. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
b. Pressure Rating: 175 psig (1200 kPa) minimum **OR** 300 psig (2070 kPa), **as directed**.
c. Body Material: Cast- or ductile-iron housing with sight glass.
d. Size: Same as connected piping.
e. Inlet and Outlet: Threaded.
6. Adjustable Drop Nipples:
a. Standard: UL 1474.
b. Pressure Rating: 250 psig (1725 kPa) minimum **OR** 300 psig (2070 kPa), **as directed**.
c. Body Material: Steel pipe with EPDM O-ring seals.
d. Size: Same as connected piping.
e. Length: Adjustable.

f. Inlet and Outlet: Threaded.

7. Flexible, Sprinkler Hose Fittings:
   a. Standard: UL 1474.
   b. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
   c. Pressure Rating: 175 psig (1200 kPa) minimum **OR** 300 psig (2070 kPa), **as directed**.
   d. Size: Same as connected piping, for sprinkler.

M. Sprinklers
1. General Requirements:
   a. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   b. Pressure Rating for Residential Sprinklers: 175 psig (1200 kPa) maximum.
   c. Pressure Rating for Automatic Sprinklers: 175 psig (1200 kPa) minimum.
   d. Pressure Rating for High-Pressure Automatic Sprinklers: 250 psig (1725 kPa) minimum **OR** 300 psig (2070 kPa), **as directed**.
2. Automatic Sprinklers with Heat-Responsive Element:
   a. Nonresidential Applications: UL 199.
   b. Residential Applications: UL 1626.
   c. Characteristics: Nominal 1/2-inch (12.7-mm) orifice with discharge coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
3. Sprinkler Finishes:
   a. Chrome plated.
   b. Bronze.
   c. Painted.
4. Special Coatings:
   a. Wax.
   b. Lead.
   c. Corrosion-resistant paint.
5. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
   a. Ceiling Mounting: Chrome-plated steel, one piece, flat **OR** Chrome-plated steel, two piece, with 1-inch (25-mm) vertical adjustment **OR** Plastic, white finish, one piece, flat, **as directed**.
   b. Sidewall Mounting: Chrome-plated steel **OR** Plastic, white finish, **as directed**, one piece, flat.
6. Sprinkler Guards:
   a. Standard: UL 199.
   b. Type: Wire cage with fastening device for attaching to sprinkler.

N. Alarm Devices
1. Alarm-device types shall match piping and equipment connections.
2. Water-Motor-Operated Alarm:
   a. Standard: UL 753.
   b. Type: Mechanically operated, with Pelton wheel.
   c. Alarm Gong: Cast aluminum with red-enamel factory finish.
   d. Size: 10-inch (250-mm) diameter.
   e. Components: Shaft length, bearings, and sleeve to suit wall construction.
   f. Inlet: NPS 3/4 (DN 20).
   g. Outlet: NPS 1 (DN 25) drain connection.
3. Electrically Operated Alarm Bell:
   a. Standard: UL 464.
   b. Type: Vibrating, metal alarm bell.

c. Size: 6-inch (150-mm) minimum **OR** 8-inch (200-mm) minimum **OR** 10-inch (250-mm), **as directed**, diameter.
d. Finish: Red-enamel factory finish, suitable for outdoor use.

4. Pressure Switches:
   a. Standard: UL 346.
   b. Type: Electrically supervised water-flow switch with retard feature.
   c. Components: Single-pole, double-throw switch with normally closed contacts.
   d. Design Operation: Rising pressure signals water flow.
5. Valve Supervisory Switches:
   a. Standard: UL 346.
   b. Type: Electrically supervised.
   c. Components: Single-pole, double-throw switch with normally closed contacts.
   d. Design: Signals that controlled valve is in other than fully open position.
6. Indicator-Post Supervisory Switches:
   a. Standard: UL 346.
   b. Type: Electrically supervised.
   c. Components: Single-pole, double-throw switch with normally closed contacts.
   d. Design: Signals that controlled indicator-post valve is in other than fully open position.

O. Manual Control Stations
1. Description: UL listed or FM Global approved, hydraulic operation, with union, NPS 1/2 (DN 15) pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

P. Control Panels
1. Description: Single-area, two-area, or single-area cross-zoned type control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves. Panels contain power supply; battery charger; standby batteries; field-wiring terminal strip; electrically supervised solenoid valves and polarized fire-alarm bell; lamp test facility; single-pole, double-throw auxiliary alarm contacts; and rectifier.

2. Panels: UL listed and FM Global approved when used with thermal detectors and Class A detector circuit wiring. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
   a. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.
      OR
      Manual Control Stations: Hydraulic operation, with union, NPS 1/2 (DN 15) pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

Q. Pressure Gages
1. Standard: UL 393.
2. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.
3. Pressure Gage Range: 0 to 250 psig (0 to 1725 kPa) minimum **OR** 0 to 300 psig (0 to 2070 kPa), **as directed**.
4. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
5. Air System Piping Gage: Include retard feature, **as directed**, and "AIR" or "AIR/WATER" label on dial face.

R. Escutcheons
1. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.

2. One-Piece, Cast-Brass Escutcheons: Polished chrome-plated or rough-brass finish with set-screws.
3. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with chrome-plated finish.
4. One-Piece, Stamped-Steel Escutcheons: Chrome-plated finish with set-screw or spring clips.
5. Split-Casting, Cast-Brass Escutcheons: Polished chrome-plated or rough-brass finish with concealed hinge and set-screw.
6. Split-Plate, Stamped-Steel Escutcheons: Chrome-plated finish with concealed **OR** exposed-rivet, **as directed**, hinge, set-screw or spring clips.
7. One-Piece Floor Plates: Cast-iron flange with holes for fasteners, **as directed**.
8. Split-Casting Floor Plates: Cast brass with concealed hinge.

S. Sleeves
1. Cast-Iron Wall Pipe Sleeves: Cast or fabricated of cast iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
2. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
3. Molded-PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
4. Molded-PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.
5. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
6. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, standard weight, zinc coated, plain ends.
7. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
   a. Underdeck Clamp: Clamping ring with set-screws.

T. Sleeve Seals
1. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
   a. Sealing Elements: EPDM-rubber or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   b. Pressure Plates: Carbon steel **OR** Plastic **OR** Stainless steel, **as directed**.
   c. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating **OR** Stainless steel, **as directed**, of length required to secure pressure plates to sealing elements.

U. Grout
1. Standard: ASTM C 1107, Grade B, posthardening and volume adjusting, dry, hydraulic-cement grout.
2. Characteristics: Nonshrink, and recommended for interior and exterior applications.
3. Design Mix: 5000-psi (34-MPa), 28-day compressive strength.
4. Packaging: Premixed and factory packaged.

1.3 EXECUTION

A. Preparation
1. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
2. Report test results promptly and in writing.

B. Service-Entrance Piping
1. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements in Division 02 Section "Facility Fire-suppression Water-service Piping" for exterior piping.

2. Install shutoff valve, backflow preventer, **as directed**, pressure gage, drain, and other accessories indicated at connection to water-service piping. Comply with requirements in Division 02 Section "Facility Fire-suppression Water-service Piping" for backflow preventers, **as directed**.
3. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

C. Water-Supply Connections
1. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements in Division 15 Section "Domestic Water Piping" for interior piping.
2. Install shutoff valve, backflow preventer, **as directed**, pressure gage, drain, and other accessories indicated at connection to water-distribution piping. Comply with requirements in Division 15 Section "Domestic Water Piping Specialties" for backflow preventers, **as directed**.
3. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

D. Piping Installation
1. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
   a. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with the Owner before deviating from approved working plans.
2. Piping Standard: Comply with requirements in NFPA 13 for installation of sprinkler piping.
3. Install seismic restraints on piping. Comply with requirements in NFPA 13 for seismic-restraint device materials and installation.
4. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
5. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.
6. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
7. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
8. Install sprinkler piping with drains for complete system drainage.
9. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
10. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or to outside building.
11. Connect compressed-air supply to dry-pipe sprinkler piping.
    OR
    Connect air compressor to the following piping and wiring:
    a. Pressure gages and controls.
    b. Electrical power system.
    c. Fire-alarm devices, including low-pressure alarm.
12. Install alarm devices in piping systems.
13. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements in NFPA 13 for hanger materials.
14. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
15. Drain dry-pipe sprinkler piping.
16. Pressurize and check dry-pipe sprinkler system piping and air-pressure maintenance devices **OR** air compressors, **as directed**.

E. Joint Construction

1. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
2. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.
3. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
4. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
5. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
6. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
7. 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:
   a. Apply appropriate tape or thread compound to external pipe threads.
   b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
8. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
9. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
10. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
11. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
12. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and copper pressure-seal fittings with tools recommended by fitting manufacturer.
13. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
14. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

F. Valve And Specialties Installation
1. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
2. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
3. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
4. Specialty Valves:
   a. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
   b. Dry-Pipe and Deluge Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
      1) Install air compressor and compressed-air supply piping.
      2) Air-Pressure Maintenance Device: Install shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with 14- to 60-psig (95- to 410-kPa) adjustable range; and 175-psig (1200-kPa) maximum inlet pressure.
      3) Install compressed-air supply piping from building's compressed-air piping system.

G. Sprinkler Installation
   1. Install sprinklers in suspended ceilings in center of narrow dimension of, **as directed**, acoustical ceiling panels.
   2. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
   3. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

H. Fire-Department Connection Installation
   1. Install wall-type, fire-department connections.
   2. Install yard-type, fire-department connections in concrete slab support. Comply with requirements for concrete in Division 03 Section "Cast-in-place Concrete".
      a. Install two **OR** three, **as directed**, protective pipe bollards around **OR** on sides of, **as directed**, each fire-department connection. Comply with requirements for bollards in Division 05 Section "Metal Fabrications".
   3. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

I. Escutcheon Installation
   1. Install escutcheons for penetrations of walls, ceilings, and floors.
   2. Escutcheons for New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
      b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish **OR** stamped steel with set-screw **OR** stamped steel with set-screw or spring clips **OR** stamped steel with spring clips, **as directed**.
      c. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish **OR** One piece or split casting, cast brass with polished chrome-plated finish **OR** Split casting, cast brass with polished chrome-plated finish **OR** One piece, stamped steel with set-screw **OR** One piece or split plate, stamped steel with set-screw **OR** Split plate, stamped steel with set-screw, **as directed**.
      d. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish **OR** cast brass with rough-brass finish **OR** stamped steel with set-screw **OR** stamped steel with spring clips **OR** stamped steel with set-screw or spring clips, **as directed**.
      e. Bare Piping in Equipment Rooms: One piece, cast brass **OR** stamped steel with set-screw **OR** stamped steel with spring clips **OR** stamped steel with set-screw or spring clips, **as directed**.
      f. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.
   3. Escutcheons for Existing Piping:
      a. Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.
      b. Insulated Piping: Split plate, stamped steel with concealed or exposed-rivet hinge and spring clips.
      c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish **OR** plate, stamped steel with concealed hinge and spring clips, **as directed**.
      d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish **OR** plate, stamped steel with concealed hinge and set-screw, **as directed**.
      e. Bare Piping in Unfinished Service Spaces: Split casting, cast brass with polished chrome-plated finish **OR** casting, cast brass with rough-brass finish **OR** plate, stamped steel with concealed hinge and set-screw or spring clips **OR** plate, stamped steel with concealed or exposed-rivet hinge and set-screw or spring clips **OR** plate, stamped steel with exposed-rivet hinge and set-screw or spring clips, **as directed**.
      f. Bare Piping in Equipment Rooms: Split casting, cast brass **OR** plate, stamped steel with set-screw or spring clips, **as directed**.
      g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.

J. Sleeve Installation
1. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
2. Sleeves are not required for core-drilled holes.
3. Permanent sleeves are not required for holes formed by removable PE sleeves.
4. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
5. Install sleeves in new partitions, slabs, and walls as they are built.
6. For interior wall penetrations, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants".
7. 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 for joint sealants in Division 07 Section "Joint Sealants".
8. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals.
9. Seal space outside of sleeves in concrete slabs and walls with grout.
10. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe unless otherwise indicated.
11. Install sleeve materials according to the following applications:
    a. Sleeves for Piping Passing through Concrete Floor Slabs: Molded PE **OR** Molded PVC **OR** Galvanized-steel pipe, **as directed**.
    b. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Galvanized-steel pipe **OR** Stack sleeve fittings, **as directed**.
        1) Extend sleeves 2 inches (50 mm) above finished floor level.
        2) For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Comply with requirements for flashing in Division 07 Section "Sheet Metal Flashing And Trim".
    c. Sleeves for Piping Passing through Gypsum-Board Partitions:
        1) PVC-pipe **OR** Galvanized-steel-pipe, **as directed**, sleeves for pipes smaller than NPS 6 (DN 150).
        2) Galvanized-steel-sheet sleeves for pipes NPS 6 (DN 150) and larger.
        3) Exception: Sleeves are not required for water-supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
    d. Sleeves for Piping Passing through Concrete Roof Slabs: Molded PE **OR** Molded PVC **OR** Galvanized-steel pipe, **as directed**.
    e. Sleeves for Piping Passing through Exterior Concrete Walls:
        1) Galvanized-steel-pipe sleeves for pipes smaller than NPS 6 (DN 150).
        2) Cast-iron wall pipe sleeves for pipes NPS 6 (DN 150) and larger.
        3) Install sleeves that are large enough to provide 1-inch (25-mm) annular clear space between sleeve and pipe when sleeve seals are used.
    f. Sleeves for Piping Passing through Interior Concrete Walls:
        1) PVC-pipe **OR** Galvanized-steel pipe, **as directed**, sleeves for pipes smaller than NPS 6 (DN 150).
        2) Galvanized-steel-sheet sleeves for pipes NPS 6 (DN 150) and larger.
12. 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 "Through-penetration Firestop Systems" for firestop materials and installations.

K. Sleeve Seal Installation
1. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
2. 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.

L. Identification
1. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
2. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 16 Section "Electrical Identification".

M. Field Quality Control
1. Perform tests and inspections.
2. Tests and Inspections:
   a. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
   b. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
   c. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
   d. Energize circuits to electrical equipment and devices.
   e. Start and run air compressors.
   f. Coordinate with fire-alarm tests. Operate as required.
   g. Coordinate with fire-pump tests. Operate as required.
   h. Verify that equipment hose threads are same as local fire-department equipment.
3. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
4. Prepare test and inspection reports.

N. Cleaning
1. Clean dirt and debris from sprinklers.
2. Remove and replace sprinklers with paint other than factory finish.

O. Demonstration
1. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

P. Piping Schedule
1. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded **OR** grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved, **as directed**, joints.
2. Sprinkler specialty fittings may be used, downstream of control vales, instead of specified fittings.
3. Copper-tube, extruded-tee connections may be used for tee branches in copper tubing instead of specified copper fittings. Branch-connection joints must be brazed.
4. Standard-pressure, dry-pipe sprinkler system, NPS 2 (DN 50) and smaller, shall be one of the following:
   a. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
   b. Standard-weight **OR** Schedule 30 **OR** thinwall, **as directed**, galvanized-steel pipe with plain ends; plain-end-pipe fittings; and twist-locked joints.
   c. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
   d. Type L (Type B) **OR** Type M (Type C), **as directed**, hard copper tube with plain ends; cast- or wrought-copper solder-joint fittings; and brazed joints.
   e. Type L (Type B) **OR** Type M (Type C), **as directed**, hard copper tube with plain ends; copper pressure-seal fittings; and pressure-sealed joints.
   f. NPS 2 (DN 50), Type L (Type B) **OR** Type M (Type C), **as directed**, hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.

5. Standard-pressure, dry-pipe sprinkler system, NPS 2-1/2 to NPS 4 (DN 65 to DN 100), shall be one of the following:
   a. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
   b. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
   c. Type L (Type B) **OR** Type M (Type C), **as directed**, hard copper tube with plain ends; cast- or wrought-copper solder-joint fittings; and brazed joints.
   d. Type L (Type B) **OR** Type M (Type C), **as directed**, hard copper tube with plain ends; copper pressure-seal fittings; and pressure-sealed joints.
   e. Type L (Type B) **OR** Type M (Type C), **as directed**, hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.
6. Standard-pressure, dry-pipe sprinkler system, NPS 5 and NPS 6 (DN 125 and DN 150), shall be one of the following:
   a. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
   b. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
   c. Type L (Type B) **OR** Type M (Type C), **as directed**, hard copper tube with plain ends; cast- or wrought-copper solder-joint fittings; and brazed joints.
   d. Type L (Type B) **OR** Type M (Type C), **as directed**, hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.

Q. Sprinkler Schedule
1. Use sprinkler types in subparagraphs below for the following applications:
   a. Rooms without Ceilings: Upright sprinklers.
   b. Rooms with Suspended Ceilings: Dry pendent sprinklers **OR** Dry recessed sprinklers **OR** Dry flush sprinklers **OR** Dry concealed sprinklers, **as directed**.
   c. Wall Mounting: Dry sidewall sprinklers.
   d. Spaces Subject to Freezing: Upright sprinklers **OR** Dry pendent sprinklers **OR** Dry sidewall sprinklers**, as directed**.
   e. Special Applications: Extended-coverage and quick-response sprinklers where indicated.
2. Provide sprinkler types in subparagraphs below with finishes indicated.
   a. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
   b. Flush Sprinklers: Bright chrome, with painted white escutcheon.
   c. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
   d. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 13935

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SECTION 13955 - FOAM FIRE EXTINGUISHING

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for foam fire extinguishing. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. This Section includes fixed, low-expansion, AFFF fire-extinguishing systems and the following:
   a. Concentrate piping and piping specialties.
   b. Proportioning tanks and proportioning devices.
   c. Foam concentrate.
   d. Discharge devices.
   e. Monitoring and alarm devices.

C. Definitions
1. AFFF: Aqueous film-forming foam.
2. AR-AFFF: Alcohol-resistant aqueous film-forming foam.
3. ATS: Acceptance Testing Specifications.

D. System Description
1. Description: Engineered, fixed, wet-pipe **OR** dry-pipe, **OR** preaction, **OR** deluge, **as directed**, automatically actuated, low-expansion, AFFF **OR** AR-AFFF, **as directed**, fire-extinguishing system for flammable-liquid fires. System includes diaphragm proportioning tanks and devices as described in NFPA 16.

E. Performance Requirements
1. Standard Piping System Component Working Pressure: Listed for at least 175 psig (1200 kPa).
2. Minimum design parameters to be used with the approval of authorities having jurisdiction are as follows:
   a. Solution: 3 percent foam-water solution.
   b. Sprinkler Spacing: Maximum of 100 sq. ft. (9.5 sq. m) per sprinkler, and maximum 12-foot (3.7-m) spacing.
   c. Design Density: Minimum 0.16 gpm/sq. ft. (0.108 L/s per sq. m).
   d. Foam Supply: Minimum 10-minute discharge time.
   e. Water Supply: Minimum 60 minutes.
   f. Remote Area: Minimum 5000-sq. ft. (476-sq. m) design area for closed-sprinkler systems. Open-sprinkler systems shall discharge over the entire system area.
   g. Sprinkler Temperature Rating: Maximum 250 to 300 deg F (121 to 149 deg C) at a roof or ceiling, and 135 to 170 deg F (57 to 77 deg C) for intermediate sprinklers.
3. Seismic Performance: Fire-suppression piping shall be capable of withstanding the effects of earthquake motions determined according to NFPA 13.

F. Submittals
1. Product Data: For the following:
   a. Piping and equipment seismic restraints.
   b. Valves.
   c. Proportioning tanks and proportioning devices.
   d. Foam concentrate.
   e. Discharge devices. Include flow characteristics.
   f. Monitoring and alarm devices. Include electrical data.

2. Shop Drawings: Signed and sealed by a qualified professional engineer. Include the following for each hazard area, drawn to scale:
   a. Include plans, elevations, sections, details, and attachments to other work. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   b. Wiring Diagrams: Power, signal, and control wiring.
   c. Design Calculations: For amount of foam concentrate required for each hazard area.
   d. Plans: Show the following:
      1) Foam-solution proportioning tanks and devices, piping, discharge devices, monitoring and alarm devices, and accessories.
      2) Method of attaching hangers to building structure.
      3) Fire alarm panel.
      4) Equipment and furnishings.
3. Permit-Approved Drawings: Working plans, prepared according to NFPA 16, that have been approved by authorities having jurisdiction. Include design calculations.
4. Welding certificates.
5. Field quality-control test reports.
6. Operation and Maintenance Data: For foam fire extinguishing to include in emergency, operation, and maintenance manuals.

G. Quality Assurance
1. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
2. 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.
3. FMG Compliance: Provide components that are FMG approved and that are listed in FMG's "Fire Protection Approval Guide."
4. UL Compliance: Provide equipment listed in UL's "Fire Protection Equipment Directory."

1.2 PRODUCTS

A. Pipe And Fittings
1. Steel Pipe: ASTM A 53/A 53M, ASTM A 135, ASTM A 106, or ASTM A 795, Type E or S, Grade A or B, Schedule 40, with factory- or field-formed threaded ends.
   a. Cast-Iron Threaded Flanges: ASME B16.1.
   b. Malleable-Iron Threaded Fittings: ASME B16.3.
   c. Gray-Iron Threaded Fittings: ASME B16.4.
   d. Butt-Weld Fittings: ASTM A 234/A 234M, Grade WPB, Schedule 40, carbon-steel butt-weld fittings.
   e. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
   f. Steel Threaded Couplings: ASTM A 865.
2. Stainless Steel: ASTM A 312/A 312M, Schedule 40, with factory-formed threaded or beveled ends; ASTM A 376/A 376M for seamless pipe; or ASTM A 213/A 213M, ASTM A 249/A 249M, and ASTM A 269 for seamless and welded tubing.
   a. Class 150 Threaded Fittings: ASME B16.3 and MSS SP 114.
   b. Butt-Weld Fittings: ASTM A 403/A 403M.
   c. Flanges, Forged Fittings and Flanges, and Socket-Weld Fittings: ASTM A 182/A 182M.
   d. Bar Stock and Compression Fittings: ASTM A 276 and ASTM A 479/A 479M.
3. Red Brass Pipe: ASTM B 43, Schedule 40, with factory- or field-formed threaded ends.
   a. Threaded Flanges and Fittings: ASTM B 584.
4. Refer to Division 15 Section "Common Work Results For Fire Suppression" for basic joining materials.

B. Valves
1. Ball Valves: Bronze body with threaded or flanged ends. Comply with UL 1091, except with stainless-steel ball instead of disc.

C. Specialties
1. Concentrate Storage Tank: Buna-N, bladder-type proportioning tank complying with UL 162 and ASME Boiler and Pressure Vessel Code: Section VIII. Include bladder, internal piping, fill and drain, pipe assembly, glass sight gage, piping, and valves. Concentrate to be contained in the bladder.
   a. Orientation: Horizontal design with saddle **OR** Vertical design with skirt, **as directed**, support.
2. Proportioning Controller: Venturi type complying with UL 162 and of capacity to match design at minimum and maximum flow.
3. Concentrate Control Valve: Water-operated ball or deluge valve designed to open with flow through the proportioning controller.
4. Concentrate Strainers: Bronze body and stainless-steel mesh strainer with minimum 0.125-inch (3.2-mm) perforations to remove solids that would block system components.
5. Provide devices that comply with NFPA 16, are compatible with the foam concentrate, and are designed to be drained and cleaned.

D. Foam Concentrate
1. Description: AFFF **OR** AR-AFFF, **as directed**, liquid concentrate, complying with NFPA 11 and UL 162, for making foam-water fire-extinguishing foam solution.

E. Pressure Gages
1. Description: Comply with UL 393, with 3-1/2-inch- (90-mm-) minimum diameter dial, 0- to 300-psig (0- to 2070-kPa) dial range, and caption "WATER" or "CONCENTRATE" on dial face.

F. Discharge Devices
1. General: Discharge devices shall be listed and approved by UL and FMG.
2. Sprinklers: Closed **OR** Open, **as directed**, air-aspirating **OR** non-air-aspirating, **as directed**, type complying with UL 162 and suitable for discharging foam.
3. Spray Nozzles: Foam-water spray nozzles including foam generator and distributing deflector complying with UL 162 and designed to distribute foam or water in the absence of foam solution in a special pattern peculiar to a particular head.

G. Monitoring Devices
1. Valve Supervisory Switches: UL 753, electrical, single pole, double throw, with normally closed contacts. Include design that signals controlled valve is in other than fully open position.

H. Alarm Devices
1. Description: UL listed or FMG approved, low voltage, and surface mounting. Alarm and monitoring devices are specified in Division 13 Section(s) "Digital, Addressable Fire-alarm System" OR "Zoned (dc Loop) Fire-alarm System".

1.3 EXECUTION

A. Concentrate Storage Tank Installation
1. Install proportioning tanks on concrete bases. Concrete bases are specified in Division 15 Section "Common Work Results For Fire Suppression".
2. Install tanks level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
3. Install seismic restraints for tanks. Anchor tanks to substrate.

B. Piping Applications
1. Flanged pipe and fittings and flanged joints may be used to connect to specialties and accessories and where required for maintenance.
2. AFFF-Concentrate Piping: Steel pipe, malleable- or cast-iron threaded fittings, and threaded joints.
3. AFFF-Concentrate Piping: Steel pipe with welded fittings and joints.
4. AR-AFFF-Concentrate Piping: Brass **OR** Stainless-steel, **as directed**, pipe, threaded fittings, and joints.
5. AR-AFFF-Concentrate Piping: Stainless-steel pipe with welded fittings and joints.
6. Foam-solution piping is specified in Division 13 Section "Wet-pipe Fire-suppression Sprinklers".

C. Piping Installation
1. Install piping and other components level and plumb.
2. Refer to Division 15 Section "Common Work Results For Fire Suppression" for basic pipe installation and joint construction.
3. Install proportioning tanks anchored to substrate.
4. Install pipe and fittings, valves, and discharge devices according to requirements listed in NFPA 16, "Installation of Deluge Foam-Water Sprinkler and Foam-Water Spray Systems."
   a. Support piping using supports and methods according to NFPA 13.
   b. Install seismic restraints for proportioning tanks and piping systems.
   c. Install monitoring and alarm devices according to NFPA 16 and NFPA 72.

D. Connections
1. Piping installation requirements are specified in Division 13 Section "Wet-pipe Fire-suppression Sprinklers". Drawings indicate general arrangement of piping, fittings, and specialties.
2. Provide concentrate control, maintenance service, and drain valves with piping to permit maintenance of the foam concentrate with continuous sprinkler system service.
3. Install proportioning controller in fire-suppression piping to provide coverage to area indicated on Drawings.
4. Install piping adjacent to equipment to allow service and maintenance.
5. Connect electrical devices to building's fire alarm system. Electrical power, wiring, and devices are specified in Division 13 Section(s) "Digital, Addressable Fire-alarm System" OR "Zoned (dc Loop) Fire-alarm System".

E. Labeling
1. Install labeling on piping, equipment, and panels according to Division 15 Section "Identification For Plumbing Piping And Equipment".

F. Charging System
1. Fill proportioning tanks with foam concentrate after field quality-control testing is complete and satisfactory results have been achieved.

G. Field Quality Control
1. Inspection: Engage the services of a qualified professional engineer to inspect installed fire-extinguishing systems, prepare installation report, and certify that installation complies with the Contract Documents, calculations, and requirements of authorities having jurisdiction.
2. Comply with operating instructions and procedures in NFPA 16, "Acceptance Tests" Chapter. Include the following tests and inspections to demonstrate compliance with requirements:
   a. Check mechanical items.
   b. Inspect equipment and fire-extinguishing foam concentrate, and check mountings for adequate anchoring to substrate.
   c. Check electrical systems.
   d. Flush piping.
   e. Perform acceptance test.
   f. Perform pressure test.

g. Perform operating test.
h. Perform discharge test.
i. Correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment that cannot be satisfactorily corrected or does not perform as specified and indicated, then retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.
   1) Report test results promptly and in writing and authorities having jurisdiction.

3. Perform the following field tests and inspections and prepare test reports:
   a. After installing foam fire-extinguishing piping system and after electrical circuitry has been energized, test for compliance with requirements.
   b. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, "Inspection and Test Procedures" and "System Function Tests." Certify compliance with test parameters.
   c. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   d. Operational Test: After electrical circuitry has been energized, start systems to confirm proper unit operation.
   e. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
4. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 13955

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SECTION 13965 - CLEAN-AGENT EXTINGUISHING SYSTEMS

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for clean-agent extinguishing systems. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. This Section includes clean-agent extinguishing systems and the following:
   a. Piping and piping specialties.
   b. Extinguishing-agent containers.
   c. Extinguishing agent.
   d. Detection and alarm devices.
   e. Control and alarm panels.
   f. Accessories.
   g. Connection devices for and wiring between system components.
   h. Connection devices for power and integration into building's fire alarm system.

C. Definitions
1. ATS: Acceptance Testing Specifications.
2. EPO: Emergency Power Off.

D. System Description
1. Clean-agent fire-extinguishing system shall be an engineered system for total flooding of the hazard area including the room cavity below the ceiling and below the raised floor. Provide separate zones above and below the raised floor. If smoke is detected below the raised floor, agent shall be discharged in the underfloor zone only. If smoke is detected above the raised floor, agent shall be discharged in zones above and below the floor.

E. Performance Requirements
1. Design clean-agent extinguishing system and obtain approval from authorities having jurisdiction. Design system for Class A, B, or C fires as appropriate for areas being protected and include safety factor. Use clean agent indicated and in concentration suitable for normally occupied areas.
2. Performance Requirements: Discharge HFC 227ea within 10 seconds and maintain 7.1 percent concentration by volume at 70 deg F (21 deg C) for 10-minute holding time in hazard areas.
   a. HFC 227ea concentration in hazard areas greater than 9.0 percent immediately after discharge or less than 5.8 percent throughout holding time will not be accepted without written authorization from Owner and authorities having jurisdiction.
   b. System Capabilities: Minimum 620-psig (4278-kPa) calculated working pressure and 360-psig (2484-kPa) initial charging pressure.
3. Performance Requirements: Discharge IG-541 within 60 seconds and maintain 38 percent concentration by volume at 70 deg F (21 deg C) for 10-minute holding time in hazard areas.
   a. IG-541 concentration in hazard areas greater than 40 percent immediately after discharge or less than 32 percent throughout holding time will not be accepted without written authorization from Owner and authorities having jurisdiction.
   b. System Capabilities: Minimum 2175-psig (15-MPa) calculated working pressure upstream from orifice union, minimum 1000-psig (6895-kPa) calculated working pressure downstream from orifice union, and 2175-psig (15-MPa) initial charging pressure.

4. Cross-Zoned Detection: Devices located in two separate zones. Sound alarm on activating single-detection device, and discharge extinguishing agent on actuating single-detection device in other zone.
   OR
   Verified Detection: Devices located in single zone. Sound alarm on activating single-detection device, and discharge extinguishing agent on actuating second-detection device.
5. System Operating Sequence: As follows:
   a. Actuating First Detector: Visual indication on annunciator panel, energize audible alarm and visual alarms (slow pulse), shut down air-conditioning and ventilating systems serving protected area, close doors in protected area, and send signal to fire alarm system.
   b. Actuating Second Detector: Visual indication on annunciator panel, energize audible and visual alarms (fast pulse), shut down power to protected equipment, start time delay for extinguishing-agent discharge for 30 seconds, and discharge extinguishing agent. On agent discharge, release preaction valve to allow water to fill sprinkler system.
   c. Extinguishing-agent discharge will operate audible alarms and strobe lights inside and outside the protected area.
6. System Operating Sequence: System shall be cross-zoned, air-sampling detectors and photoelectric detectors reporting to a fully programmable microprocessor-based control panel programmed to operate as follows:
   a. If one photoelectric detector and air-sampling detector reaches the third detection level (Fire 1), agent discharge will be initiated as described for the third detection level (Fire 1) below.
   b. Air-Sampling System:
      1) First Detection Level (Alert): Mild audible and visual indication on annunciator panel. Strobe lights flash slowly in the protected area.
      2) Second Detection Level (Action): Strong audible and visual indication on annunciator panel. Strobe lights flash rapidly in the protected area.
      3) Third Detection Level (Fire 1): Strong audible and visual indication on annunciator panel. Energize horn(s), bell(s), and strobe light(s) in the protected area and outside entry doors. Shut down air-conditioning and ventilating systems serving the protected area, and close doors in the protected area. Send signal to fire alarm system, initiate 30-second time delay for extinguishing-agent discharge, and discharge extinguishing agent. At agent discharge, terminate power to equipment in the protected area, and release preaction valve to allow water flow to sprinkler system.
      4) Fourth Detection Level (Fire 2): Same as Fire 1.
7. Manual stations shall immediately discharge extinguishing agent when activated.
8. Operating abort switches will delay extinguishing-agent discharge while being activated, and switches must be reset to prevent agent discharge. Release of hand pressure on the switch will cause agent discharge if the time delay has expired.
9. EPO: Will terminate power to protected equipment immediately on actuation.
10. Low-Agent Pressure Switch: Initiate trouble alarm if sensing less than set pressure.
11. Power Transfer Switch: Transfer from normal to stand-by power source.
12. Seismic Performance: Fire-suppression piping and containers shall be capable of withstanding the effects of earthquake motions determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."

F. Submittals
   1. Product Data: For each product indicated.
   2. LEED Submittal:
      a. Product Data for Credit EA 4: Documentation required by Credit EA 4 indicating that clean agents comply.
   3. Shop Drawings: Signed and sealed by a qualified professional engineer. Include design calculations.

4. Permit Approved Drawings: Working plans, prepared according to NFPA 2001, that have been approved by authorities having jurisdiction. Include design calculations.
5. Field quality-control test reports.
6. Maintenance Data: For components to include in maintenance manuals.

G. Quality Assurance
1. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of clean-agent extinguishing systems that are similar to those indicated for this Project in material, design, and extent.
2. 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.

1.2 PRODUCTS

A. Piping Materials
1. Refer to Part 1.3 piping applications Article retained for applications of pipe, tube, fitting, and joining materials.
2. Piping, Valves, and Discharge Nozzles: Comply with types and standards listed in NFPA 2001, Section "Distribution," for charging pressure of system.

B. Pipe And Fittings
1. Steel Pipe: ASTM A 53/A 53M, Type S, Grade B or ASTM A 106, Grade B; Schedule 40, or Schedule 80, seamless steel pipe.
   a. Threaded Fittings:
      1) Malleable-Iron Fittings: ASME B16.3, Class 300.
      2) Flanges and Flanged Fittings: ASME B16.5, Class 300, unless Class 600 is indicated.
   b. Forged-Steel Welding Fittings: ASME B16.11, Class 3000, socket pattern.
   c. Grooved-End Fittings: FMG approved and NRTL listed, ASTM A 47/A 47M malleable iron or ASTM A 536 ductile iron, with dimensions matching steel pipe and ends factory grooved according to AWWA C606.

   Plain-End, Hard Copper Tube: ASTM B 88, Type K **OR** L, **as directed**, (ASTM B 88M, Type A **OR** B, **as directed**,), water tube, drawn temper.
   d. Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper alloy, pressure.
   e. Bronze Flanges and Flanged Fittings: ASME B16.24, Class 300.
2. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   a. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness, unless thickness or specific material is indicated.
3. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.
4. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing.
5. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
6. Steel, Keyed Couplings: UL 213, AWWA C606, approved or listed for clean-agent service, and matching steel-pipe dimensions. Include ASTM A 536, ductile-iron housing, rubber gasket, and steel bolts and nuts.

C. Valves
1. General: Brass; suitable for intended operation.
2. Container Valves: With rupture disc or solenoid and manual-release lever, capable of immediate and total agent discharge and suitable for intended flow capacity.

3. Valves in Sections of Closed Piping and Manifolds: Fabricate to prevent entrapment of liquid, or install valve and separate pressure relief device.
4. Valves in Manifolds: Check valve; installed to prevent loss of extinguishing agent when container is removed from manifold.

D. Extinguishing-Agent Containers
1. Description: Steel tanks complying with ASME Boiler and Pressure Vessel Code: Section VIII, for unfired pressure vessels. Include minimum working-pressure rating that matches system charging pressure, valve, pressure switch, and pressure gage.
   a. Finish: Red **OR** Manufacturer's standard color, **as directed**, enamel or epoxy paint.
   b. Manifold: Fabricate with valves, pressure switches, and connections for multiple storage containers, as indicated.
      OR
      Manifold: Fabricate with valves, pressure switches, selector switch, and connections for main- and reserve-supply banks of multiple storage containers.
   c. Storage-Tank Brackets: Factory- or field-fabricated retaining brackets consisting of steel straps and channels; suitable for container support, maintenance, and tank refilling or replacement.

E. Fire-Extinguishing Clean Agent
1. Clean Agent: HFC 227ea, heptafluoropropane.
   OR
   Clean Agent: IG-541, mixture of nitrogen, argon, and carbon dioxide inert gases.

F. Discharge Nozzles
1. Equipment manufacturer's standard one-piece brass or aluminum alloy of type, discharge pattern, and capacity required for application.

G. Manifold And Orifice Unions
1. Description: NRTL-listed device with minimum 2175-psig (15-MPa) pressure rating, to control flow and reduce pressure of IG-541 gas in piping.
   a. NPS 2 (DN 50) and Smaller: Piping assembly with orifice, sized for system design requirements.
   b. NPS 2-1/2 (DN 65) and Larger: Piping assembly with nipple, sized for system design requirements.

H. Control Panels
1. Description: FMG approved or NRTL listed, including equipment and features required for testing, supervising, and operating fire-extinguishing system.
2. Power Requirements: 120/240-V ac; with electrical contacts for connection to system components and fire alarm system, and transformer or rectifier as needed to produce power at voltage required for accessories and alarm devices.
3. Enclosure: NEMA ICS 6, Type 1, enameled-steel cabinet.
   a. Mounting: Recessed flush with surface **OR** Surface, **as directed**.
4. Supervised Circuits: Separate circuits for each independent hazard area.
   a. Detection circuits equal to the required number of zones, or addressable devices assigned to the required number of zones.
   b. Manual pull-station circuit.
   c. Alarm circuit.
   d. Release circuit.
   e. Abort circuit.
   f. EPO circuit.
5. Provide the following control-panel features:
   a. Electrical contacts for shutting down fans, activating dampers, and operating system electrical devices.

b. Automatic switchover to standby power at loss of primary power.
c. Storage container, low-pressure indicator.
d. Service disconnect to interrupt system operation for maintenance with visual status indication on the annunciator panel.

6. Annunciator Panel: Graphic type showing protected, hazard-area plans and locations of detectors, abort, EPO, and manual stations. Include lamps to indicate device-initiating alarm, electrical contacts for connection to control panel, and stainless-steel or aluminum enclosure.
7. Standby Power: Lead-acid or nickel-cadmium batteries with capacity to operate system for 72 hours and alarm for minimum of 15 minutes. Include automatic battery charger, with varying charging rate between trickle and high depending on battery voltage, that is capable of maintaining batteries fully charged. Include manual voltage control, dc voltmeter, dc ammeter, electrical contacts for connection to control panel, and suitable enclosure.

I. Detection Devices
1. Description: Comply with NFPA 2001 and NFPA 72, and include the following types:
a. Ionization Detectors: Comply with UL 268, dual-chamber type, having sampling and referencing chambers, with smoke-sensing element.
b. Photoelectric Detectors: Comply with UL 268, consisting of LED light source and silicon photodiode receiving element.
c. Remote Air-Sampling Detector System: Includes air-sampling pipe network, a laser-based photoelectric detector, a sample transport fan, and a control unit.
1) Comply with UL 268 and NRTL listed, operating at 24-V dc, nominal.
2) Pipe Network: CPVC tubing connects control unit with calibrated sampling holes.
3) Smoke Detector: Particle-counting type with continuous laser beam. Sensitivity adjustable to a minimum of four preset values.
4) Sample Transport Fan: Centrifugal type, creating a minimum static pressure of 0.05-inch wg (12.5 Pa) at all sampling ports.
5) Control Unit: Multizone unit as indicated on Drawings. Provides same system power supply, supervision, and alarm features as specified for the control panel plus separate trouble indication for airflow and detector problems.
6) Signals to the Central Fire Alarm Control Panel: Any type of local system trouble is reported to the central fire alarm control panel as a composite "trouble" signal. Alarms on each system zone are individually reported to the central fire alarm control panel as separately identified zones.

J. Manual Stations
1. General Description: Surface **OR** Semirecessed, **as directed**, FMG approved or NRTL listed, with clear plastic hinged cover, 120-V ac or low voltage compatible with controls. Include contacts for connection to control panel.
2. Manual Release: "MANUAL RELEASE" caption, and red finish. Unit can manually discharge extinguishing agent with operating device that remains engaged until unlocked.
3. Abort Switch: "ABORT" caption, momentary contact, with green finish.
4. EPO Switch: "EPO" caption, with yellow finish.

K. Switches
1. Description: FMG approved or NRTL listed, where available, 120-V ac or low voltage compatible with controls. Include contacts for connection to control panel.
a. Low-Agent Pressure Switches: Pneumatic operation.
b. Power Transfer Switches: Key-operation selector, for transfer of release circuit signal from main supply to reserve supply.
c. Door Closers: Magnetic retaining and release device or electrical interlock to cause the door operator to drive the door closed.

L. Alarm Devices
1. Description: FMG approved or NRTL listed, low voltage, and surface mounting, unless otherwise indicated.

2. Bells: Minimum 6-inch (150-mm) diameter.
3. Horns: 90 to 94 dBA.
4. Strobe Lights: Translucent lens, with "FIRE" or similar caption.

M. Electrical Power And Wiring
1. Electrical power, wiring, and devices are specified in Division 15.

1.3 EXECUTION

A. Piping Applications
1. Flanged pipe and fittings and flanged joints may be used to connect to specialties and accessories and where required for maintenance.
2. Fittings Working Pressure: 620 psig (4278 kPa) minimum.
3. Flanged Joints: Class 300 minimum.
4. NPS 2 (DN 50) and Smaller: ASTM B 88, Type K **OR** L, **as directed**, (ASTM B 88M, Type A **OR** B, **as directed**,) copper tube; copper, solder-joint fittings; and brazed joints.
OR
NPS 2 (DN 50) and Smaller: Schedule 40, steel pipe; malleable-iron threaded fittings; and threaded joints.
5. NPS 2-1/2 and NPS 3 (DN 65 and DN 80): ASTM B 88, Type K **OR** L, **as directed**, (ASTM B 88M, Type A **OR** B, **as directed**,) copper tube; copper, solder-joint fittings; and brazed joints.
OR
NPS 2-1/2 and NPS 3 (DN 65 and DN 80): Schedule 40, steel pipe; forged-steel welding fittings; and welded joints.
OR
NPS 2-1/2 and NPS 3 (DN 65 and DN 80): Schedule 40, steel pipe; steel, grooved-end fittings; steel, keyed couplings; and grooved joints.
6. NPS 4 (DN 100) and Larger: Schedule 40, steel pipe; steel, grooved-end fittings; steel, keyed couplings; and grooved joints.
OR
NPS 4 (DN 100) and Larger: Schedule 40, steel pipe; forged-steel welding fittings; and welded joints.

B. Piping Applications
1. Piping between Storage Containers and Orifice Union:
a. Flanged pipe and fittings and flanged joints may be used to connect to specialties and accessories and where required for maintenance.
b. Fittings Working Pressure: 2175 psig (15 MPa) minimum.
c. Flanged Joints: Class 600 minimum.
d. All Sizes: Schedule 80, steel pipe; forged-steel welding fittings; and welded joints.
2. Piping Downstream from Orifice Union:
a. Flanged pipe and fittings and flanged joints may be used to connect to specialties and accessories and where required for maintenance.
b. Fittings Working Pressure: 1000 psig (6900 kPa) minimum.
c. Flanged Joints: Class 300 minimum.
d. All Sizes: Schedule 40 **OR** 80, **as directed**, steel pipe; forged-steel welding fittings; and welded joints.

C. Clean-Agent Extinguishing Piping Installation
1. Install clean-agent extinguishing piping and other components level and plumb and according to manufacturers' written instructions.
2. Refer to Division 15 Section "Common Work Results For Fire Suppression" for basic pipe installation and joint construction.

3. Grooved Piping Joints: Groove pipe ends according to AWWA C606 dimensions. Assemble grooved-end steel pipe and steel, grooved-end fittings with steel, keyed couplings and lubricant according to manufacturer's written instructions.
4. Install extinguishing-agent containers anchored to substrate.
5. Install pipe and fittings, valves, and discharge nozzles according to requirements listed in NFPA 2001, Section "Distribution," and in ASME B31.1.
   a. Install valves designed to prevent entrapment of liquid or install pressure relief devices in valved sections of piping systems.
   b. Support piping using supports and methods according to NFPA 13.
   c. Install seismic restraints for extinguishing-agent containers and piping systems.
   d. Install control panels, detection system components, alarms, and accessories, complying with requirements of NFPA 2001, Section "Detection, Actuation, and Control Systems," as required for supervised system application.

D. Connections
1. Drawings indicate general arrangement of piping, fittings, and specialties.
2. Install piping adjacent to extinguishing-agent containers to allow service and maintenance.
3. Connect electrical devices to control panel and to building's fire alarm system. Electrical power, wiring, and devices are specified in Division 13 Section(s) "Digital, Addressable Fire-alarm System" OR "Zoned (dc Loop) Fire-alarm System".

E. Labeling
1. Install labeling on piping, extinguishing-agent containers, other equipment, and panels according to NFPA 2001.
2. Install signs at entry doors for protected areas to warn occupants that they are entering a room protected with a clean-agent fire extinguishing system.
3. Install signs at entry doors to advise persons outside the room the meaning of the horn(s), bell(s), and strobe light(s) outside the protected space.

F. Field Quality Control
1. Comply with operating instructions and procedures of NFPA 2001, Section "Approval of Installations." Include the following tests and inspections to demonstrate compliance with requirements:
   a. Check mechanical items.
   b. Inspect extinguishing-agent containers and extinguishing agent, and check mountings for adequate anchoring to substrate.
   c. Check electrical systems.
   d. Check enclosure integrity. Comply with NFPA 2001, Section "Enclosure Inspection," and Appendix C, "Enclosure Integrity Procedure."
   e. Perform functional pre-discharge test.
   f. Perform system functional operational test including, EPO, abort, and manual release.
   g. Check remote monitoring operations.
   h. Check control-panel primary power source.
   i. Perform "puff" test on piping system, using nitrogen.
2. Perform field-acceptance tests of each clean-agent extinguishing system when installation is complete. Perform system testing only after hazard-area enclosure construction has been completed and openings sealed. Comply with operating instructions and procedures of NFPA 2001, Section "Approval of Installations." Include the following to demonstrate compliance with requirements:
   a. Perform functional predischarge test.
   b. Perform system functional operational test.
   c. Check remote monitoring operations.
   d. Check control-panel primary power source.
   e. Perform "puff" test on piping system, using nitrogen.

3. Correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment that cannot be corrected or does not perform as specified and indicated, then retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.
   a. Report test results promptly and in writing to the Owner and authorities having jurisdiction.
4. Perform the following field tests and inspections and prepare test reports:
   a. After installing clean-agent extinguishing piping system and after electrical circuitry has been energized, test for compliance with requirements.
   b. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections "Inspection and Test Procedures" and "System Function Tests." Certify compliance with test parameters.
   c. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   d. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
   e. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
5. Remove and replace malfunctioning units and retest as specified above.

G. Cleaning
1. Each pipe section shall be cleaned internally after preparation and before assembly by means of swabbing, using a suitable nonflammable cleaner. Pipe network shall be free of particulate matter and oil residue before installing nozzles or discharge devices.

H. System Filling
1. Preparation:
   a. Verify that piping system installation is completed and cleaned.
   b. Check for complete enclosure integrity.
   c. Check operation of ventilation and exhaust systems.
2. Filling Procedures:
   a. Fill extinguishing-agent containers with extinguishing agent and pressurize to indicated charging pressure.
   b. Install filled extinguishing-agent containers.
   c. Energize circuits.
   d. Adjust operating controls.

I. Demonstration
1. Train Owner's maintenance personnel to adjust, operate, and maintain clean-agent extinguishing systems.

END OF SECTION 13965

Task	Specification	Specification Description
13965	01352	No Specification Required

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SECTION 13975 - FIRE-SUPPRESSION STANDPIPES

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for fire-suppression standpipes. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section Includes:
a. Pipes, fittings, and specialties.
b. Fire-protection valves.
c. Hose connections.
d. Hose stations.
e. Monitors.
f. Fire-department connections.
g. Alarm devices.
h. Manual control stations.
i. Control panels.
j. Pressure gages.

C. Definitions
1. High-Pressure Standpipe Piping: Fire-suppression standpipe piping designed to operate at working pressure higher than standard 175 psig (1200 kPa), but not higher than 250 psig (1725 kPa) **OR** 300 psig (2070 kPa), **as directed**.
2. Standard-Pressure Standpipe Piping: Fire-suppression standpipe piping designed to operate at working pressure 175 psig (1200 kPa) maximum.

D. System Descriptions
1. Automatic Wet-Type, Class I Standpipe System: Includes NPS 2-1/2 (DN 65) hose connections. Has open water-supply valve with pressure maintained and is capable of supplying water demand.
2. Automatic Wet-Type, Class II Standpipe System: Includes NPS 1-1/2 (DN 40) hose stations. Has open water-supply valve with pressure maintained and is capable of supplying water demand.
3. Automatic Wet-Type, Class III Standpipe System: Includes NPS 1-1/2 (DN 40) hose stations and NPS 2-1/2 (DN 65) hose connections. Has open water-supply valve with pressure maintained and is capable of supplying water demand.
4. Automatic Dry-Type, Class I Standpipe System: Includes NPS 2-1/2 (DN 65) hose connections. Has open water-supply valve and dry-pipe valve with standpipes containing compressed air. Opening fire-hose valve releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into standpipes.
5. Automatic Dry-Type, Class II Standpipe System: Includes NPS 1-1/2 (DN 40) hose stations. Has open water-supply valve and dry-pipe valve with standpipes containing compressed air. Opening fire-hose valve releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into standpipes.
6. Automatic Dry-Type, Class III Standpipe System: Includes NPS 1-1/2 (DN 40) hose stations and NPS 2-1/2 (DN 65) hose connections. Has open water-supply valve and dry-pipe valve with standpipes containing compressed air. Opening fire-hose valve releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into standpipes.
7. Semiautomatic Dry-Type, Class I Standpipe System: Includes NPS 2-1/2 (DN 65) hose connections. Has open water-supply valve and deluge valve with standpipes containing air.

Actuation of detection device permits water pressure to open deluge valve. Water then flows into standpipes.

8. Semiautomatic Dry-Type, Class II Standpipe System: Includes NPS 1-1/2 (DN 40) hose stations. Has open water-supply valve and deluge valve with standpipes containing air. Actuation of detection device permits water pressure to open deluge valve. Water then flows into standpipes.
9. Semiautomatic Dry-Type, Class III Standpipe System: Includes NPS 1-1/2 (DN 40) hose stations and NPS 2-1/2 (DN 65) hose connections. Has open water-supply valve and deluge valve with standpipes containing air. Actuation of detection device permits water pressure to open deluge valve. Water then flows into standpipes.
10. Manual Wet-Type, Class I Standpipe System: Includes NPS 2-1/2 (DN 65) hose connections. Has small water supply to maintain water in standpipes. Piping is wet, but water must be pumped into standpipes to satisfy demand.
11. Manual Dry-Type, Class I Standpipe System: Includes NPS 2-1/2 (DN 65) hose connections. Does not have permanent water supply. Piping is dry. Water must be pumped into standpipes to satisfy demand.

E. Performance Requirements
1. Standard-Pressure, Fire-Suppression Standpipe System Component: Listed for 175-psig (1200-kPa) minimum working pressure.
2. High-Pressure, Fire-Suppression Standpipe System Component: Listed for 250-psig (1725-kPa) minimum **OR** 300-psig (2070-kPa), **as directed**, working pressure.
3. Delegated Design: Design fire-suppression standpipes, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
4. Fire-suppression standpipe design shall be approved by authorities having jurisdiction.
   a. Minimum residual pressure at each hose-connection outlet is as follows:
      1) NPS 1-1/2 (DN 40) Hose Connections: 65 psig (450 kPa).
      2) NPS 2-1/2 (DN 65) Hose Connections: 100 psig (690 kPa).
   b. Maximum residual pressure at required flow at each hose-connection outlet is as follows unless otherwise indicated:
      1) NPS 1-1/2 (DN 40) Hose Connections: 100 psig (690 kPa).
      2) NPS 2-1/2 (DN 65) Hose Connections: 175 psig (1200 kPa).
5. Seismic Performance: Fire-suppression standpipes shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

F. Submittals
1. Product Data: For each type of product indicated.
2. Shop Drawings: For fire-suppression standpipes. Include plans, elevations, sections, details, and attachments to other work.
   a. Wiring Diagrams: For power, signal, and control wiring.
3. Delegated-Design Submittal: For standpipe systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
4. Qualification Data: For qualified Installer and professional engineer.
5. Approved Standpipe Drawings: Working plans, prepared according to NFPA 14, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
6. Welding certificates.
7. Fire-hydrant flow test report.
8. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."
9. Field quality-control reports.
10. Operation and Maintenance Data: For fire-suppression standpipes specialties to include in emergency, operation, and maintenance manuals.

G. Quality Assurance
1. Installer Qualifications:
a. Installer's responsibilities include designing, fabricating, and installing fire-suppression standpipes and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
1) Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
2. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
3. 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.
4. NFPA Standards: Fire-suppression standpipe equipment, specialties, accessories, installation, and testing shall comply with NFPA 14, "Installation of Standpipe and Hose Systems."

H. Project Conditions
1. Interruption of Existing Fire-Suppression Standpipe Service: Do not interrupt fire-suppression standpipe service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary fire-suppression standpipe service according to requirements indicated:
a. Notify the Owner no fewer than two days in advance of proposed interruption of fire-suppression standpipe service.
b. Do not proceed with interruption of fire-suppression standpipe service without the Owner's written permission.

1.2 PRODUCTS

A. Piping Materials
1. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

B. Steel Pipe And Fittings
1. Standard Weight, Galvanized- and Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.
2. Schedule 30, Galvanized- and Black-Steel Pipe: ASTM A 135; ASTM A 795/A 795M, Type E; or ASME B36.10M, wrought steel; with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.
3. Thinwall Galvanized- and Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.
4. Schedule 10, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 10 in NPS 5 (DN 125) and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10 (DN 150 to DN 250), plain end.
5. Nonstandard OD, Thinwall Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, thinwall, with plain ends and wall thickness less than Schedule 10.
6. Hybrid Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, lightwall, with wall thickness less than Schedule 10 and greater than Schedule 5.
7. Standard-Weight, Galvanized- and Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, seamless steel pipe with threaded ends.
8. Galvanized and Uncoated, Steel Couplings: ASTM A 865, threaded.
9. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
10. Malleable- or Ductile-Iron Unions: UL 860.
11. Cast-Iron Flanges: ASME B16.1, Class 125.
12. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
13. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

14. Grooved-Joint, Steel-Pipe Appurtenances:
    a. Pressure Rating: 175 psig (1200 kPa) **OR** 250 psig (1725 kPa) **OR** 300 psig (2070 kPa), **as directed**, minimum.
    b. Galvanized and Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
    c. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

C. Copper Tube And Fittings
1. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) and ASTM B 88, Type M (ASTM B 88M, Type C) water tube, drawn temper.
2. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
3. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.
4. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
5. 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.
6. Grooved-Joint, Copper-Tube Appurtenances:
    a. Grooved-End, Copper Fittings: ASTM B 75 (ASTM B 75M), copper tube or ASTM B 584, bronze castings.
    b. Grooved-End-Tube Couplings: To fit copper tube dimensions, with design similar to AWWA C606. Include ferrous housing sections, EPDM-rubber gasket suitable for hot and cold water, and bolts and nuts.

D. Piping Joining Materials
1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free.
    a. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
    b. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.
2. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
3. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
4. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

E. Listed Fire-Protection Valves
1. General Requirements:
    a. Valves shall be UL listed or FM approved.
    b. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig (1200 kPa).
    c. Minimum Pressure Rating for High-Pressure Piping: 250 psig (1725 kPa) **OR** 300 psig (2070 kPa), **as directed**.
2. Ball Valves:
    a. Standard: UL 1091 except with ball instead of disc.
    b. Valves NPS 1-1/2 (DN 40) and Smaller: Bronze body with threaded ends.
    c. Valves NPS 2 and NPS 2-1/2 (DN 50 and DN 65): Bronze body with threaded ends or ductile-iron body with grooved ends.
    d. Valves NPS 3 (DN 80): Ductile-iron body with grooved ends.
3. Bronze Butterfly Valves:
    a. Standard: UL 1091.
    b. Pressure Rating: 175 psig (1200 kPa).
    c. Body Material: Bronze.
    d. End Connections: Threaded.

4. Iron Butterfly Valves:
   a. Standard: UL 1091.
   b. Pressure Rating: 175 psig (1200 kPa).
   c. Body Material: Cast or ductile iron.
   d. Style: Lug or wafer.
      OR
      End Connections: Grooved.
5. Check Valves:
   a. Standard: UL 312.
   b. Pressure Rating: 250 psig (1725 kPa) minimum **OR** 300 psig (2070 kPa), **as directed**.
   c. Type: Swing check.
   d. Body Material: Cast iron.
   e. End Connections: Flanged or grooved.
6. Bronze OS&Y Gate Valves:
   a. Standard: UL 262.
   b. Pressure Rating: 175 psig (1200 kPa).
   c. Body Material: Bronze.
   d. End Connections: Threaded.
7. Iron OS&Y Gate Valves:
   a. Standard: UL 262.
   b. Pressure Rating: 250 psig (1725 kPa) minimum **OR** 300 psig (2070 kPa), **as directed**.
   c. Body Material: Cast or ductile iron.
   d. End Connections: Flanged or grooved.
8. Indicating-Type Butterfly Valves:
   a. Standard: UL 1091.
   b. Pressure Rating: 175 psig (1200 kPa) minimum.
   c. Valves NPS 2 (DN 50) and Smaller:
      1) Valve Type: Ball or butterfly.
      2) Body Material: Bronze.
      3) End Connections: Threaded.
   d. Valves NPS 2-1/2 (DN 65) and Larger:
      1) Valve Type: Butterfly.
      2) Body Material: Cast or ductile iron.
      3) End Connections: Flanged, grooved, or wafer.
   e. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch **OR** electrical, 115-V ac, prewired, two-circuit, supervisory switch **OR** visual, **as directed**, indicating device.
9. NRS Gate Valves:
   a. Standard: UL 262.
   b. Pressure Rating: 250 psig (1725 kPa) minimum **OR** 300 psig (2070 kPa), **as directed**.
   c. Body Material: Cast iron with indicator post flange.
   d. Stem: Nonrising.
   e. End Connections: Flanged or grooved.
10. Indicator Posts:
   a. Standard: UL 789.
   b. Type: Horizontal for wall mounting.
   c. Body Material: Cast iron with extension rod and locking device.
   d. Operation: Wrench **OR** Hand wheel, **as directed**.

F. Trim And Drain Valves
1. General Requirements:
   a. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   b. Pressure Rating: 175 psig (1200 kPa) minimum.
2. Angle Valves.
3. Ball Valves.

4. Globe Valves.
5. Plug Valves.

G. Specialty Valves
1. General Requirements:
   a. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   b. Pressure Rating:
      1) Standard-Pressure Piping Specialty Valves: 175 psig (1200 kPa) minimum.
      2) High-Pressure Piping Specialty Valves: 250 psig (1725 kPa) minimum **OR** 300 psig (2070 kPa), **as directed**.
   c. Body Material: Cast or ductile iron.
   d. Size: Same as connected piping.
   e. End Connections: Flanged or grooved.
2. Alarm Valves:
   a. Standard: UL 193.
   b. Design: For horizontal or vertical installation.
   c. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, **as directed**, and fill-line attachment with strainer.
   d. Drip Cup Assembly (if retarding chamber is required): Pipe drain without valves and separate from main drain piping.
   e. Drip Cup Assembly (if retarding chamber is not required): Pipe drain with check valve to main drain piping.
3. Dry-Pipe Valves:
   a. Standard: UL 260.
   b. Design: Differential-pressure type.
   c. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
   d. Air-Pressure Maintenance Device:
      1) Standard: UL 260.
      2) Type: Automatic device to maintain minimum air pressure in piping.
      3) Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig (95- to 410-kPa) adjustable range, and 175-psig (1200-kPa) **OR** 300-psig (2070-kPa), **as directed**, outlet pressure.
   e. Air Compressor:
      1) Standard: UL's "Fire Protection Equipment Directory" listing.
      2) Motor Horsepower: Fractional.
      3) Power: 120-V ac, 60 Hz, single phase.
4. Deluge Valves:
   a. Standard: UL 260.
   b. Design: Hydraulically operated, differential-pressure type.
   c. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, drip cup assembly piped without valves and separate from main drain line, fill-line attachment with strainer, and push-rod chamber supply connection.
   d. Wet, Pilot-Line Trim Set: Include gage to read push-rod chamber pressure, globe valve for manual operation of deluge valve, and connection for actuation device.
   e. Dry, Pilot-Line Trim Set: Include dry, pilot-line actuator; air- and water-pressure gages; low-air-pressure warning switch; air relief valve; and actuation device. Dry, pilot-line actuator includes cast-iron, operated, diaphragm-type valve with resilient facing plate, resilient diaphragm, and replaceable bronze seat. Valve includes threaded water and air inlets and water outlet. Loss of air pressure on dry, pilot-line side allows pilot-line actuator to open and causes deluge valve to open immediately.
   f. Air-Pressure Maintenance Device:

1) Standard: UL 260.
2) Type: Automatic device to maintain minimum air pressure in piping.
3) Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator, or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig (95- to 410-kPa) adjustable range, and 175-psig (1200-kPa) **OR** 300-psig (2070-kPa), **as directed**, outlet pressure.

g. Air Compressor:
1) Standard: UL's "Fire Protection Equipment Directory" listing.
2) Motor Horsepower: Fractional.
3) Power: 120-V ac, 60 Hz, single phase.

5. Pressure-Reducing Valves:
a. UL 668 hose valve, with integral UL 1468 reducing device.
b. Pressure Rating: 300 psig (2070 kPa) minimum.
c. Material: Brass or bronze.
d. Inlet: Female pipe threads.
e. Outlet: Threaded with or without adapter having male hose threads.
f. Pattern: Angle or gate.
g. Finish: Polished chrome plated **OR** Rough brass or bronze **OR** Rough chrome plated, **as directed**.

6. Automatic (Ball Drip) Drain Valves:
a. Standard: UL 1726.
b. Pressure Rating: 175 psig (1200 kPa) minimum.
c. Type: Automatic draining, ball check.
d. Size: NPS 3/4 (DN 20).
e. End Connections: Threaded.

H. Hose Connections
1. Adjustable-Valve Hose Connections:
a. Standard: UL 668 hose valve, with integral UL 1468 reducing or restricting pressure-control device, for connecting fire hose.
b. Pressure Rating: 300 psig (2070 kPa) minimum.
c. Material: Brass or bronze.
d. Size: NPS 1-1/2 or NPS 2-1/2 (DN 40 or DN 65), as indicated.
e. Inlet: Female pipe threads.
f. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.
g. Pattern: Angle or gate.
h. Pressure-Control Device Type: Pressure reducing **OR** restricting, **as directed**.
i. Design Outlet Pressure Setting: as directed by the Owner.
j. Finish: Polished chrome plated **OR** Rough brass or bronze **OR** Rough chrome plated, **as directed**.

2. Nonadjustable-Valve Hose Connections:
a. Standard: UL 668 hose valve for connecting fire hose.
b. Pressure Rating: 300 psig (2070 kPa) minimum.
c. Material: Brass or bronze.
d. Size: NPS 1-1/2 or NPS 2-1/2 (DN 40 or DN 65), as indicated.
e. Inlet: Female pipe threads.
f. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.
g. Pattern: Angle or gate.
h. Finish: Polished chrome plated **OR** Rough brass or bronze **OR** Rough chrome plated, **as directed**.

I. NPS 1-1/2 (DN 40) Rack-Type Hose Stations
1. Hose Rack:
a. Standard: UL 47.

b. Material: Brass or bronze with polished chrome-plated **OR** Steel with red-enamel, **as directed**, finish.
c. Type: Hose-rack assembly. Include hose valve, hose rack, water-retention device, hose pins, and hose.
d. Operation: Semiautomatic.
e. Sized to hold fire hose.

2. Hose Valve:
a. Standard: UL 668 NPS 1-1/2 (DN 40), for connecting fire hose.
b. Type: Adjustable **OR** Nonadjustable, **as directed**.
c. Pressure-Control Device: Not required **OR** Pressure reducing **OR** Pressure restricting, **as directed**.
d. Design Outlet Pressure Setting: Not applicable **OR as directed**.
e. Hose Valve and Trim Finish: Polished chrome plated **OR** Rough brass or bronze **OR** Rough chrome plated, **as directed**.
f. Pressure Rating: 300 psig (2070 kPa) minimum.
g. Pattern: Angle.
h. Material: Brass or bronze.
i. Pressure-Control Device: UL 1468 integral or for field installation if indicated.
j. Size: NPS 1-1/2 (DN 40).
k. Inlet: Female pipe threads.
l. Outlet: Male hose threads according to NFPA 1963 and matching local fire-department threads.

3. Hose:
a. Standards: NFPA 1961 and UL 219 lined fire hose with swivel inlet, coupling, gaskets, and nozzle.
b. Size: NPS 1-1/2 (DN 40).
c. Length: 50 feet (15 m) **OR** 75 feet (23 m) **OR** 100 feet (30 m), **as directed**.
d. Jacket: Combination of natural and synthetic threads **OR** Natural thread **OR** Synthetic thread, **as directed**.
e. Lining: Combination of rubber and plastic compounds **OR** Rubber compound **OR** Plastic compound, **as directed**.
f. Cover: Rubber, plastic, or combination of rubber and plastic compounds.
g. Nozzle: UL 401.
1) Material: Brass **OR** Polished brass **OR** Rough chrome-plated brass **OR** Polished chrome-plated brass **OR** Polycarbonate plastic, **as directed**.
2) Type: Plain, for nonadjustable water stream **OR** Spray, adjustable from shutoff to fog spray or straight stream **OR** Spray, adjustable from shutoff to full fog; for use on electrical fires, **as directed**.

J. NPS 1-1/2 BY NPS 2-1/2 (DN 40 BY DN 65) Rack-Type Hose Stations

1. Hose Rack:
a. Standard: UL 47.
b. Material: Brass or bronze with polished chrome-plated **OR** Steel with red-enamel, **as directed**, finish.
c. Type: Hose-rack assembly. Include hose valve, reducer adapter, hose rack, water-retention device, hose pins, and hose.
d. Operation: Semiautomatic.
e. Sized to hold fire hose.

2. Hose Valve:
a. Standard: UL 668, NPS 2-1/2 (DN 65), for connecting fire hose.
b. Type: Adjustable **OR** Nonadjustable, **as directed**.
c. Pressure-Control Device: Not required **OR** Pressure reducing **OR** Pressure restricting, **as directed**.
d. Design Outlet Pressure Setting: Not applicable **OR as directed**.

e. Hose Valve and Trim Finish: Polished chrome plated **OR** Rough brass or bronze **OR** Rough chrome plated, **as directed**.
f. Pressure Rating: 300 psig (2070 kPa) minimum.
g. Pattern: Angle.
h. Material: Brass or bronze.
i. Pressure-Control Device: UL 1468, integral or for field installation if indicated.
j. Size: NPS 2-1/2 (DN 65).
k. Inlet: Female pipe threads.
l. Outlet: Male hose threads according to NFPA 1963 and matching local fire-department threads.
m. Reducer Adapter: NPS 2-1/2 by NPS 1-1/2 (DN 65 by DN 40).

3. Hose:
a. Standards: NFPA 1961 and UL 219, lined fire hose with swivel inlet, coupling, gaskets, and nozzle.
b. Size: NPS 1-1/2 (DN 40).
c. Length: 50 feet (15 m) **OR** 75 feet (23 m) **OR** 100 feet (30 m), **as directed**.
d. Jacket: Combination of natural and synthetic threads **OR** Natural thread **OR** Synthetic thread, **as directed**.
e. Lining: Combination of rubber and plastic compounds **OR** Rubber compound **OR** Plastic compound, **as directed**.
f. Cover: Rubber, plastic, or combination of rubber and plastic compounds.
g. Nozzle: UL 401 spray nozzle unless plain nozzle is indicated.
1) Material: Brass **OR** Polished brass **OR** Rough chrome-plated brass **OR** Polished chrome-plated brass **OR** Polycarbonate plastic, **as directed**.
2) Type: Plain, for nonadjustable water stream **OR** Spray, adjustable from shutoff to fog spray or straight stream **OR** Spray, adjustable from shutoff to full fog; for use on electrical fires, **as directed**.

K. NPS 1-1/2 (DN 40) Reel-Type Hose Stations
1. Hose Reel:
a. Standard: UL 47.
b. Hose Reel and Bracket Material: Steel.
c. Type: Hose-reel assembly. Include hose valve, wall bracket, hose reel, water-retention device, hose pins, and hose.
d. Operation: Semiautomatic.
e. Sized to hold fire hose.
f. Finish: Red enamel.

2. Hose Valve:
a. Standard: UL 668, NPS 1-1/2 (DN 40), for connecting fire hose.
b. Type: Adjustable **OR** Nonadjustable, **as directed**.
c. Pressure-Control Device: Not required **OR** Pressure reducing **OR** Pressure restricting, **as directed**.
d. Design Outlet Pressure Setting: Not applicable **OR as directed**.
e. Hose Valve and Trim Finish: Polished chrome plated **OR** Rough brass or bronze **OR** Rough chrome plated, **as directed**.
f. Pressure Rating: 300 psig (2070 kPa) minimum.
g. Pattern: Angle.
h. Material: Brass or bronze.
i. Pressure-Control Device: UL 1468, integral or for field installation if indicated.
j. Size: NPS 1-1/2 (DN 40).
k. Inlet: Female pipe threads.
l. Outlet: Male hose threads according to NFPA 1963 and matching local fire-department threads.

3. Hose:
a. Standards: NFPA 1961 and UL 219 lined fire hose with swivel inlet, coupling, gaskets, and nozzle.

b. Size: NPS 1-1/2 (DN 40).
c. Length: 50 feet (15 m) **OR** 75 feet (23 m) **OR** 100 feet (30 m), **as directed**.
d. Jacket: Combination of natural and synthetic threads **OR** Natural thread **OR** Synthetic thread, **as directed**.
e. Lining: Combination of rubber and plastic compounds **OR** Rubber compound **OR** Plastic compound, **as directed**.
f. Cover: Rubber, plastic, or combination of rubber and plastic compounds.
g. Nozzle: UL 401.
   1) Material: Brass **OR** Polished brass **OR** Rough chrome-plated brass **OR** Polished chrome-plated brass **OR** Polycarbonate plastic, **as directed**.
   2) Type: Spray, adjustable from shutoff to fog spray or straight stream **OR** full fog; for use on electrical fires, **as directed**.

L. Monitors
1. Type: Stationary.
2. Nozzle: UL 401, NPS 2-1/2 (DN 65), brass, adjustable from fog spray to straight stream to shutoff.
3. Horizontal Rotation: 360 degrees with locking device.
4. Vertical Rotation: 80-degree elevation and 60-degree depression with locking device.
5. Waterway: Double **OR** Single, **as directed**, brass or stainless-steel tube.
6. Waterway Size: NPS 2-1/2 (DN 65) minimum.
7. Water Stream Flow: 500 gpm (31.5 L/s) **OR** 750 gpm (47.3 L/s) **OR** 1000 gpm (63 L/s), **as directed**.
8. Operation: Lever **OR** Wheel, **as directed**.
9. Base Inlet Size: NPS 2-1/2 (DN 65) **OR** NPS 3 (DN 80) **OR** NPS 4 (DN 100), **as directed**.
10. Finish: Red-painted body with brass trim.

M. Fire-Department Connections
1. Exposed-Type, Fire-Department Connection:
   a. Standard: UL 405.
   b. Type: Exposed, projecting, for wall mounting.
   c. Pressure Rating: 175 psig (1200 kPa) minimum.
   d. Body Material: Corrosion-resistant metal.
   e. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
   f. Caps: Brass, lugged type, with gasket and chain.
   g. Escutcheon Plate: Round, brass, wall type.
   h. Outlet: Back, with pipe threads.
   i. Number of Inlets: Two **OR** Three, **as directed**.
   j. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE" **OR** “STANDPIPE", **as directed**.
   k. Finish: Polished chrome plated **OR** Rough brass or bronze **OR** Rough chrome plated, **as directed**.
   l. Outlet Size: NPS 4 (DN 100) **OR** NPS 5 (DN 125) **OR** NPS 6 (DN 150), **as directed**.
2. Flush-Type, Fire-Department Connection:
   a. Standard: UL 405.
   b. Type: Flush, for wall mounting.
   c. Pressure Rating: 175 psig (1200 kPa) minimum.
   d. Body Material: Corrosion-resistant metal.
   e. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
   f. Caps: Brass, lugged type, with gasket and chain.
   g. Escutcheon Plate: Rectangular, brass, wall type.

h. Outlet: With pipe threads.
i. Body Style: Horizontal **OR** Square **OR** Vertical, **as directed**.
j. Number of Inlets: Two **OR** Three **OR** Four **OR** Six, **as directed**.
k. Outlet Location: Back **OR** Bottom **OR** Left side **OR** Right side **OR** Top, **as directed**.
l. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE" **OR** "STANDPIPE", **as directed**.
m. Finish: Polished chrome plated **OR** Rough brass or bronze **OR** Rough chrome plated, **as directed**.
n. Outlet Size: NPS 4 (DN 100) **OR** NPS 5 (DN 125) **OR** NPS 6 (DN 150) **OR** NPS 8 (DN 200), **as directed**.

3. Yard-Type, Fire-Department Connection:
a. Standard: UL 405.
b. Type: Exposed, freestanding.
c. Pressure Rating: 175 psig (1200 kPa) minimum **OR** 300 psig (2070 kPa), **as directed**.
d. Body Material: Corrosion-resistant metal.
e. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
f. Caps: Brass, lugged type, with gasket and chain.
g. Escutcheon Plate: Round, brass, floor type.
h. Outlet: Bottom, with pipe threads.
i. Number of Inlets: Two **OR** Three **OR** Four, **as directed**.
j. Sleeve: Brass **OR** Not required, **as directed**.
k. Sleeve Height: 18 inches (460 mm).
l. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE" **OR** "STANDPIPE", **as directed**.
m. Finish, Including Sleeve: Polished chrome plated **OR** Rough brass or bronze **OR** Rough chrome plated, **as directed**.
n. Outlet Size: NPS 4 (DN 100) **OR** NPS 5 (DN 125) **OR** NPS 6 (DN 150), **as directed**.

N. Alarm Devices
1. Alarm-device types shall match piping and equipment connections.
2. Water-Motor-Operated Alarm:
a. Standard: UL 753.
b. Type: Mechanically operated, with Pelton wheel.
c. Alarm Gong: Cast aluminum with red-enamel factory finish.
d. Size: 10-inch (250-mm) diameter.
e. Components: Shaft length, bearings, and sleeve to suit wall construction.
f. Inlet: NPS 3/4 (DN 20).
g. Outlet: NPS 1 (DN 25) drain connection.
3. Electrically Operated Alarm Bell:
a. Standard: UL 464.
b. Type: Vibrating, metal alarm bell.
c. Size: 6-inch (150-mm) minimum **OR** 8-inch (200-mm) minimum **OR** 10-inch (250-mm), **as directed**, diameter.
d. Finish: Red-enamel factory finish, suitable for outdoor use.
4. Water-Flow Indicators:
a. Standard: UL 346.
b. Water-Flow Detector: Electrically supervised.
c. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
d. Type: Paddle operated.
e. Pressure Rating: 250 psig (1725 kPa).
f. Design Installation: Horizontal or vertical.

5. Pressure Switches:
   a. Standard: UL 346.
   b. Type: Electrically supervised water-flow switch with retard feature.
   c. Components: Single-pole, double-throw switch with normally closed contacts.
   d. Design Operation: Rising pressure signals water flow.
6. Valve Supervisory Switches:
   a. Standard: UL 346.
   b. Type: Electrically supervised.
   c. Components: Single-pole, double-throw switch with normally closed contacts.
   d. Design: Signals that controlled valve is in other than fully open position.
7. Indicator-Post Supervisory Switches:
   a. Standard: UL 346.
   b. Type: Electrically supervised.
   c. Components: Single-pole, double-throw switch with normally closed contacts.
   d. Design: Signals that controlled indicator-post valve is in other than fully open position.

O. Manual Control Stations
1. Description: UL listed or FM approved, hydraulic operation, with union, NPS 1/2 (DN 15) pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

P. Control Panels
1. Description: Single-area, two-area, or single-area cross-zoned control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves. Panels contain power supply; battery charger; standby batteries; field-wiring terminal strip; electrically supervised solenoid valves and polarized fire-alarm bell; lamp test facility; single-pole, double-throw auxiliary alarm contacts; and rectifier.
   a. Panels: UL listed and FM approved when used with thermal detectors and Class A detector circuit wiring. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
   b. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.
      OR
      Manual Control Stations: Hydraulic operation, with union, NPS 1/2 (DN 15) pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

Q. Pressure Gages
1. Standard: UL 393.
2. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.
3. Pressure Gage Range: 0 to 250 psig (0 to 1725 kPa) minimum **OR** 0 to 300 psig (0 to 2070 kPa), **as directed**.
4. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
5. Air System Piping Gage: Include retard feature, **as directed**, and "AIR" or "AIR/WATER" label on dial face.

R. Escutcheons
1. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
2. One-Piece, Cast-Brass Escutcheons: Polished chrome-plated or rough-brass finish with set-screws.
3. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with chrome-plated finish.

4. One-Piece, Stamped-Steel Escutcheons: Chrome-plated finish with set-screw or spring clips.
5. Split-Casting, Cast-Brass Escutcheons: Polished chrome-plated or rough-brass finish with concealed hinge and set-screw.
6. Split-Plate, Stamped-Steel Escutcheons: Chrome-plated finish with concealed **OR** exposed-rivet, **as directed**, hinge, set-screw or spring clips.
7. One-Piece Floor Plates: Cast-iron flange with holes for fasteners, **as directed**.
8. Split-Casting Floor Plates: Cast brass with concealed hinge.

S. Sleeves
1. Cast-Iron Wall-Pipe Sleeves: Cast or fabricated of cast iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
2. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
3. Molded-PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
4. Molded-PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.
5. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
6. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, standard weight, zinc coated, plain ends.
7. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
   a. Underdeck Clamp: Clamping ring with set-screws.

T. Sleeve Seals
1. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
   a. Sealing Elements: EPDM-rubber or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   b. Pressure Plates: Carbon steel **OR** Plastic **OR** Stainless steel, **as directed**.
   c. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating **OR** Stainless steel, **as directed**, of length required to secure pressure plates to sealing elements.

U. Grout
1. Standard: ASTM C 1107, Grade B, posthardening and volume adjusting, dry, hydraulic-cement grout.
2. Characteristics: Nonshrink, and recommended for interior and exterior applications.
3. Design Mix: 5000-psi (34-MPa), 28-day compressive strength.
4. Packaging: Premixed and factory packaged.

1.3 EXECUTION

A. Preparation
1. Perform fire-hydrant flow test according to NFPA 14 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
2. Report test results promptly and in writing.

B. Service-Entrance Piping
1. Connect fire-suppression standpipe piping to water-service piping at service entrance into building. Comply with requirements for exterior piping in Division 02 Section "Facility Fire-suppression Water-service Piping".
2. Install shutoff valve, backflow preventer, **as directed**, pressure gage, drain, and other accessories at connection to fire-suppression water-service piping. Comply with requirements for backflow preventers in Division 02 Section "Facility Fire-suppression Water-service Piping", **as directed**.
3. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

C. Water-Supply Connections
1. Connect fire-suppression standpipe piping to building's interior water-distribution piping. Comply with requirements for interior piping in Division 15 Section "Domestic Water Piping".
2. Install shutoff valve, backflow preventer, **as directed**, pressure gage, drain, and other accessories at connection to water-distribution piping. Comply with requirements for backflow preventers in Division 15 Section "Domestic Water Piping Specialties", **as directed**.
   OR
   Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

D. Piping Installation
1. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
   a. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with the Owner before deviating from approved working plans.
2. Piping Standard: Comply with requirements in NFPA 14 for installation of fire-suppression standpipe piping.
3. Install seismic restraints on piping. Comply with requirements in NFPA 13 for seismic-restraint device materials and installation.
4. Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
5. Install drain valves on standpipes. Extend drain piping to outside of building.
6. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or outside building.
7. Install alarm devices in piping systems.
8. Install hangers and supports for standpipe system piping according to NFPA 14. Comply with requirements in NFPA 13 for hanger materials.
9. Install pressure gages on riser or feed main and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
10. Drain dry-type standpipe system piping.
11. Pressurize and check dry-type standpipe system piping and air-pressure maintenance devices **OR** air compressors, **as directed**.
12. Fill wet-type standpipe system piping with water.
13. Install electric heating cables and pipe insulation on wet-type, fire-suppression standpipe piping in areas subject to freezing. Comply with requirements for heating cables in Division 15 Section "Heat Tracing For Fire-suppression Piping" and for piping insulation in Division 15 Section "Fire-suppression Systems Insulation".
14. Connect compressed-air supply to dry-pipe sprinkler piping.
    OR
    Connect air compressor to the following piping and wiring:
    a. Pressure gages and controls.
    b. Electrical power system.
    c. Fire-alarm devices, including low-pressure alarm.

E. Joint Construction
1. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
2. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.
3. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
4. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

5. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
6. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
7. 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:
   a. Apply appropriate tape or thread compound to external pipe threads.
   b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
8. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
9. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
10. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
    a. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
11. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
12. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
13. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

F. Valve And Specialties Installation
1. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 14 and authorities having jurisdiction.
2. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
3. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
4. Specialty Valves:
   a. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
   b. Alarm Valves: Install bypass check valve and retarding chamber drain-line connection.
   c. Dry-Pipe and Deluge Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
      1) Install air compressor and compressed-air supply piping.
         OR
         Air-Pressure Maintenance Device: Install shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with 14- to 60-psig (95- to 410-kPa) adjustable range; and 175-psig (1200-kPa) maximum inlet pressure.
      2) Install compressed-air supply piping from building's compressed-air piping system.

G. Hose-Connection Installation
1. Install hose connections adjacent to standpipes.
2. Install freestanding hose connections for access and minimum passage restriction.
3. Install NPS 1-1/2 (DN 40) hose-connection valves with flow-restricting device.

4. Install NPS 2-1/2 (DN 65) hose connections with quick-disconnect NPS 2-1/2 by NPS 1-1/2 (DN 65 by DN 40) reducer adapter and flow-restricting device.
5. Install wall-mounted-type hose connections in cabinets. Include pipe escutcheons, with finish matching valves, inside cabinet where water-supply piping penetrates cabinet. Install valves at angle required for connection of fire hose. Comply with requirements for cabinets in Division 10 Section "Fire Extinguisher Cabinets".

H. Hose-Station Installation
1. Install freestanding hose stations for access and minimum passage restriction.
2. Install NPS 1-1/2 (DN 40) hose-station valves with flow-restricting device unless otherwise indicated.
3. Install NPS 2-1/2 (DN 65) hose connections with quick-disconnect NPS 2-1/2 by NPS 1-1/2 (DN 65 by DN 40) reducer adapter and flow-restricting device unless otherwise indicated.
4. Install freestanding hose stations with support or bracket attached to standpipe.
5. Install wall-mounted, rack hose stations in cabinets. Include pipe escutcheons, with finish matching valves, inside cabinet where water-supply piping penetrates cabinet. Install valves at angle required for connection of fire hose. Comply with requirements for cabinets in Division 10 Section "Fire Extinguisher Cabinets".
6. Install hose-reel hose stations on wall with bracket.

I. Monitor Installation
1. Install monitors on standpipe piping.

J. Fire-Department Connection Installation
1. Install wall-type, fire-department connections.
2. Install yard-type, fire-department connections in concrete slab support. Comply with requirements for concrete in Division 03 Section "Cast-in-place Concrete".
   a. Install two **OR** three, **as directed**, protective pipe bollards around **OR** on sides of, **as directed**, each fire-department connection. Comply with requirements for bollards in Division 05 Section "Metal Fabrications".
3. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

K. Escutcheon Installation
1. Install escutcheons for penetrations of walls, ceilings, and floors.
2. Escutcheons for New Piping:
   a. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
   b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish **OR** stamped steel with set-screw **OR** stamped steel with set-screw or spring clips **OR** stamped steel with spring clips, **as directed**.
   c. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish **OR** One piece or split casting, cast brass with polished chrome-plated finish **OR** Split casting, cast brass with polished chrome-plated finish **OR** One piece, stamped steel with set-screw **OR** One piece or split plate, stamped steel with set-screw **OR** Split plate, stamped steel with set-screw, **as directed**.
   d. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish **OR** cast brass with rough-brass finish **OR** stamped steel with set-screw **OR** stamped steel with spring clips **OR** stamped steel with set-screw or spring clips, **as directed**.
   e. Bare Piping in Equipment Rooms: One piece, cast brass **OR** stamped steel with set-screw **OR** stamped steel with spring clips **OR** stamped steel with set-screw or spring clips, **as directe**.
   f. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.
3. Escutcheons for Existing Piping:
   a. Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.

b. Insulated Piping: Split plate, stamped steel with concealed or exposed-rivet hinge and spring clips.
c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish **OR** plate, stamped steel with concealed hinge and spring clips, **as directed**.
d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish **OR** plate, stamped steel with concealed hinge and set-screw, **as directed**.
e. Bare Piping in Unfinished Service Spaces: Split casting, cast brass with polished chrome-plated finish **OR** casting, cast brass with rough-brass finish **OR** plate, stamped steel with concealed hinge and set-screw or spring clips **OR** plate, stamped steel with concealed or exposed-rivet hinge and set-screw or spring clips **OR** plate, stamped steel with exposed-rivet hinge and set-screw or spring clips, **as directed**.
f. Bare Piping in Equipment Rooms: Split casting, cast brass **OR** plate, stamped steel with set-screw or spring clips, **as directed**.
g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.

L. Sleeve Installation
1. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
2. Sleeves are not required for core-drilled holes.
3. Permanent sleeves are not required for holes formed by removable PE sleeves.
4. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
5. Install sleeves in new partitions, slabs, and walls as they are built.
6. 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 for joint sealants in Division 07 Section "Joint Sealants".
7. 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 for joint sealants in Division 07 Section "Joint Sealants".
8. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals.
9. Seal space outside of sleeves in concrete slabs and walls with grout.
10. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
11. Install sleeve materials according to the following applications:
    a. Sleeves for Piping Passing through Concrete Floor Slabs: Molded PE **OR** Molded PVC **OR** Galvanized-steel pipe, **as directed**.
    b. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Galvanized-steel pipe **OR** Stack sleeve fittings, **as directed**.
        1) Extend sleeves 2 inches (50 mm) above finished floor level.
        2) For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Comply with requirements for flashing in Division 07 Section "Sheet Metal Flashing And Trim".
    c. Sleeves for Piping Passing through Gypsum-Board Partitions:
        1) PVC-pipe **OR** Galvanized-steel-pipe, **as directed**, sleeves for pipes smaller than NPS 6 (DN 150).
        2) Galvanized-steel-sheet sleeves for pipes NPS 6 (DN 150) and larger.
        3) Exception: Sleeves are not required for water-supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
    d. Sleeves for Piping Passing through Concrete Roof Slabs: Molded PE **OR** Molded PVC **OR** Galvanized-steel pipe, **as directed**.
    e. Sleeves for Piping Passing through Exterior Concrete Walls:
        1) Galvanized-steel-pipe sleeves for pipes smaller than NPS 6 (DN 150).

2) Cast-iron wall pipe sleeves for pipes NPS 6 (DN 150) and larger.
3) Install sleeves that are large enough to provide 1-inch (25-mm) annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.

f. Sleeves for Piping Passing through Interior Concrete Walls:
1) PVC-pipe **OR** Galvanized-steel-pipe, **as directed**, sleeves for pipes smaller than NPS 6 (DN 150).
2) Galvanized-steel-sheet sleeves for pipes NPS 6 (DN 150) and larger.

12. 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 for firestop materials and installations in Division 07 Section "Through-penetration Firestop Systems".

M. Sleeve Seal Installation
1. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
2. 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.

N. Identification
1. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 14.
2. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 16 Section "Electrical Identification".

O. Field Quality Control
1. Perform tests and inspections.
2. Tests and Inspections:
a. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
b. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
c. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
d. Energize circuits to electrical equipment and devices.
e. Start and run air compressors.
f. Coordinate with fire-alarm tests. Operate as required.
g. Coordinate with fire-pump tests. Operate as required.
h. Verify that equipment hose threads are same as local fire-department equipment.
3. Fire-suppression standpipe system will be considered defective if it does not pass tests and inspections.
4. Prepare test and inspection reports.

P. Demonstration
1. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

Q. Piping Schedule
1. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded **OR** grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved, **as directed**, joints.
2. Standard-pressure, wet-type, fire-suppression standpipe piping, NPS 4 (DN 100) and smaller, shall be one of the following:
a. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.

b. Standard-weight **OR** Schedule 30 or thinwall, **as directed**, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
c. Standard-weight or Schedule 30, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
d. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
e. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
f. Thinwall **OR** Schedule 10, **as directed**, **OR** nonstandard OD, thinwall or hybrid, **as directed**, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
g. Thinwall **OR** Schedule 10, **as directed**, **OR** nonstandard OD, thinwall or hybrid, **as directed**, black-steel pipe with plain ends; welding fittings; and welded joints.
h. Type L (Type B) **OR** Type M (Type C), **as directed**, hard copper tube with plain ends; cast- or wrought-copper solder-joint fittings; and brazed joints.
i. Type L (Type B) **OR** Type M (Type B), **as directed**, hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.

3. Standard-pressure, wet-type, fire-suppression standpipe piping, NPS 5 to NPS 8 (DN 125 to DN 200), shall be one of the following:
   a. Standard-weight **OR** Schedule 30, **as directed**, or thinwall, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
   b. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
   c. Standard-weight or Schedule 30, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
   d. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
   e. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
   f. Thinwall **OR** Schedule 10, **as directed**, or hybrid black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
   g. Thinwall **OR** Schedule 10, **as directed**, or hybrid black-steel pipe with plain ends; welding fittings; and welded joints.
   h. Type L (Type B) **OR** Type M (Type C), **as directed**, hard copper tube with plain ends; cast- or wrought-copper solder-joint fittings; and brazed joints.
   i. Type L (Type B) **OR** Type M (Type C), **as directed**, hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.
4. Standard-pressure, wet-type, fire-suppression standpipe piping, NPS 10 and NPS 12 (DN 250 and DN 300), shall be one of the following:
   a. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
   b. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
   c. Standard-weight or Schedule 30, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
   d. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
   e. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.

f. Thinwall **OR** Schedule 10, **as directed**, **OR** nonstandard OD, thinwall or hybrid, **as directed**, black-steel pipe with plain ends; welding fittings; and welded joints.

5. High-pressure, wet-type, fire-suppression standpipe piping, NPS 4 (DN 100) and smaller, shall be one of the following:
   a. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
   b. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
   c. Standard-weight or Schedule 30, black-steel pipe with cut-grooved **OR** roll-grooved, **as directed**, ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
   d. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
   e. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
   f. Thinwall **OR** Schedule 10, **as directed**, **OR** nonstandard OD, thinwall or hybrid, **as directed**, black-steel pipe with plain ends; welding fittings; and welded joints.
6. High-pressure, wet-type, fire-suppression standpipe piping, NPS 5 (DN 125) and larger, shall be one of the following:
   a. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
   b. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
   c. Standard-weight or Schedule 30, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
   d. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
   e. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
   f. Thinwall **OR** Schedule 10, **as directed**, **OR** nonstandard OD, thinwall or hybrid, **as directed**, black-steel pipe with plain ends; welding fittings; and welded joints.
7. Standard-pressure, dry-type, fire-suppression standpipe piping, NPS 4 (DN 100) and smaller, shall be one of the following:
   a. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
   b. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
   c. Type L (Type B) **OR** Type M (Type C), **as directed**, hard copper tube with plain ends; cast- or wrought-copper solder-joint fittings; and brazed joints.
   d. Type L (Type B) **OR** Type M (Type C), **as directed**, hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.
8. Standard-pressure, dry-type, fire-suppression standpipe piping, NPS 5 and NPS 6 (DN 125 and DN 150), shall be one of the following:
   a. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
   b. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
   c. Type L (Type B) **OR** Type M (Type C), **as directed**, hard copper tube with plain ends; cast- or wrought-copper solder-joint fittings; and brazed joints.

d. Type L (Type B) **OR** Type M (Type C), **as directed**, hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.

END OF SECTION 13975

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Task	Specification	Specification Description
13975	01352	No Specification Required

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SECTION 14240 - HYDRAULIC ELEVATORS

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for hydraulic elevators. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. This Section includes hydraulic passenger and service elevators.

C. Definitions
1. Definitions in ASME A17.1 apply to work of this Section.
2. Defective Elevator Work: Operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
3. Service Elevator: A passenger elevator that is also used to carry freight.

D. Submittals
1. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for the following:
   a. Car enclosures and hoistway entrances.
   b. Operation, control, and signal systems.
2. Shop Drawings: Show plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment and signals. Include large-scale layout of car control station and standby power operation control panel, **as directed**. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.
3. Samples: For exposed finishes of cars, hoistway doors and frames, and signal equipment; 3-inch- (75-mm-) square Samples of sheet materials; and 4-inch (100-mm) lengths of running trim members.
4. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for elevator system being provided.
5. Qualification Data: For Installer.
6. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.
7. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
8. Warranty: Special warranty specified in this Section.

E. Quality Assurance
1. Installer Qualifications: Elevator manufacturer or manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
2. Source Limitations: Obtain elevators, including electric traction passenger elevators specified in another Division 14 Section, through one source from a single manufacturer.
   a. Provide major elevator components, including pump-and-tank units, plunger-cylinder assemblies, controllers, signal fixtures, door operators, car frames, cabs, and entrances, manufactured by a single manufacturer.

3. Regulatory Requirements: Comply with ASME A17.1 and elevator design requirements for earthquake loads in ASCE 7.
   a. Effective peak velocity acceleration (Av) for Project's location is less than 0.10 (seismic risk zones 0 and 1) **OR** greater than or equal to 0.10, but less than 0.20 (seismic risk zone 2) **OR** greater than or equal to 0.20 (seismic risk zones 3 and 4), **as directed**.
   b. Design earthquake spectral response acceleration, short period (Sds) for Project is determined by Project's location and site classification.
   c. Project's seismic design category is A **OR** B **OR** C **OR** D, **as directed**.
   d. Elevator importance factor is 1.5 **OR** 1.0, **as directed**.
4. Accessibility Requirements: Comply with Section 4.10 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)" **OR** 407 in ICC A117.1, **as directed**.
5. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 **OR** UBC Standard 7-2 **OR** UL 10B, **as directed**.

F. Delivery, Storage, And Handling
1. Deliver, store, and handle materials, components and equipment in manufacturer's protective packaging.
2. Store materials, components, and equipment off of ground, under cover, and in a dry location. Handle according to manufacturer's written recommendations to prevent damage, deterioration, or soiling.

G. Coordination
1. Coordinate installation of sleeves, block outs, and items that are embedded in concrete or masonry for elevator equipment. Furnish templates and installation instructions and deliver to Project site in time for installation.
2. Furnish well casing and coordinate delivery with related excavation work.
3. Coordinate sequence of elevator installation with other work to avoid delaying the Work.
4. Coordinate locations and dimensions of other work relating to hydraulic elevators including pit ladders, sumps, and floor drains in pits; entrance subsills; and electrical service, electrical outlets, lights, and switches in pits and machine rooms.

H. Warranty
1. Special Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to repair, restore, or replace defective elevator work within specified warranty period.
   a. Warranty Period: One year from date of Substantial Completion.

1.2 PRODUCTS

A. Systems And Components
1. General: Provide manufacturer's standard elevator systems. Where components are not otherwise indicated, provide standard components published by manufacturer as included in standard preengineered elevator systems and as required for complete system.
2. Pump Units: Positive-displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations. Provide the following, **as directed**:
   a. Pump, with fan-cooled squirrel-cage induction motor, mounted on oil tank with vibration isolation mounts. Enclose pump in prime-painted steel enclosure lined with 1-inch- (25-mm-) thick, glass-fiber insulation board.
   b. Submersible pump, with submersible squirrel-cage induction motor, suspended inside oil tank from vibration isolation mounts.
   c. Provide motor with wye-delta **OR** solid-state, **as directed**, starting.
   d. Provide variable-voltage variable-frequency motor control.

3. Hydraulic Silencers: Provide hydraulic silencer containing pulsation-absorbing material in a blowout-proof housing at pump unit.
4. Piping: Provide size, type, and weight piping recommended by manufacturer, and provide flexible connectors to minimize sound and vibration transmissions from power unit.
   a. Provide dielectric couplings at cylinder units.
   b. Casing for Underground Piping: PVC pipe complying with ASTM D 1785, joined with PVC fittings complying with ASTM D 2466 and solvent cement complying with ASTM D 2564.
5. Hydraulic Fluid: Elevator manufacturer's standard fire-resistant, **as directed**, fluid with additives as needed to prevent oxidation of fluid, corrosion of cylinder and other components, and other adverse effects.
   OR
   Hydraulic Fluid: Nontoxic, readily biodegradable, fire-resistant, **as directed**, fluid made from vegetable oil with antioxidant, anticorrosive, antifoaming, and metal-passivating additives. Hydraulic fluid is approved by elevator manufacturer for use with elevator equipment.
6. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work where installation of devices is specified in another Section.
7. Protective Cylinder Casing: PVC or HDPE pipe casing complying with ASME A17.1, of sufficient size to provide not less than 1-inch (25-mm) clearance from cylinder and extending above pit floor. Provide means to monitor casing effectiveness to comply with ASME A17.1.
8. Corrosion Protective Filler: A nontoxic, petroleum-based gel formulated for filling the space between hydraulic cylinder and protective casing. Filler is electrically nonconductive, displaces or absorbs water, and gels or solidifies at temperatures below 60 deg F (16 deg C).
9. Car Frame and Platform: Welded steel units.
10. Guides: Provide either roller guides or sliding guides at top and bottom of car and counterweight frames. If sliding guides are used, provide guide-rail lubricators or polymer-coated, nonlubricated guides.

B. Operation Systems
1. General: Provide manufacturer's standard microprocessor operation system for each elevator **OR** for each group of elevators, **as directed**, as required to provide type of operation system indicated.
2. Auxiliary **OR** Single-Car Auxiliary, **as directed**, Operations: In addition to primary operation system features, provide the following operational features for elevators where indicated:
   a. Standby Power Operation: On activation of standby power, car is returned to a designated floor and parked with doors open. Car can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at main lobby **OR** fire command station, **as directed**. Manual operation causes automatic operation to cease.
      OR
      Standby-Powered Lowering: On activation of standby power, if car is at a floor it remains at that floor, opens its doors, and shuts down. If car is between floors, it is lowered to a preselected floor, opens its doors, and shuts down. If car is below the preselected floor, it is lowered to the next lower floor, opens its doors, and shuts down.
      OR
      Standby-Powered Lowering: On activation of standby power, car is lowered to the lowest floor, opens its doors, and shuts down.
      OR
      Battery-Powered Lowering: If power fails and car is at a floor, it remains at that floor, opens its doors, and shuts down. If car is between floors, it is lowered to a preselected floor, opens its doors, and shuts down. If car is below the preselected floor, it is lowered to the next lower floor, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.
      OR

Battery-Powered Lowering: When power fails, car is lowered to the lowest floor, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.

b. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors will begin closing.

c. Nuisance Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls and predetermined weight, **as directed**, can be adjusted.

3. Group Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators and elevator groups where indicated:

a. Standby Power Operation: On activation of standby power, cars are returned to a designated floor and parked with doors open. Only one car is moved upward at a time, with priority given to loaded cars. If a car cannot be returned after two attempts, it is removed from the system. When all cars have been returned or removed from the system, one car is automatically placed in service. If car selected for service cannot operate within 60 seconds, the system removes car from service and places another car in service. Cars can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at main lobby **OR** fire command station, **as directed**. Manual operation causes automatic operation to cease.

OR

Standby Power Operation: On activation of standby power, cars are returned to lowest floor and parked with doors open. If a car cannot be returned, it is removed from the system. One car is selected for service on standby power by a switch located at main lobby **OR** fire command station, **as directed**.

OR

Standby-Powered Lowering: On activation of standby power, cars that are at a floor remain at that floor, open their doors, and shut down. Cars that are between floors are lowered to a preselected floor, open their doors, and shut down. Cars that are below the preselected floor are lowered to the next lower floor, open their doors, and shut down.

OR

Standby-Powered Lowering: On activation of standby power, cars are lowered to the lowest floor, open their doors, and shut down.

OR

Battery-Powered Lowering: If power fails, cars that are at a floor remain at that floor, open their doors, and shut down. Cars that are between floors are lowered to a preselected floor, open their doors, and shut down. Cars that are below the preselected floor are lowered to the next lower floor, open their doors, and shut down. System includes rechargeable battery and automatic recharging system.

OR

Battery-Powered Lowering: When power fails, cars are lowered to the lowest floor, open their doors, and shut down. System includes rechargeable battery and automatic recharging system.

b. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors will begin closing.

c. Nuisance Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls and predetermined weight, **as directed**, can be adjusted.

d. Emergency Hospital **OR** Priority, **as directed**, Service: Service is initiated by a keyswitch **OR** card reader **OR** remote switch, **as directed**, at designated floors. One elevator is removed from group operation and directed to the floor where service was initiated. On arriving at the floor, elevator opens its doors and parks and a lighted sign directs passengers to exit elevator, **as directed**. Car is placed in operation by selecting a floor and pressing door close button or by operating keyswitch to put car in independent service. After responding to floor selected or being removed from independent service, car is

returned to group operation. If car is not placed in operation within a preset time after being called, it is returned to group operation.

e. Independent Service: Keyswitch in car control station removes car from group operation and allows it to respond only to car calls. Key cannot be removed from keyswitch when car is in independent service. When in independent service, doors close only in response to door close button.

f. Loaded-Car Bypass: When car load exceeds 80 percent of rated capacity, car will respond only to car calls, not to hall calls.

4. Security Features: Provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.

a. Card-Reader Operation: System uses card readers at car control stations **OR** hall push-button stations, **as directed**, to authorize calls. Security system determines which landings and at what times calls require authorization by card reader. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. Allow space as indicated for card reader in car **OR** Provide stripe-swipe card reader integral with each car control station, **as directed**.

1) Security access system equipment is specified in Division 13 Section "Security Access".

OR

Security access system equipment is not in the Contract.

b. Keyswitch Operation: Push buttons are activated and deactivated by security keyswitches at car control stations **OR** hall push-button stations, **as directed**. Key is removable only in deactivated position **OR** in either position, **as directed**.

c. Keypad Operation: Allows each landing to be restricted or unrestricted. When a restricted landing button is pressed, a "Restricted Floor" lamp lights and remains lit until landing access code has been entered into a keypad or predetermined time period has elapsed. Car calls for restricted landings do not register until landing access code is entered into keypad within predetermined time period after landing button is pressed.

1) Access codes are programmed at each car operating panel using a security keyswitch. Keypad operation can be activated and deactivated by security keyswitch at main landing.

d. Car-to-Lobby Feature: Feature, activated by keyswitch at main lobby, that causes car **OR** all cars in a group, **as directed**, to return immediately to lobby and open doors for inspection. On deactivation by keyswitch, calls registered before keyswitch activation are completed and normal operation is resumed.

C. Door Reopening Devices

1. Infrared Array: Provide door reopening devices with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more of the light beams shall cause doors to stop and reopen.

2. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.

D. Finish Materials

1. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.

2. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.

3. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.

4. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.

a. Textured Stainless-Steel Sheet: Product with coined **OR** embossed, **as directed**, texture rolled into exposed surface.

1) Metal surface is satin polished **OR** satin relieved **OR** titanium nitride colored **OR** oxide colored **OR** satin polished and titanium nitride colored **OR** satin relieved and

titanium nitride colored **OR** satin polished and oxide colored **OR** satin relieved and oxide colored **OR** color coated and satin relieved **OR** color coated and bright relieved, **as directed**, after rolling.

5. Stainless-Steel Bars: ASTM A 276, Type 304.
6. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.
7. Bronze Plate and Sheet: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal).
8. Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (architectural bronze).
9. Bronze Tubing: ASTM B 135 (ASTM B 135M), Alloy UNS No. C23000 (red brass, 85 percent copper).
10. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063.
11. Nickel Silver Extrusions: ASTM B 151/B 151M, Alloy UNS No. C74500 or No. C77600.
12. Plastic Laminate: High-pressure type complying with NEMA LD 3, Type HGS for flat applications **OR** Type HGL for flat applications, **as directed**, Type HGP for postformed applications and Type BKV for panel backing.

E. Car Enclosures

1. General: Provide enameled-steel car enclosures to receive removable **OR** steel-framed car enclosures with nonremovable, **as directed**, wall panels, with car **OR** removable car, **as directed**, roof, access doors, power door operators, and ventilation.
   a. Provide standard railings complying with ASME A17.1 on car tops where required by ASME A17.1.
   b. Provide finished car including materials and finishes specified below.
2. Materials and Finishes: Provide manufacturer's standards, but not less than the following:
   a. Subfloor: Underlayment grade, exterior plywood, 5/8-inch (16-mm) nominal thickness.
   b. Floor Finish: Specified in a Division 07 **OR** Elevator manufacturer's standard level-loop nylon carpet; color as selected from manufacturer's full range, **as directed**.
   c. Enameled-Steel Wall Panels: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected from manufacturer's full range.
   d. Stainless-Steel Wall Panels: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
   e. Bronze Wall Panels: Flush, hollow-metal construction; fabricated from bronze sheet.
   f. Plastic-Laminate Wall Panels: Plastic laminate adhesively applied to 1/2-inch (13-mm) fire-retardant-treated particleboard **OR** manufacturer's standard honeycomb core, **as directed**, with plastic-laminate panel backing and, **as directed**, manufacturer's standard protective edge trim. Panels have a flame-spread index of 25 **OR** 75, **as directed**, or less, when tested according to ASTM E 84. Plastic-laminate color, texture, and pattern as selected from plastic-laminate **OR** elevator, **as directed**, manufacturer's full range.
   g. Fabricate car with recesses and cutouts for signal equipment.
   h. Fabricate car door frame integrally with front wall of car.
   i. Enameled-Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected from manufacturer's full range.
   j. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet **OR** by laminating stainless-steel sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning, **as directed**.
   k. Bronze Doors: Flush, hollow-metal construction; fabricated by laminating bronze sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
   l. Plastic-Laminate Doors: Flush, hollow-metal construction; fabricated by laminating plastic laminate to exposed faces of enameled cold-rolled steel doors and covering edges with protective edge trim matching return panels, **as directed**. Plastic-laminate color, texture, and pattern as selected from plastic-laminate **OR** elevator, **as directed**, manufacturer's full range.

m. Sight Guards: Provide sight guards on car doors.
n. Sills: Extruded metal, with grooved surface, 1/4 inch (6.4 mm) thick.
o. Luminous Ceiling: Fluorescent light fixtures and ceiling panels of translucent acrylic or other permanent rigid plastic.
p. Metal **OR** Metallic-Finish, Plastic-Laminate, **as directed**, Ceiling: Flush panels, with incandescent downlights in the center of **OR** four low-voltage downlights in, **as directed**, each panel. Align ceiling panel joints with joints between wall panels, **as directed**.
q. Handrails: Manufacturer's standard handrails, of shape, metal, and finish indicated.

F. Hoistway Entrances
1. General: Provide manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Provide frame size and profile to coordinate with hoistway wall construction.
a. Where gypsum board wall construction is indicated, provide self-supporting frames with reinforced head sections.
2. Materials and Fabrication: Provide manufacturer's standards, but not less than the following:
a. Enameled-Steel Frames: Formed from cold-rolled or hot-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected from manufacturer's full range.
b. Steel Subframes: Formed from cold-rolled or hot-rolled steel sheet with factory-applied enamel finish or corrosion-inhibiting primer. Fabricate to receive applied finish as indicated.
c. Stainless-Steel Frames: Formed from stainless-steel sheet.
d. Bronze Frames: Formed from cold-rolled or hot-rolled steel sheet, with enamel finish, and with formed-bronze sheet laminated to steel frames using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
e. Enameled-Steel Doors and Transoms: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected from manufacturer's full range.
f. Stainless-Steel Doors and Transoms: Flush, hollow-metal construction; fabricated from stainless-steel sheet **OR** by laminating stainless-steel sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning, **as directed**.
g. Bronze Doors and Transoms: Flush, hollow-metal construction; fabricated by laminating bronze sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
h. Plastic-Laminate Doors and Transoms: Flush, hollow-metal construction; fabricated by laminating plastic laminate to exposed faces of enameled cold-rolled steel doors and covering edges with protective edge trim matching door frames, **as directed**. Plastic-laminate color, texture, and pattern as selected from plastic-laminate **OR** elevator, **as directed**, manufacturer's full range.
i. Sight Guards: Provide sight guards on doors matching door edges.
j. Sills: Extruded metal, with grooved surface, 1/4 inch (6.4 mm) thick.
k. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107.

G. Signal Equipment
1. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements with long-life incandescent lamps and acrylic or other permanent, nonyellowing translucent plastic diffusers **OR** LEDs, **as directed**.
2. Car Control Stations: Provide manufacturer's standard recessed **OR** semirecessed, **as directed**, car control stations. Mount in return panel adjacent to car door, unless otherwise indicated.
OR
Swing-Return Car Control Stations: Provide car control stations mounted on rear of hinged return panel adjacent to car door and with buttons, switches, controls, and indicator lights projecting through return panel but substantially flush with face of return panel.

a. Mark buttons and switches with standard identification for required use or function that complies with ASME A17.1. Use both tactile symbols and Braille.
b. Provide "No Smoking" sign matching car control station, either integral with car control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.

3. Emergency Communication System: Provide system that complies with ASME A17.1 and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." On activation, system dials preprogrammed number of monitoring station and identifies elevator location to monitoring station. System provides two-way voice communication without using a handset and provides visible signals that indicate when system has been activated and when monitoring station has responded. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.
4. Firefighters' Two-Way Telephone Communication Service: Provide flush-mounted cabinet **OR** telephone jack, **as directed**, in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Division 13 Section(s) "Digital, Addressable Fire-alarm System" OR "Zoned (dc Loop) Fire-alarm System"
5. Car Position Indicator: Provide illuminated, **as directed**, digital-type car position indicator, located above car door or above car control station. Also provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served.
   a. Include travel direction arrows if not provided in car control station.
6. Hall Push-Button Stations: Provide one hall push-button station at each landing for each single elevator or group of elevators, but not less than one station for each four elevators in a group, **as directed**.
   OR
   Hall Push-Button Stations: Provide hall push-button stations at each landing as indicated.
   a. Provide manufacturer's standard wall-mounted units.
   b. Provide units with flat faceplate for mounting with body of unit recessed in wall.
   c. Equip units with buttons for calling elevator and for indicating desired direction of travel.
   d. Provide telephone jack in each unit for firefighters' two-way telephone communication service specified in Division 13 Section(s) "Digital, Addressable Fire-alarm System" OR "Zoned (dc Loop) Fire-alarm System".
7. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide one of the following, **as directed**:
   a. Manufacturer's standard wall-mounted units, for mounting above entrance frames.
   b. Units with flat faceplate for mounting with body of unit recessed in wall and with illuminated elements projecting from faceplate for ease of angular viewing.
   c. Units mounted in both jambs of entrance frame for each elevator, **as directed**.
   d. Units mounted in both car door jambs; may be used only for single elevators or for two-car groups, **as directed**.
8. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
   a. At manufacturer's option, audible signals may be placed on car **OR** each car, **as directed**.
9. Hall Position Indicators: Provide illuminated, **as directed**, digital-display-type position indicators, located above each, **as directed**, hoistway entrance at ground floor. Provide units with flat faceplate for mounting and with body of unit recessed in wall.
   a. Integrate ground-floor hall lanterns with hall position indicators.
10. Standby Power Elevator Selector Switches: Provide switches, as required by ASME A17.1, where indicated. Adjacent to switches, provide illuminated signal that indicates when normal power supply has failed. For each elevator, provide illuminated signals that indicate when they are operational and when they are at the designated emergency return level with doors open, **as directed**.
    OR
    Fire Command Center Annunciator Panel: Provide panel containing illuminated position indicators for each elevator, clearly labeled with elevator designation; include illuminated signal

that indicates when elevator is operational and when it is at the designated emergency return level with doors open. Provide standby power elevator selector switch(es), as required by ASME A17.1, adjacent to position indicators. Provide illuminated signal that indicates when normal power supply has failed.

11. Corridor Call Station Pictograph Signs: Provide signs matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station, unless otherwise indicated.

H. Elevators

1. Elevator Description:
   a. Group Number: Insert a different number for each group of elevators that share a group operation system, as directed by the Owner.
   b. Elevator Number(s): Insert elevator number(s) as shown on Drawings, as directed by the Owner.
   c. Service Elevator Number(s): Insert elevator number(s) as shown on Drawings, as directed by the Owner.
   d. Type: Under-the-car single cylinder.
      OR
      Type: Holeless, beside-the-car, single-acting, single **OR** dual, **as directed**, cylinder.
      OR
      Type: Holeless, beside-the-car, telescoping, single **OR** dual, **as directed**, cylinder.
      OR
      Type: Holeless, beside-the-car, roped hydraulic, single **OR** dual, **as directed**, cylinder.
   e. Rated Load: 2000 lb (908 kg) **OR** 2100 lb (953 kg) **OR** 2500 lb (1135 kg) **OR** 3000 lb (1362 kg) **OR** 3500 lb (1589 kg) **OR** 4000 lb (1816 kg) **OR** 4500 lb (2043 kg) **OR** 5000 lb (2270 kg), **as directed**.
   f. Freight Loading Class for Service Elevators: Class A.
   g. Rated Speed: 75 or 80 fpm (0.38 or 0.41 m/s) **OR** 100 fpm (0.51 m/s) **OR** 125 fpm (0.64 m/s) **OR** 150 fpm (0.76 m/s) **OR** 175 fpm (0.89 m/s) **OR** 200 fpm (1.0 m/s), **as directed**.
   h. Operation System: Single automatic **OR** Selective collective automatic **OR** Group automatic, **as directed**, operation.
   i. Auxiliary Operations:
      1) Standby power operation.
      2) Standby-powered lowering.
      3) Battery-powered lowering.
      4) Automatic dispatching of loaded car.
      5) Nuisance call cancel.
      6) Emergency hospital **OR** Priority, **as directed**, service at designated floors **OR** all floors, **as directed**.
      7) Independent service for service elevator **OR** all cars in group, **as directed**.
      8) Loaded-car bypass.
   j. Security Features: Card-reader operation **OR** Keyswitch operation **OR** Keypad operation **OR** Car-to-lobby feature, **as directed**.
   k. Dual Car Control Stations: Provide two car control stations in each elevator, **as directed**; equip only one with required keyswitches, if any.
   l. Car Enclosures:
      1) Inside Width: 64 inches (1626 mm) **OR** 68 inches (1727 mm) **OR** 80 inches (2032 mm) **OR** 92 inches (2337 mm), **as directed**, from side wall to side wall.
      2) Inside Depth: 51 inches (1295 mm) **OR** 53 inches (1346 mm) **OR** 57 inches (1448 mm) **OR** 65 inches (1651 mm) **OR** 87-1/2 inches (2222 mm) **OR** 90 inches (2286 mm) **OR** 93 inches (2362 mm) **OR** 93-1/2 inches (2375 mm) **OR** 96 inches (2438 mm) **OR** 101 inches (2565 mm) **OR** 102 inches (2591 mm), **as directed**, from back wall to front wall (return panels).

3) Inside Height: 88 inches (2235 mm) **OR** 92 inches (2337 mm) **OR** 94 inches (2388 mm) **OR** 100 inches (2540 mm) **OR** 104 inches (2642 mm) **OR** 108 inches (2743 mm) **OR** 112 inches (2845 mm), **as directed**, to underside of ceiling.
4) Front Walls (Return Panels): Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered, **as directed**, with integral car door frames.
5) Car Fixtures: Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered, **as directed**.
6) Side and Rear Wall Panels: Enameled steel **OR** Plastic laminate **OR** Satin stainless steel, No. 4 finish **OR** Textured stainless steel, **as directed**.
7) Reveals: Enameled steel **OR** Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered, **as directed**.
8) Door Faces (Interior): Enameled steel **OR** Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Textured stainless steel **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered **OR** Plastic laminate, **as directed**.
9) Door Sills: Aluminum, mill finish **OR** Bronze, polished **OR** Nickel silver, polished, **as directed**.
10) Ceiling: Luminous ceiling **OR** Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Polished bronze, lacquered **OR** Reflective metallic-finish, plastic-laminate, stainless steel **OR** Reflective metallic-finish, plastic-laminate, bronze, **as directed**.
11) Handrails: 1-1/2 inches (38 mm) round **OR** 1/2 by 2 inches (13 by 50 mm) rectangular, **as directed**, mirror-polished stainless steel, No. 8 finish **OR** satin stainless steel, No. 4 finish **OR** mirror-polished bronze, lacquered **OR** satin bronze, lacquered, **as directed**, at sides **OR** sides and rear, **as directed**, of car.
12) Floor: Manufacturer's standard carpet.
OR
Floor prepared to receive carpet (specified in Division 09 Section "Carpet").
OR
Floor prepared to receive resilient tile (specified in Division 09 Section "Resilient Floor Tile").
OR
Floor prepared to receive sheet vinyl (specified in Division 09 Section "Resilient Sheet Flooring").
OR
Floor recessed and prepared to receive dimension stone tile (specified in Division 09 Section "Dimension Stone Tile") **OR** ceramic tile (specified in Division 09 Section "Ceramic Tile"), **as directed**.
OR
Floor Thickness, Including Setting Materials: Thickness above plywood subfloor, shall be as directed by the Owner.

m. Hoistway Entrances:
1) Width: 36 inches (914 mm) **OR** 42 inches (1067 mm) **OR** 48 inches (1219 mm) **OR** 54 inches (1372 mm), **as directed**.
2) Height: 84 inches (2134 mm) **OR** 96 inches (2438 mm), **as directed**.
3) Type: Single-speed side sliding **OR** Two-speed side sliding **OR** Single-speed center opening **OR** Two-speed center opening, **as directed**.
4) Fire-Protection Rating: 1 hour **OR** 1-1/2 hours, **as directed**, with 30-minute temperature rise of 450 deg F (250 deg C), **as directeed**.
5) Frames at First Floor **OR** at Basement Floors, **as directed**: Enameled steel **OR** Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered, **as directed**.

6) Frames at Other Floors: Enameled steel **OR** Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered, **as directed**.
7) Doors and Transoms at First Floor **OR** at Basement Floors, **as directed**: Enameled steel **OR** Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Textured stainless steel **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered **OR** Plastic laminate, **as directed**.
8) Doors and Transoms at Other Floors: Enameled steel **OR** Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Textured stainless steel **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered **OR** Plastic laminate, **as directed**.
9) Sills at First Floor **OR** at Basement Floors, **as directed**: Aluminum, mill finish **OR** Bronze, polished **OR** Nickel silver, polished, **as directed**.
10) Sills at Other Floors: Aluminum, mill finish **OR** Bronze, polished **OR** Nickel silver, polished, **as directed**.

n. Hall Fixtures at First Floor **OR** at Basement Floors, **as directed**: Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered **OR** Recessed type with no exposed-metal surfaces, **as directed**.

o. Hall Fixtures at Other Floors: Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered **OR** Recessed type with no exposed-metal surfaces, **as directed**.

p. Additional Requirements:
1) Provide inspection certificate in each car, mounted under acrylic cover with frame made from polished stainless steel, No. 8 finish **OR** satin stainless steel, No. 4 finish **OR** polished bronze, lacquered **OR** satin bronze, lacquered, **as directed**.
2) Provide blanket hooks in all cars, **as directed**, and one **OR** two, **as directed**, complete set(s) of full-height protective blankets.

1.3 EXECUTION

A. Examination
1. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Verify critical dimensions and examine supporting structure and other conditions under which elevator work is to be installed.
a. For the record, prepare a written report, endorsed by Installer, listing dimensional discrepancies and conditions detrimental to performance or indicating that dimensions and conditions were found to be satisfactory.
b. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Installation
1. Excavation for Cylinder: Drill well hole in each, **as directed**, elevator pit to accommodate installation of cylinder; comply with applicable requirements in Division 02 Section "Earthwork".
2. Provide waterproof well casing as necessary to retain walls of well hole.
3. Install cylinder in protective casing within well hole. Before installing protective casing, remove water and debris from well hole and provide permanent waterproof seal at bottom of well casing, **as directed**.
a. Fill void space between protective casing and cylinder with corrosion protective filler.
b. Align cylinders and fill space around protective casing with fine sand.
4. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor. Seal between well **OR** protective, **as directed**, casing and pit floor with 4 inches (100 mm) of nonshrink, nonmetallic grout.
5. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor and braced at intervals as needed to maintain alignment. Anchor cylinder guides at spacing needed to maintain alignment and avoid overstressing guides.

6. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.
7. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts designed to effectively prevent transmission of vibrations to structure and thereby eliminate sources of structure-borne noise from elevator system.
8. Install piping above the floor, where possible. Where not possible, install underground piping in Schedule 40 PVC pipe casing assembled with solvent-cemented fittings.
   OR
   Install piping above the floor, where possible. Where not possible, cover underground piping with permanent protective wrapping before backfilling.
9. Lubricate operating parts of systems as recommended by manufacturers.
10. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.
11. Leveling Tolerance: 1/4 inch (6 mm), up or down, regardless of load and direction of travel.
12. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.
13. Locate hall signal equipment for elevators as follows, unless otherwise indicated:
    a. For groups of elevators, locate hall push-button stations between two elevators at center of group or at location most convenient for approaching passengers.
    b. Place hall lanterns either above or beside each hoistway entrance.
    c. Mount hall lanterns at a minimum of 72 inches (1829 mm) above finished floor.

C. Field Quality Control
1. Acceptance Testing: On completion of elevator installation and before permitting use (either temporary or permanent) of elevators, perform acceptance tests as required and recommended by ASME A17.1 and by governing regulations and agencies.
2. Advise Owner and authorities having jurisdiction in advance of dates and times tests are to be performed on elevators.

D. Protection
1. Temporary Use: Limit temporary use for construction purposes to one elevator, **as directed**. Comply with the following requirements for each, **as directed**, elevator used for construction purposes:
   a. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
   b. Provide strippable protective film on entrance and car doors and frames.
   c. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
   d. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
   e. Do not load elevators beyond their rated weight capacity.
   f. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
   g. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

E. Demonstration
1. Train Owner's maintenance personnel to operate, adjust, and maintain elevator(s).

2. Check operation of each, **as directed**, elevator with Owner's personnel present and before date of Substantial Completion. Determine that operation systems and devices are functioning properly.
3. Check operation of each, **as directed**, elevator with Owner's personnel present not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

END OF SECTION 14240

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SECTION 14240a - HYDRAULIC FREIGHT ELEVATORS

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for hydraulic freight elevators. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. This Section includes hydraulic freight elevators.

C. Definitions
1. Definitions in ASME A17.1 apply to work of this Section.
2. Defective Elevator Work: Operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

D. Submittals
1. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information.
2. Shop Drawings: Show plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment and signals. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.
3. Samples for Initial Selection: For finishes involving color selection.
4. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for elevator system being provided.
5. Qualification Data: For Installer.
6. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.
7. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
8. Warranty: Special warranty specified in this Section.

E. Quality Assurance
1. Installer Qualifications: Elevator manufacturer or manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
2. Source Limitations: Obtain freight elevators, including electric traction freight elevators specified in another Division 14 Section, through one source from a single manufacturer.
   a. Provide major elevator components, including pump-and-tank units, plunger-cylinder assemblies, controllers, signal fixtures, door operators, car frames, cabs, and entrances, manufactured by a single manufacturer.
3. Regulatory Requirements: Comply with ASME A17.1 and elevator design requirements for earthquake loads in ASCE 7.
   a. Effective peak velocity acceleration (Av) for Project's location is less than 0.10 (seismic risk zones 0 and 1) **OR** greater than or equal to 0.10, but less than 0.20 (seismic risk zone 2) **OR** greater than or equal to 0.20 (seismic risk zones 3 and 4), **as directed**.
   b. Design earthquake spectral response acceleration, short period (Sds) for Project is determined by Project's location and site classification.

c. Project's seismic design category is A **OR** B **OR** C **OR** D, **as directed**.
d. Elevator importance factor is 1.5 **OR** 1.0, **as directed**.

4. Accessibility Requirements: Comply with Section 4.10 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)" **OR** 407 in ICC A117.1, **as directed**.
5. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 **OR** UBC Standard 7-2 **OR** UL 10B, **as directed**.

F. Delivery, Storage, And Handling
1. Deliver, store, and handle materials, components and equipment in manufacturer's protective packaging.
2. Store materials, components, and equipment off of ground, under cover, and in a dry location. Handle according to manufacturer's written recommendations to prevent damage, deterioration, or soiling.

G. Coordination
1. Coordinate installation of sleeves, block outs, and items that are embedded in concrete or masonry for elevator equipment. Furnish templates and installation instructions and deliver to Project site in time for installation.
2. Furnish well casing and coordinate delivery with related excavation work.
3. Coordinate sequence of freight elevator installation with other work to avoid delaying the Work.
4. Coordinate locations and dimensions of other work relating to hydraulic freight elevators including pit ladders, sumps, and floor drains in pits; entrance subsills; and electrical service, electrical outlets, lights, and switches in pits and machine rooms.

H. Warranty
1. Special Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to repair, restore, or replace defective elevator work within specified warranty period.
a. Warranty Period: One year from date of Substantial Completion.

1.2 PRODUCTS

A. Systems And Components
1. General: Provide manufacturer's standard freight elevator systems. Where components are not otherwise indicated, provide standard components published by manufacturer as included in standard preengineered freight elevator systems and as required for complete system.
2. Pump Units: Positive-displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations. Provide either of the following:
a. Pump, with fan-cooled squirrel-cage induction motor, mounted on oil tank with vibration isolation mounts. Enclose pump in prime-painted steel enclosure lined with 1-inch- (25-mm-) thick, glass-fiber insulation board.
b. Submersible pump, with submersible squirrel-cage induction motor, suspended inside oil tank from vibration isolation mounts.
c. Provide motor with wye-delta or solid-state starting.
3. Hydraulic Silencers: Provide hydraulic silencer containing pulsation-absorbing material in a blowout-proof housing at pump unit.
4. Piping: Provide size, type, and weight piping recommended by manufacturer, and provide flexible connectors to minimize sound and vibration transmissions from power unit.
a. Provide dielectric couplings at cylinder units.
b. Casing for Underground Piping: PVC pipe complying with ASTM D 1785, joined with PVC fittings complying with ASTM D 2466 and solvent cement complying with ASTM D 2564.

5. Hydraulic Fluid: Elevator manufacturer's standard fluid **OR** fire-resistant fluid, **as directed**, with additives as needed to prevent oxidation of fluid, corrosion of cylinder and other components, and other adverse effects.
   OR
   Hydraulic Fluid: Nontoxic, readily biodegradable, fluid **OR** fire-resistant fluid, **as directed**, made from vegetable oil with antioxidant, anticorrosive, antifoaming, and metal-passivating additives. Hydraulic fluid is approved by elevator manufacturer for use with elevator equipment.
6. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work where installation of devices is specified in another Section.
7. Protective Cylinder Casing: PVC or HDPE pipe casing complying with ASME A17.1, of sufficient size to provide not less than 1-inch (25-mm) clearance from cylinder and extending above pit floor. Provide means to monitor casing effectiveness to comply with ASME A17.1.
8. Corrosion Protective Filler: A nontoxic, petroleum-based gel formulated for filling the space between hydraulic cylinder and protective casing. Filler is electrically nonconductive, displaces or absorbs water, and gels or solidifies at temperatures below 60 deg F (16 deg C).
9. Car Frame and Platform: Welded steel units.
   a. Provide special heavy-duty units where indicated for power truck loading, designed to withstand impacts and wheel loadings indicated.
10. Guides: Provide either roller guides or sliding guides at top and bottom of car and counterweight frames. If sliding guides are used, provide guide-rail lubricators or polymer-coated, nonlubricated guides.

B. Operation Systems
1. General: Provide manufacturer's standard microprocessor operation system for each elevator **OR** for each group of elevators, **as directed**, as required to provide type of operation system indicated.
2. Battery-Powered Lowering: When power fails, car is lowered to the lowest floor, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.
3. Load-Weighing Device: When car load exceeds 80 percent of rated capacity, a signal light is lit in the car control station; when car load exceeds rated capacity, car will not respond to car or hall calls.
4. Security Features: Provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.
   a. Card-Reader Operation: System uses card readers at car control stations **OR** hall push-button stations, **as directed**, to authorize calls. Security system determines which landings and at what times calls require authorization by card reader. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. Allow space as indicated for card reader in car **OR** Provide stripe-swipe card reader integral with each car control station, **as directed**.
      1) Security access system equipment is specified in Division 13 Section "Security Access".
         OR
         Security access system equipment is not in the Contract.

      OR
      Keyswitch Operation: Push buttons are activated and deactivated by security keyswitches at car control stations **OR** hall push-button stations, **as directed**. Key is removable only in deactivated position **OR** in either position, **as directed**.

C. Door Reopening Devices
1. Infrared Array: Provide door reopening devices with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more of the light beams shall cause doors to stop and reopen.

D. Finish Materials

1. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.
2. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
3. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.
4. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, commercial steel, with G60 (Z180) zinc coating (galvanized) or A60 (ZF180) zinc-iron-alloy coating (galvannealed).
5. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
   a. Textured Stainless-Steel Sheet: Product with coined **OR** embossed, **as directed**, texture rolled into exposed surface.
6. Stainless-Steel Bars: ASTM A 276, Type 304.
7. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.
8. Rolled Steel Floor Plate: ASTM A 786/A 786M.
9. Rolled Stainless-Steel Floor Plate: ASTM A 793.
10. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Pattern 1, Alloy 6061-T6.

E. Car Enclosures
1. General: Provide car enclosures as indicated, including ventilation, lighting, finishes, access doors, thresholds, trim, and accessories. Fabricate with recesses and cutouts for signal equipment.
   a. Provide power door operators with linkages for hoistway door operation.
   b. Provide standard railings complying with ASME A17.1 on car tops where required by ASME A17.1.
2. Materials and Fabrication: Provide manufacturer's standard, flush panel, welded construction made from metal sheet, of metal indicated, not less than 0.067 inch (1.7 mm) and reinforced at 16-inch (406-mm) maximum spacing.
   a. Provide perforated panels for ceiling and for walls above 72 inches (1829 mm) from car floor unless required to be solid by ASME A17.1.

F. Hoistway Entrances
1. General: Structural-steel frames and sills for hoistway entrances are specified in Division 05 Section(s) "Structural Steel" OR "Metal Fabrications", **as directed**. Unless otherwise indicated, provide hoistway entrance doors of type indicated below, with truckable sill bars and resilient safety meeting-rail gaskets.
   a. Equip for power operation by means of coordinated linkage with power-operated car door.
   b. Where gypsum board wall construction is indicated, provide fire-resistance-rated, hollow-metal, door-and-frame hoistway entrances. Provide self-supporting frames with reinforced head sections.
2. Materials and Fabrication: Provide manufacturer's standards, but not less than the following:
   a. Metal Door Panels: Constructed of metal sheets, flush on room side, welded and reinforced in steel framing with vertical reinforcing spaced not more than 24 inches (610 mm) o.c. Fabricate panel faces from metal sheet, of metal indicated, not less than 0.097 inch (2.5 mm) thick.

G. Signal Equipment
1. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements of acrylic or other permanent, nonyellowing translucent plastic.
2. Car Control Stations: Provide manufacturer's standard car control station. Mount adjacent to car door, unless otherwise indicated.
   a. Mark buttons and switches with manufacturer's standard identification for required use or function that complies with ASME A17.1. Use both tactile symbols and Braille.
   b. Mount controls at heights complying with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)" **OR** ICC A117.1, **as directed**.

3. Emergency Communication System: Provide system that complies with ASME A17.1 and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Building and Facilities (ADAAG)." On activation, system dials preprogrammed number of monitoring station and identifies elevator location to monitoring station. System provides two-way voice communication without using a handset and provides visible signals that indicate when system has been activated and when monitoring station has responded. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.
4. Firefighters' Two-Way Telephone Communication Service: Provide flush-mounted cabinet **OR** telephone jack, **as directed**, in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Division 13 Section(s) "Digital, Addressable Fire-alarm System" OR "Zoned (dc Loop) Fire-alarm System".
5. Car Position Indicator: Provide illuminated digital-type car position indicator, located above car door or above car control station.
6. Hall Push-Button Stations: Provide hall push-button stations at each landing as indicated.
   a. Provide single-button stations with position **OR** "In-Use", **as directed**, indicator.

H. Elevators
1. Elevator No(s).: <**Insert elevator number(s) as shown on Drawings.**>
   a. Type: Under-the-car single or dual cylinder.
      OR
      Type: Holeless, beside-the-car, single-acting, single **OR** dual, **as directed**, cylinder.
      OR
      Type: Holeless, beside-the-car, telescoping, single **OR** dual, **as directed**, cylinder.
      OR
      Type: Holeless, beside-the-car, roped hydraulic, single **OR** dual, **as directed**, cylinder.
   b. Rated Load: 2000 lb (908 kg) **OR** 2500 lb (1135 kg) **OR** 3000 lb (1362 kg) **OR** 4000 lb (1816 kg) **OR** 5000 lb (2270 kg) **OR** 6000 lb (2720 kg) **OR** 8000 lb (3632 kg) **OR** 10 000 lb (4540 kg), **as directed**.
   c. Freight Loading Class: Class A **OR** B **OR** C1 **OR** C2 **OR** C3, **as directed**.
   d. Rated Speed (Up): 50 fpm (0.25 m/s) **OR** 75 or 80 fpm (0.38 or 0.41 m/s) **OR** 100 fpm (0.51 m/s), **as directed**.
   e. Operational Speed (Down): Approximately 30 percent more than **OR** Same as, **as drected**, rated speed (up).
   f. Operation System: Single automatic **OR** Car-switch automatic floor-stop **OR** Selective collective automatic, **as directed**, operation.
   g. Auxiliary Operations: Battery-powered lowering **OR** Card-reader operation **OR** Keyswitch operation **OR** Load-weighing device, **as directed**.
   h. Auxiliary Car Control Station: Provide additional car control station mounted on side of car at height to facilitate operation by forklift-truck operator without leaving truck.
   i. Car Enclosures:
      1) Platform Width: 60 inches (1524 mm) **OR** 64 inches (1626 mm) **OR** 66 inches (1676 mm) **OR** 76 inches (1930 mm) **OR** 78 inches (1981 mm) **OR** 88 inches (2235 mm) **OR** 100 inches (2540 mm) **OR** 102 inches (2591 mm) **OR** 124 inches (3150 mm) **OR** 126 inches (3200 mm), **as directed**.
      2) Platform Depth: 72 inches (1829 mm) **OR** 84 inches (2134 mm) **OR** 96 inches (2438 mm) **OR** 120 inches (3048 mm) **OR** 144 inches (3658 mm) **OR** 168 inches (4267 mm), **as directed**.
      3) Ceiling Height: 84 inches (2134 mm) **OR** 96 inches (2438 mm) **OR** 108 inches (2743 mm), **as directed**.
      4) Walls and Ceiling: Prime-painted steel **OR** Prime-painted, metallic-coated steel **OR** Satin stainless steel, No. 4 finish **OR** Textured stainless steel, **as directed**.
      5) Car Fixtures: Satin stainless steel, No. 4 finish.
      6) Floor: Rolled steel floor plate **OR** Aluminum-alloy rolled tread plate **OR** Rolled stainless-steel floor plate, **as directed**.

7) Car Gate Type: Vertical biparting **OR** Single-speed vertical lift **OR** Two-speed vertical lift, **as directed**.
8) Car Gate Operation: Manual **OR** Power operated, **as directed**.
9) Car Gate Material: Prime-painted steel **OR** Satin stainless steel, No. 4 finish, **as directed**.
10) Car Sill: Steel angle.
11) Lighting: One **OR** Two **OR** Three, **as directed**, 48-inch (1219-mm), suspended, **OR** surface-mounted, **as directed**, 2-tube fluorescent light fixture(s) with white reflectors **OR** wire lamp guards, **as directed**.
OR
Lighting: One **OR** Two, **as directed**, 48-inch (1219-mm), recessed, 2 **OR** 3, **as directed**,-tube fluorescent light fixture(s) with UV stabilized acrylic diffusers not less than 0.125 inch (3.2 mm) thick.

j. Hoistway Entrances:
1) Width: 56 inches (1422 mm) **OR** 60 inches (1524 mm) **OR** 62 inches (1575 mm) **OR** 72 inches (1829 mm) **OR** 96 inches (2438 mm) **OR** 98 inches (2489 mm) **OR** 120 inches (3048 mm) **OR** 122 inches (3099 mm), **as directed**.
2) Height: 84 inches (2134 mm) **OR** 96 inches (2438 mm), **as directed**.
3) Door Type: Vertical biparting **OR** Single-speed vertical lift **OR** Two-speed vertical lift, **as directed**.
4) Fire-Protection Rating: 1 hour **OR** 1-1/2 hours, **as directed**, with 30-minute temperature rise of 450 deg F (250 deg C), **as directed**.
5) Door Operation: Manual **OR** Power operated, **as directed**.
6) Door Material: Prime-painted steel **OR** Satin stainless steel, No. 4 finish, **as directed**.
7) Door Frame Material: Prime-painted steel **OR** Satin stainless steel, No. 4 finish, **as directed**.
8) Door frames and sills are specified in Division 05 Section(s) "Structural Steel" OR "Metal Fabrications", **as directed**.

k. Hall Fixtures: Satin stainless steel, No. 4 finish.

l. Auxiliary Hall Stations: Provide additional pendant-mounted, hall push-button stations where indicated mounted at height to facilitate operation by forklift-truck operator without leaving truck.

m. Additional Requirements:
1) Provide door reopening device.

1.3 EXECUTION

A. Examination
1. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Verify critical dimensions and examine supporting structure and other conditions under which elevator work is to be installed.
a. For the record, prepare a written report, endorsed by Installer, listing dimensional discrepancies and conditions detrimental to performance or indicating that dimensions and conditions were found to be satisfactory.
b. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Installation
1. Excavation for Cylinder: Drill well hole in each elevator pit to accommodate installation of cylinder; comply with applicable requirements in Division 02 Section "Earthwork".
2. Provide waterproof well casing as necessary to retain walls of well hole.
3. Install cylinder in protective casing within well hole. Before installing protective casing, remove water and debris from well hole and provide permanent waterproof seal at bottom of well casing.
a. Fill void space between protective casing and cylinder with corrosion-protective filler.

b. Align cylinders and fill space around protective casing with fine sand.

4. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor. Seal between well **OR** protective, **as directed**, casing and pit floor with 4 inches (100 mm) of nonshrink, nonmetallic grout.
5. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor and braced at intervals as needed to maintain alignment. Anchor cylinder guides at spacing needed to maintain alignment and avoid overstressing guides.
6. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.
7. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts designed to effectively prevent transmission of vibrations to structure and thereby eliminate sources of structure-borne noise from elevator system.
8. Install piping above the floor, where possible. Where not possible, install underground piping in Schedule 40 PVC pipe casing assembled with solvent-cemented fittings.
   OR
   Install piping above the floor, where possible. Where not possible, cover underground piping with permanent protective wrapping before backfilling.
9. Lubricate operating parts of systems as recommended by manufacturers.
10. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

C. Field Quality Control

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

D. Protection

1. Temporary Use: Limit temporary use for construction purposes to one elevator, **as directed**. Comply with the following requirements for each, **as directed**, elevator used for construction purposes:
   a. Provide protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
   b. Do not load elevators beyond their rated weight capacity.
   c. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
   d. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

E. Demonstration

1. Train Owner's maintenance personnel to operate, adjust, and maintain elevator(s).
2. Check operation of each elevator with Owner's personnel present and before date of Substantial Completion. Determine that operation systems and devices are functioning properly.
3. Check operation of each elevator with Owner's personnel present not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

END OF SECTION 14240a

SECTION 14290 - ELECTRIC TRACTION ELEVATORS

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for electric traction elevators. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. This Section includes electric traction passenger and service elevators.

C. Definitions
1. Definitions in ASME A17.1 apply to work of this Section.
2. Defective Elevator Work: Operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
3. Service Elevator: A passenger elevator that is also used to carry freight.

D. Submittals
1. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for the following:
   a. Car enclosures and hoistway entrances.
   b. Operation, control, and signal systems.
2. Shop Drawings: Show plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment and signals. Include large-scale layout of car control station and standby power operation control panel, **as directed**. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.
3. Samples: For exposed finishes of cars, hoistway doors and frames, and signal equipment; 3-inch- (75-mm-) square Samples of sheet materials; and 4-inch (100-mm) lengths of running trim members.
4. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for elevator system being provided.
5. Qualification Data: For Installer.
6. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.
7. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
8. Warranty: Special warranty specified in this Section.

E. Quality Assurance
1. Installer Qualifications: Elevator manufacturer or manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
2. Source Limitations: Obtain elevators, including hydraulic passenger elevators specified in another Division 14 Section, through one source from a single manufacturer.
   a. Provide major elevator components, including driving machines, controllers, signal fixtures, door operators, car frames, cabs, and entrances, manufactured by a single manufacturer.
3. Regulatory Requirements: Comply with ASME A17.1 and elevator design requirements for earthquake loads in ASCE 7.

a. Effective peak velocity acceleration (Av) for Project's location is less than 0.10 (seismic risk zones 0 and 1) **OR** greater than or equal to 0.10, but less than 0.20 (seismic risk zone 2) **OR** greater than or equal to 0.20 (seismic risk zones 3 and 4), **as directed**.
b. Provide earthquake equipment required by ASME A17.1.
c. Design earthquake spectral response acceleration, short period (Sds) for Project is determined by Project's location and site classification.
d. Project's seismic design category is A **OR** B **OR** C **OR** D, **as directed**.
e. Elevator importance factor is 1.5 **OR** 1.0, **as directed**.

4. Accessibility Requirements: Comply with Section 4.10 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)" **OR** 407 in ICC A117.1, **as directed**.
5. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 **OR** UBC Standard 7-2 **OR** UL 10B, **as directed**.

F. Delivery, Storage, And Handling
1. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging.
2. Store materials, components, and equipment off of ground, under cover, and in a dry location. Handle according to manufacturer's written recommendations to prevent damage, deterioration, or soiling.

G. Coordination
1. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.
2. Coordinate sequence of elevator installation with other work to avoid delaying the Work.
3. Coordinate locations and dimensions of other work relating to electric traction elevators including pit ladders, sumps, and floor drains in pits; entrance subsills; machine beams, **as directed**; and electrical service, electrical outlets, lights, and switches in pits and machine rooms **OR** hoistways, **as directed**.

H. Warranty
1. Special Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to repair, restore, or replace defective elevator work within specified warranty period.
a. Warranty Period: One year from date of Substantial Completion.

1.2 PRODUCTS

A. Systems And Components
1. General: Provide manufacturer's standard elevator systems. Where components are not otherwise indicated, provide standard components published by manufacturer as included in standard preengineered elevator systems and as required for complete system.
2. Elevator Machines: Provide variable-voltage, variable-frequency, ac-type hoisting machines **OR** At manufacturer's option, provide either variable-voltage, variable-frequency, ac-type or variable-voltage, dc-type hoisting machines, **as directed**. Provide solid-state power converters.
a. Provide regenerative **OR** nonregenerative, **as directed**, system.
b. Limit total harmonic distortion of regenerated power to 5 percent per IEEE 519.
c. Provide means for absorbing regenerated power when elevator system is operating on standby power.
d. Provide line filters or chokes to prevent electrical peaks or spikes from feeding back into building power system.

3. Fluid for Oil Buffers: If oil buffers are used, use only fire-resistant hydraulic fluid containing antioxidant, anticorrosive, antifoaming, and metal-passivating additives.
4. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work where installation of devices is specified in another Section.
5. Machine Beams: Provide framing to support elevator hoisting machine and deflector sheaves from the building structure. Comply with Division 5 Section "Metal Fabrications" for materials and fabrication.
6. Car Frame and Platform: Welded steel units.
7. Guides: Provide roller guides **OR** polymer-coated, nonlubricated sliding guides, **as directed**, at top and bottom of car and counterweight frames.

B. Operation Systems
1. General: Provide manufacturer's standard microprocessor operation system for each elevator **OR** for each group of elevators, **as directed**, as required to provide type of operation system indicated.
2. Group Automatic Operation with Demand-Based Dispatching: Provide reprogrammable, **as directed**, group automatic system that assigns cars to hall calls based on a dispatching program designed to minimize passenger waiting time. System automatically adjusts to changes in demand for different traffic conditions including heavy incoming, heavy two-way, heavy outgoing, and light off-hours as variations of normal two-way traffic.
3. Destination-Based Group Automatic Operation: Provide reprogrammable group automatic system that assigns elevators leaving the main lobby in the up direction to a selected group of floors and directs passengers to an elevator serving their destination floor. System dispatches cars in a regulated sequence for optimum system efficiency; dispatch is based on origin and destination of calls. System automatically adjusts to changes in demand for different traffic conditions including heavy incoming, heavy two-way, heavy outgoing, and light off-hours as variations of normal two-way traffic.
4. Auxiliary **OR** Single-Car Auxiliary, **as directed**, Operations: In addition to primary operation system features, provide the following operational features for elevators where indicated:
   a. Standby Power Operation: On activation of standby power, car is returned to a designated floor and parked with doors open. Car can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at main lobby **OR** fire command station, **as directed**. Manual operation causes automatic operation to cease.
   b. Standby Powered Lowering: On activation of standby power, if car is at a floor, it remains at that floor, opens its doors, and shuts down. If car is between floors, it is lowered to the next floor below, opens its doors, and shuts down.
   c. Battery-Powered Lowering: If power fails and car is at a floor, it remains at that floor, opens its doors, and shuts down. If car is between floors, it is lowered to the next floor below, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.
   d. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors will begin closing.
   e. Nuisance Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls and predetermined weight, **as directed**, can be adjusted.
5. Group Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators and elevator groups where indicated:
   a. Standby Power Operation: On activation of standby power, cars are returned to a designated floor and parked with doors open. One car is returned at a time, with priority given to loaded cars. If a car cannot be returned after two attempts, it is removed from the system. When all cars have been returned or removed from the system, one car is automatically placed in service. If car selected for service cannot operate within 60 seconds, the system removes car from service and places another car in service. Cars can be manually put in service on standby power, either for return operation or for regular

operation, by switches in control panel located at main lobby **OR** fire command station, **as directed**. Manual operation causes automatic operation to cease.

b. Standby Power Operation: On activation of standby power, cars are returned, one at a time, to a designated floor and parked with doors open. If a car cannot be returned, it is removed from the system. When all cars have been returned or removed from the system, one car can be put in service on standby power by a selector switch in control panel located at main lobby **OR** fire command station, **as directed**.

c. Battery-Powered Lowering: If power fails, cars that are at a floor remain at that floor, open their doors, and shut down. Cars that are between floors are lowered one at a time to the next floor below, open their doors, and shut down. System includes rechargeable battery and automatic recharging system.

d. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors will begin closing.

e. Nuisance Call Cancel: When car calls exceed a preset number while the car load is less than a predetermined weight, all car calls are canceled. Preset number of calls and predetermined weight, **as directed**, can be adjusted.

f. Emergency Hospital **OR** Priority, **as directed**, Service: Service is initiated by a keyswitch **OR** card reader **OR** remote switch, **as directed**, at designated floors. One elevator is removed from group operation and directed to the floor where service was initiated. On arriving at the floor, elevator opens its doors and parks and a lighted sign directs passengers to exit elevator, **as directed**. Car is placed in operation by selecting a floor and pressing door close button or by operating keyswitch to put car in independent service. After responding to floor selected or being removed from independent service, car is returned to group operation. If car is not placed in operation within a preset time after being called, it is returned to group operation.

g. Independent Service: Keyswitch in car control station removes car from group operation and allows it to respond only to car calls. Key cannot be removed from keyswitch when car is in independent service. When in independent service, doors close only in response to door close button.

h. Loaded-Car Bypass: When car load exceeds 80 percent of rated capacity, car will respond only to car calls, not to hall calls.

i. Distributed Parking: When cars are not required for response to calls, they are parked with doors closed, distributed in predetermined zones throughout the building. One zone shall include the main floor and adjacent floors; remaining floors shall be divided into approximately equal zones.

6. Security Features: Provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.

a. Card-Reader Operation: System uses card readers at car control stations **OR** hall push-button stations, **as directed**, to authorize calls. Security system determines which landings and at what times calls require authorization by card reader. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. Allow space as indicated for card reader in car **OR** Provide stripe-swipe card reader integral with each car control station, **as directed**.

1) Security access system equipment is specified in Division 13 Section "Security Access".

OR

Security access system equipment is not in the Contract.

b. Keyswitch Operation: Push buttons are activated and deactivated by security keyswitches at car control stations **OR** hall push-button stations, **as directed**. Key is removable only in deactivated position **OR** in either position, **as directed**.

c. Keypad Operation: Allows each landing to be restricted or unrestricted. When a restricted landing button is pressed, a "Restricted Floor" lamp lights and remains lit until landing access code has been entered into a keypad or predetermined time period has elapsed.

Car calls for restricted landings do not register until landing access code is entered into keypad within predetermined time period after landing button is pressed.

1) Access codes are programmed at each car operating panel using a security keyswitch. Keypad operation can be activated and deactivated by security keyswitch at main landing.

d. Car-to-Lobby Feature: Feature, activated by keyswitch at main lobby, that causes car **OR** all cars in a group, **as directed**, to return immediately to lobby and open doors for inspection. On deactivation by keyswitch, calls registered before keyswitch activation are completed and normal operation is resumed.

C. Door Reopening Devices

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

D. Finish Materials

1. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.
2. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
3. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.
4. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
   a. Textured Stainless-Steel Sheet: Product with coined **OR** embossed, **as directed**, texture rolled into exposed surface.
      1) Metal surface is satin polished **OR** satin relieved **OR** titanium nitride colored **OR** oxide colored **OR** satin polished and titanium nitride colored **OR** satin relieved and titanium nitride colored **OR** satin polished and oxide colored **OR** satin relieved and oxide colored **OR** color coated and satin relieved **OR** color coated and bright relieved, **as directed**, after rolling.
5. Stainless-Steel Bars: ASTM A 276, Type 304.
6. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.
7. Bronze Plate and Sheet: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal).
8. Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (architectural bronze).
9. Bronze Tubing: ASTM B 135 (ASTM B 135M), Alloy UNS No. C23000 (red brass, 85 percent copper).
10. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063.
11. Nickel Silver Extrusions: ASTM B 151/B 151M, Alloy UNS No. C74500 or No. C77600.
12. Plastic Laminate: High-pressure type complying with NEMA LD 3, Type HGS for flat applications **OR** Type HGL for flat applications, **as directed**, Type HGP for postformed applications and Type BKV for panel backing.

E. Car Enclosures

1. General: Provide enameled-steel car enclosures to receive removable **OR** steel-framed car enclosures with nonremovable, **as directed**, wall panels, with car **OR** removable car, **as directed**, roof, access doors, power door operators, and ventilation.
   a. Provide standard railings complying with ASME A17.1 on car tops where required by ASME A17.1.
   b. Provide finished car including materials and finishes specified below.
2. Materials and Finishes: Provide manufacturer's standards, but not less than the following:
   a. Subfloor: Underlayment grade, exterior plywood, 5/8-inch (16-mm) nominal thickness.
   b. Floor Finish: Specified in a Division 9 Section **OR** Elevator manufacturer's standard level-loop nylon carpet; color as selected from manufacturer's full range, **as directed**.

c. Enameled-Steel Wall Panels: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected from manufacturer's full range.
d. Stainless-Steel Wall Panels: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
e. Bronze Wall Panels: Flush, hollow-metal construction; fabricated from bronze sheet.
f. Plastic-Laminate Wall Panels: Plastic laminate adhesively applied to 1/2-inch (13-mm) fire-retardant-treated particleboard **OR** manufacturer's standard honeycomb core, **as directed**, with plastic-laminate panel backing and, **as directed**, manufacturer's standard protective edge trim. Panels have a flame-spread index of 25 **OR** 75, **as directed**, or less, when tested according to ASTM E 84. Plastic-laminate color, texture, and pattern as selected from plastic-laminate **OR** elevator, **as directed**, manufacturer's full range.
g. Fabricate car with recesses and cutouts for signal equipment.
h. Fabricate car door frame integrally with front wall of car.
i. Enameled-Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected from manufacturer's full range.
j. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet **OR** by laminating stainless-steel sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning, **as directed**.
k. Bronze Doors: Flush, hollow-metal construction; fabricated by laminating bronze sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
l. Plastic-Laminate Doors: Flush, hollow-metal construction; fabricated by laminating plastic laminate to exposed faces of enameled cold-rolled steel doors and covering edges with protective edge trim matching return panels, **as directed**. Plastic-laminate color, texture, and pattern as selected from plastic-laminate **OR** elevator, **as directed**, manufacturer's full range.
m. Sight Guards: Provide sight guards on car doors.
n. Sills: Extruded metal, with grooved surface, 1/4 inch (6.4 mm) thick.
o. Luminous Ceiling: Fluorescent light fixtures and ceiling panels of translucent acrylic or other permanent rigid plastic.
p. Metal **OR** Metallic-Finish, Plastic-Laminate, **as directed**, Ceiling: Flush panels, with incandescent downlights in the center of **OR** four low-voltage downlights in, **as directed**, each panel. Align ceiling panel joints with joints between wall panels, **as directed**.
q. Handrails: Manufacturer's standard handrails, of shape, metal, and finish indicated.

F. Hoistway Entrances
1. General: Provide manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Provide frame size and profile to coordinate with hoistway wall construction.
   a. Where gypsum board wall construction is indicated, provide self-supporting frames with reinforced head sections.
2. Materials and Fabrication: Provide manufacturer's standards, but not less than the following:
   a. Enameled-Steel Frames: Formed from cold-rolled or hot-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected from manufacturer's full range.
   b. Steel Subframes: Formed from cold-rolled or hot-rolled steel sheet with factory-applied enamel finish or corrosion-inhibiting primer. Fabricate to receive applied finish as indicated.
   c. Stainless-Steel Frames: Formed from stainless-steel sheet.
   d. Bronze Frames: Formed from cold-rolled or hot-rolled steel sheet, with enamel finish, and with formed-bronze sheet laminated to steel frames using adhesive that fully bonds metal to metal without telegraphing or oil-canning.

e. Enameled-Steel Doors and Transoms: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected from manufacturer's full range.
f. Stainless-Steel Doors and Transoms: Flush, hollow-metal construction; fabricated from stainless-steel sheet **OR** by laminating stainless-steel sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning, **as directed**.
g. Bronze Doors and Transoms: Flush, hollow-metal construction; fabricated by laminating bronze sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
h. Plastic-Laminate Doors and Transoms: Flush, hollow-metal construction; fabricated by laminating plastic laminate to exposed faces of enameled cold-rolled steel doors and covering edges with protective edge trim matching door frames, **as directed**. Plastic-laminate color, texture, and pattern as selected from plastic-laminate **OR** elevator, **as directed**, manufacturer's full range.
i. Sight Guards: Provide sight guards on doors matching door edges.
j. Sills: Extruded metal, with grooved surface, 1/4 inch (6.4 mm) thick.
k. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107.

G. Signal Equipment
1. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements with long-life incandescent lamps and acrylic or other permanent, nonyellowing translucent plastic diffusers **OR** LEDs, **as directed**.
OR
General: Provide signal equipment designed for destination-based system. Fabricate lighted elements with long-life incandescent lamps and acrylic or other permanent, nonyellowing translucent plastic diffusers **OR** LEDs, **as directed**.
2. Car Control Stations: Provide manufacturer's standard recessed **OR** semirecessed, **as directed**, car control stations. Mount in return panel adjacent to car door, unless otherwise indicated.
OR
Swing-Return Car Control Stations: Provide car control stations mounted on rear of hinged return panel adjacent to car door and with buttons, switches, controls, and indicator lights projecting through return panel but substantially flush with face of return panel.
a. Mark buttons and switches with standard identification for required use or function that complies with ASME A17.1. Use both tactile symbols and Braille.
b. Provide "No Smoking" sign matching car control station, either integral with car control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.
3. Emergency Communication System: Provide system that complies with ASME A17.1 and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." On activation, system dials preprogrammed number of monitoring station and identifies elevator location to monitoring station. System provides two-way voice communication without using a handset and provides visible signals that indicate when system has been activated and when monitoring station has responded. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.
4. Firefighters' Two-Way Telephone Communication Service: Provide flush-mounted cabinet **OR** telephone jack, **as directed**, in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Division 13 Section(s) "Digital, Addressable Fire-alarm System" OR "Zoned (dc Loop) Fire-alarm System".
5. Car Position Indicator: Provide illuminated, **as directed**, digital-type car position indicator, located above car door or above car control station. Also provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served.
a. Include travel direction arrows if not provided in car control station.

6. Hall Push-Button Stations: Provide one hall push-button station at each landing for each single elevator or group of elevators, but not less than one station for each four elevators in a group, **as directed**.
   OR
   Hall Push-Button Stations: Provide hall push-button stations at each landing as indicated.
   a. Provide manufacturer's standard wall-mounted units.
      OR
      Provide units with flat faceplate for mounting with body of unit recessed in wall.
   b. Equip units with buttons for calling elevator and for indicating desired direction of travel.
      OR
      Equip units with buttons **OR** touch screen, **as directed**, for calling elevator and for indicating direction of travel or destination as required by system. Provide a signaling system to verify floor selection, where destination registration is required, and to direct passengers to appropriate car.
      1) Provide a means for passengers to indicate that they have disabilities so control system can allow extra room in assigned car.
      2) Provide for connecting units that require destination registration to building security access system so a card reader can be used to register calls.
   c. Provide telephone jack in each unit for firefighters' two-way telephone communication service specified in Division 13 Section(s) "Digital, Addressable Fire-alarm System" OR "Zoned (dc Loop) Fire-alarm System".
7. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide one of the following:
   a. Manufacturer's standard wall-mounted units, for mounting above entrance frames.
   b. Units with flat faceplate for mounting with body of unit recessed in wall and with illuminated elements projecting from faceplate for ease of angular viewing.
   c. Units mounted in both jambs of entrance frame for each elevator, **as directed**.
   d. Units mounted in both car door jambs; may be used only for single elevators or for two-car groups, **as directed**.
8. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
   a. At manufacturer's option, audible signals may be placed on car **OR** each car, **as directed**.
9. Hall Position Indicators: Provide illuminated, **as directed**, digital-display-type position indicators, located above each, **as directed**, hoistway entrance at ground floor. Provide units with flat faceplate for mounting with body of unit recessed in wall.
   a. Integrate ground-floor hall lanterns with hall position indicators.
10. Standby Power Elevator Selector Switches: Provide switches, as required by ASME A17.1, where indicated. Adjacent to switches, provide illuminated signal that indicates when normal power supply has failed. For each elevator, provide illuminated signals that indicate when they are operational and when they are at the designated emergency return level with doors open.
    OR
    Fire Command Center Annunciator Panel: Provide panel containing illuminated position indicators for each elevator, clearly labeled with elevator designation; include illuminated signal that indicates when elevator is operational and when it is at the designated emergency return level with doors open. Provide standby power elevator selector switch(es), as required by ASME A17.1, adjacent to position indicators. Provide illuminated signal that indicates when normal power supply has failed.
11. Corridor Call Station Pictograph Signs: Provide signs matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station, unless otherwise indicated.

H. Elevators
   1. Elevator Description:

a. Group Number: <**Insert a different number for each group of elevators that share a group operation system.**>
b. Elevator Number(s): <**Insert elevator number(s) as shown on Drawings.**>
c. Service Elevator Number(s): <**Insert elevator number(s) as shown on Drawings.**>
d. Type: Geared **OR** Gearless, **as directed**, traction.
e. Machine Location: Machine room above hoistway **OR** Hoistway; no machine room is provided, **as directed**.
f. Rated Load: 2000 lb (908 kg) **OR** 2100 lb (953 kg) **OR** 2500 lb (1135 kg) **OR** 3000 lb (1362 kg) **OR** 3500 lb (1589 kg) **OR** 4000 lb (1816 kg) **OR** 4500 lb (2043 kg) **OR** 5000 lb (2270 kg), **as directed**.
g. Freight Loading Class for Service Elevator(s): Class A.
h. Rated Speed: 200 fpm (1.0 m/s) **OR** 350 fpm (1.8 m/s) **OR** 400 fpm (2.0 m/s) **OR** 450 fpm (2.3 m/s) **OR** 500 fpm (2.5 m/s) **OR** 700 fpm (3.6 m/s) **OR** 800 fpm (4.1 m/s) **OR** 1000 fpm (5.1 m/s) **OR** 1200 fpm (6.1 m/s) **OR** 1400 fpm (7.1 m/s), **as directed**.
i. Operation System: Selective collective automatic operation **OR** Group automatic operation **OR** Group automatic operation with demand-based dispatching **OR** Destination-based group automatic operation, **as directed**.
j. Auxiliary Operations:
   1) Standby power operation.
   2) Standby powered lowering.
   3) Battery-powered lowering.
   4) Earthquake Emergency Operation: Comply with requirements in ASME A17.1.
   5) Automatic dispatching of loaded car.
   6) Nuisance call cancel.
   7) Emergency hospital **OR** Priority, **as directed**, service at designated floors **OR** all floors, **as directed**.
   8) Independent service for service elevator **OR** all cars in group, **as directed**.
   9) Loaded-car bypass.
   10) Distributed parking.
k. Security Features: Card-reader operation **OR** Keyswitch operation **OR** Keypad operation **OR** Car-to-lobby feature, **as directed**.
l. Dual Car Control Stations: Provide two car control stations in each elevator, **aas directed**; equip only one with required keyswitches if any.
m. Car Enclosures:
   1) Inside Width: 64 inches (1626 mm) **OR** 68 inches (1727 mm) **OR** 80 inches (2032 mm) **OR** 92 inches (2337 mm), **as directed**, from side wall to side wall.
   2) Inside Depth: 51 inches (1295 mm) **OR** 53 inches (1346 mm) **OR** 57 inches (1448 mm) **OR** 65 inches (1651 mm) **OR** 87-1/2 inches (2222 mm) **OR** 90 inches (2286 mm) **OR** 93 inches (2362 mm) **OR** 93-1/2 inches (2375 mm) **OR** 96 inches (2438 mm) **OR** 101 inches (2565 mm) **OR** 102 inches (2591 mm), **as directed**, from back wall to front wall (return panels).
   3) Inside Height: 88 inches (2235 mm) **OR** 92 inches (2337 mm) **OR** 94 inches (2388 mm) **OR** 100 inches (2540 mm) **OR** 104 inches (2642 mm) **OR** 108 inches (2743 mm) **OR** 112 inches (2845 mm), **as directed**, to underside of ceiling.
   4) Front Walls (Return Panels): Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered, **as directed**.
   5) Car Fixtures: Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered, **as directed**.
   6) Side and Rear Wall Panels: Enameled steel **OR** Plastic laminate **OR** Satin stainless steel, No. 4 finish **OR** Textured stainless steel, **as directed**.
   7) Reveals: Enameled steel **OR** Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered, **as directed**.

8) Door Faces (Interior): Enameled steel **OR** Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Textured stainless steel **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered **OR** Plastic laminate, **as directed**.
9) Door Sills: Aluminum, mill finish **OR** Bronze, polished **OR** Nickel silver, polished, **as directed**.
10) Ceiling: Luminous ceiling **OR** Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Polished bronze, lacquered **OR** Reflective metallic-finish, plastic-laminate, stainless steel **OR** Reflective metallic-finish, plastic-laminate, bronze, **as directed**.
11) Handrails: 1-1/2 inches (38 mm) round **OR** 1/2 by 2 inches (13 by 50 mm) rectangular, **as directed**, mirror-polished stainless steel, No. 8 finish **OR** satin stainless steel, No. 4 finish **OR** mirror-polished bronze, lacquered **OR** satin bronze, lacquered, **as directed**, at sides **OR** rear **OR** sides and rear, **as directed**, of car.
12) Floor: Manufacturer's standard carpet.
OR
Floor prepared to receive carpet (specified in Division 09 Section "Carpet").
OR
Floor prepared to receive resilient tile (specified in Division 09 Section "Resilient Floor Tile").
OR
Floor prepared to receive sheet vinyl (specified in Division 09 Section "Resilient Sheet Flooring").
OR
Floor recessed and prepared to receive dimension stone tile (specified in Division 09 Section "Dimension Stone Tile") **OR** ceramic tile (specified in Division 09 Section "Ceramic Tile"), **as directed**.
13) Floor Thickness, Including Setting Materials: <**Insert thickness**> above plywood subfloor.

n. Hoistway Entrances: As follows:
1) Width: 36 inches (914 mm) **OR** 42 inches (1067 mm) **OR** 48 inches (1219 mm) **OR** 54 inches (1372 mm), **as directed**.
2) Height: 84 inches (2134 mm) **OR** 96 inches (2438 mm), **as directed**.
3) Type: Single-speed side sliding **OR** Two-speed side sliding **OR** Single-speed center opening **OR** Two-speed center opening, **as directed**.
4) Fire-Protection Rating: 1 hour **OR** 1-1/2 hours, **as directed**, with 30-minute temperature rise of 450 deg F (250 deg C), **as directed**.
5) Frames at First Floor **OR** at Basement Floors, **as directed**: Enameled steel **OR** Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered, **as directed**.
6) Frames at Other Floors: Enameled steel **OR** Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered, **as directed**.
7) Doors and Transoms at First Floor **OR** at Basement Floors, **as directed**: Enameled steel **OR** Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Textured stainless steel **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered **OR** Plastic laminate, **as directed**.
8) Doors and Transoms at Other Floors: Enameled steel **OR** Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Textured stainless steel **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered **OR** Plastic laminate, **as directed**.
9) Sills at First Floor **OR** at Basement Floors, **as directed**: Aluminum, mill finish **OR** Bronze, polished **OR** Nickel silver, polished, **as directed**.
10) Sills at Other Floors: Aluminum, mill finish **OR** Bronze, polished **OR** Nickel silver, polished, **as directed**.

o. Hall Fixtures at First Floor **OR** at Basement Floors, **as directed**: Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered **OR** Recessed type with no exposed-metal surfaces, **as directed**.

p. Hall Fixtures at Other Floors: Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered **OR** Recessed type with no exposed-metal surfaces, **as directed**.

q. Additional Requirements:

1) Provide inspection certificate in each car, mounted under acrylic cover with frame made from polished stainless steel, No. 8 finish **OR** satin stainless steel, No. 4 finish **OR** polished bronze, lacquered **OR** satin bronze, lacquered, **as directed**.

2) Provide blanket hooks in all cars, **as directed**, and one **OR** two, **as directed**, complete set(s) of full-height protective blankets.

1.3 EXECUTION

A. Examination

1. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Examine hoistways, hoistway openings, pits, and machine rooms as constructed; verify critical dimensions; and examine supporting structure and other conditions under which elevator work is to be installed.

a. For the record, prepare a written report, endorsed by Installer, listing dimensional discrepancies and conditions detrimental to performance or indicating that dimensions and conditions were found to be satisfactory.

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

B. Installation

1. Comply with manufacturer's written instructions.
2. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.
3. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts designed to minimize transmission of vibrations to structure and thereby minimize structure-borne noise from elevator system.
4. Lubricate operating parts of systems, including ropes, as recommended by manufacturers.
5. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.
6. Leveling Tolerance: 1/8 inch (3 mm), up or down, regardless of load and direction of travel.
7. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.
8. Locate hall signal equipment for elevators as follows, unless otherwise indicated:

a. For groups of elevators, locate hall push-button stations between two elevators at center of group or at location most convenient for approaching passengers.

b. Place hall lanterns either above or beside each hoistway entrance.

c. Mount hall lanterns at a minimum of 72 inches (1829 mm) above finished floor.

C. Field Quality Control

1. Acceptance Testing: On completion of elevator installation and before permitting use (either temporary or permanent) of elevators, perform acceptance tests as required and recommended by ASME A17.1 and by governing regulations and agencies.
2. Operating Test: Load elevator **OR** each elevator **OR** one elevator of each type, capacity, speed, and travel distance, **as directed**, to rated capacity and operate continuously for 30 minutes over full travel distance, stopping at each level and proceeding immediately to the next. Record

temperature rise of elevator machine during 30-minute test period. Record failure to perform as required.

3. Advise Owner and authorities having jurisdiction in advance of dates and times tests are to be performed on elevators.

D. Protection

1. Temporary Use: Limit temporary use for construction purposes to one elevator **as directed**. Comply with the following requirements for each, **as directed**, elevator used for construction purposes:
   a. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
   b. Provide strippable protective film on entrance and car doors and frames.
   c. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
   d. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
   e. Do not load elevators beyond their rated weight capacity.
   f. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
   g. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

E. Demonstration

1. Train Owner's maintenance personnel to operate, adjust, and maintain elevator(s).
2. Check operation of each elevator with Owner's personnel present and before date of Substantial Completion. Determine that operation systems and devices are functioning properly.
3. Check operation of each elevator with Owner's personnel present not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

END OF SECTION 14290

Task	Specification	Specification Description
14290	14240	Hydraulic Elevators

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SECTION 14310 - ESCALATORS

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for escalators. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. This Section includes high-traffic, interior and exterior escalators.

C. Definitions
1. High-Traffic Escalators: Escalators designed specifically for use where high-traffic volumes produce dense occupancy resulting in structural, machinery, and brake loads much higher than normal.
2. Defective Escalator Work: Operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

D. Performance Requirements
1. Rated Speed: 90 fpm (0.46 m/s) or 100 fpm (0.5 m/s).
2. Braking Performance: Provide brakes that stop escalator in up-running mode at a rate no greater than 3 ft./s^2 (0.91 m/s^2).
OR
Braking Performance: Provide brakes that produce a stopping force on escalator in up-running mode that is one-third that used in down-running mode.
3. Step/Skirt Performance Index: Not more than 0.15.
4. Structural and Mechanical Performance for High-Traffic Escalators: For the purpose of structural design, driving machine and power transmission calculations, and brake calculations, design high-traffic escalators for loads not less than 2 times the design loads required by ASME A17.1.
5. Structural Performance of Balustrades, Deck Barricades, and Handrails: Provide components and assemblies capable of withstanding the effects of loads indicated in ASCE 7 for handrail assemblies and guardrail systems.

E. Submittals
1. Product Data: Include capacities, sizes, performances, safety features, finishes, and similar information.
2. Shop Drawings: Show plans, elevations, sections, and details indicating coordination with building structure and relationships with other construction. Indicate variations from specified requirements, maximum loads imposed on building structure at points of support, and power requirements. Indicate access and ventilation for escalator machine space.
3. Samples: For exposed finishes, 3-inch- (75-mm-) square Samples of sheet materials, and 4-inch (100-mm) lengths of running trim members.
4. Manufacturer Certificates: Signed by manufacturer certifying that escalator layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for escalator system being provided.
5. Qualification Data: For Installer.
6. Operation and Maintenance Data: For escalators to include in emergency, operation, and maintenance manuals.
7. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted escalator use.

8. Warranty: Special warranty specified in this Section.

F. Quality Assurance
1. Installer Qualifications: Escalator manufacturer or manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
2. Source Limitations: Obtain escalators and moving walks, specified in another Division 14 Section, through one source from a single manufacturer.
3. Regulatory Requirements: Comply with ASME A17.1.

G. Delivery, Storage, And Handling
1. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging.
2. Store materials, components, and equipment off of ground, under cover, and in a dry location. Handle according to manufacturer's recommendations to prevent damage, deterioration, or soiling.

H. Coordination
1. Coordinate installation of sleeves, block outs, escalator equipment with integral anchors, and other items that are embedded in concrete or masonry for escalator equipment. Furnish templates, sleeves, escalator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.
2. Coordinate sequence of escalator installation with other work to avoid delaying the Work.
3. Coordinate locations and dimensions of other work relating to escalators including sumps and floor drains in pits, electrical service, and electrical outlets, lights, and switches in pits.

I. Warranty
1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair, restore, or replace defective escalator work within specified warranty period.
   a. Warranty Period: One year from date of Substantial Completion.

1.2 PRODUCTS

A. Materials
1. Stainless Steel: ASTM A 240/A 240M, Type 304 **OR** 316 **OR** 304, except use Type 316 for exterior escalators, **as directed**.
   a. Satin Finish: No. 4 directional satin.
   b. Polished Finish: No. 8 mirror polish.
   c. Gold-Colored Satin Finish: No. 4 directional satin with gold-colored oxide or titanium nitride finish.
   d. Gold-Colored Mirror Finish: No. 8 mirror polish with gold-colored oxide or titanium nitride finish.
2. Satin Bronze Sheet: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal), fine satin finish, lacquered.
3. Satin Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (architectural bronze), fine satin finish, lacquered.
4. Steel Sheet: Cold-rolled steel sheet, ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
5. Clear Tempered Glass: ASTM C 1048, Condition A (uncoated surfaces), Type 1 (transparent glass, flat), Class 1 (clear), Quality q3 (glazing, select), Kind FT (fully tempered), [**10.0**] [**12.0**] mm thick.
6. Tinted Tempered Glass: ASTM C 1048, Condition A (uncoated surfaces), Type 1 (transparent glass, flat), Class 2 (tinted), Quality q3 (glazing, select), Kind FT (fully tempered), [**10.0**] [**12.0**] mm thick.
   a. Color: Bronze **OR** Gray **OR** Green, **as directed**.

B. Components
1. General: Provide preengineered escalators complying with requirements. Unless otherwise indicated, provide standard components as indicated in manufacturers' publications and as required for a complete escalator.
2. General: Provide high-traffic escalators complying with requirements. Unless otherwise indicated, provide heavy-duty components as indicated in manufacturers' publications and as required for a complete escalator.
   a. Provide escalators with two **OR** three **OR** four, **as directed**, flat steps at top and bottom landings.
   b. Fabricate exposed metalwork, including deck covers, balustrade panels, and trim to provide surface flatness equivalent to stretcher-leveled standard of flatness and sufficient strength for indicated use; increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as necessary. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.
3. Opaque Balustrades: Manufacturer's standard profile or arrangement of moving handrails on fully paneled guide rail with interior balustrade panels, deck covers, skirts, trim, and accessories. Prepare for exterior finish below the deck covers, specified in another Section.
4. Transparent Balustrades: Manufacturer's standard profile or arrangement of moving handrails on guide rail that is supported by tempered glass panels, with deck covers, skirts, trim, and accessories. Prepare for exterior finish below the deck covers, specified in another Section.
5. Guards at Ceiling Intersection: Clear plastic.
6. Handrails: Smooth, jointless, reinforced neoprene.
   a. Color: Black **OR** As selected from manufacturer's full range, **as directed**.
7. Deck Covers and Trim: Satin stainless steel **OR** Polished stainless steel **OR** Gold-colored satin stainless steel **OR** Gold-colored polished stainless steel **OR** Satin bronze, **as directed**.
8. Antislide Devices: Satin stainless steel **OR** Polished stainless steel **OR** Gold-colored satin stainless steel **OR** Gold-colored polished stainless steel **OR** Satin bronze, **as directed**.
9. Balustrade Interior Panels: Satin stainless steel **OR** Polished stainless steel **OR** Gold-colored satin stainless steel **OR** Gold-colored polished stainless steel **OR** Satin bronze, **as directed**.
10. Balustrade Exterior Panels and Escalator Soffits: Satin stainless steel **OR** Polished stainless steel **OR** Gold-colored satin stainless steel **OR** Gold-colored polished stainless steel **OR** Satin bronze, **as directed**.
11. Skirt Panels, if Applicable: Satin stainless steel **OR** Polished stainless steel **OR** Satin stainless steel with exposed surface coated with clear PTFE **OR** Steel panels with exposed surface coated with PTFE **OR** Manufacturer's standard low-friction material, **as directed**.
12. Steps: One-piece, die-cast aluminum with demarcation grooves at front and rear of tread surface.
    a. Finish: Powder-coated, gray **OR** black, **as directed**.
    b. Step Demarcation: Yellow inserts at sides and back of step treads.
    c. Nosing Demarcation: 2-inch- (50-mm-) wide yellow stripe at nosings of step treads.
13. Combs: Integrally colored structural plastic **OR** Cast aluminum **OR** Cast aluminum with powder-coated finish, **as directed**.
    a. Comb Color: Yellow.
14. Floor Plates: Cast or extruded aluminum with grooved or patterned surface and mill finish.
15. Abrasive-Surface Floor Plates: Cast or extruded aluminum **OR** Stainless steel, **as directed**, with grooved or patterned surface and with abrasive material embedded in or metallically bonded to floor-plate surface and having a coefficient of friction of 0.6 or higher when tested according to ASTM C 1028.
16. Operational Control: Provide escalators designed and equipped to run equally in either direction. Provide key-operated switches for directional control and key-operated starter switches located on exterior deck above newel base at both upper and lower landings of escalators.

C. Features
1. Fault Indicator: Provide escalators with a microprocessor unit that monitors safety devices, motor temperature, and escalator speed and records in nonvolatile memory date, time, and device identification if a safety device is activated or escalator malfunctions.

a. Provide built-in or plug-in unit to display recorded information.

2. Reduced-Current Starting: Provide escalator motors with wye-delta or solid-state starting.
3. Energy-Saving Feature: Provide escalator motors and controls designed for motors to run on partial windings (at reduced power) when not under full load.
4. Provide motors complying with NEMA MG 1, Insulation Class B.
5. Brake-Saving Feature: Provide stopping mechanism that allows escalator to coast to a stop before applying brakes, unless stopping is initiated by a safety device.
6. Equip step drive mechanism with automatic step-chain lubricators.
7. Oil Drip Pan: Provide metal pan under full width and length of escalator to collect and hold oil and grease drippings from lubricated components. Design and fabricate drip pan to sustain a load of 250 lbf (1.1 kN) on a 1.0-sq. ft. (0.9-sq. m) area at any location without permanent deflection.
8. Direction Indicator Lights: Provide red and green indicator lights at least 2 inches (50 mm) in diameter in right-hand **OR** both, **as directed**, balustrade newels at both upper and lower landings. Green light indicates entrance end, and red light indicates exit end. When escalator is stopped, red lights are illuminated at both ends.
9. Combplate Lights: Provide recessed light fixtures with flush lenses mounted in skirt panels at each side of combplates designed to illuminate steps at combplate.
10. Overspeed Governor: Provide units with overspeed governor that is activated if speed of steps exceeds rated speed by more than 20 percent.
11. Upper-Landing, Step Upthrust Device: Activated if a step is displaced against upthrust track at upper curve in passenger-carrying line of track system.
12. Comb-Step Impact Device: Activated if a horizontal force in direction of travel is applied exceeding 112 lbf (500 N) at either side or exceeding 225 lbf (1000 N) at center of front edge of combplate, or a resultant force in upward direction is applied exceeding 150 lbf (688 N) at center of front edge of combplate.

D. Exterior Escalators

1. Fabricate exposed components from stainless steel **OR** bronze, **as directed**, unless otherwise indicated.
2. Hot-dip galvanize escalator trusses and other structural components to comply with ASTM A 123/A 123M. Use only stainless-steel or zinc-plated fasteners for assembly of escalator components.
3. Fabricate oil drip pan from galvanized steel sheet. Provide drain and oil/water separator in oil drip pan.
4. Provide drains, weeps, and drips to prevent water accumulation on horizontal surfaces and to direct water away from electrical equipment and moving parts.
5. Provide enclosures complying with NEMA 250, Type 4 for electrical connections, switches, and equipment.
6. Provide totally enclosed motors complying with NEMA MG 1, Insulation Class B.
7. Equip step drive mechanism with automatic step-chain lubricators.
8. Provide electric heaters with integral thermostats in escalator truss space to maintain temperature above 40 deg F (4.4 deg C).
9. Equip combplates with 400-W electric heaters to prevent ice and snow accumulation.

1.3 EXECUTION

A. Examination

1. Examine escalator areas, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance. Examine supporting structure, machine spaces, and pits; verify critical dimensions; and examine conditions under which escalators are to be installed.
   a. Proceed with installation only after unsatisfactory conditions have been corrected.

b. For the record, prepare written report, endorsed by Installer, listing dimensional discrepancies and conditions detrimental to performance or indicating that dimensions and conditions were found to be satisfactory.

B. Installation
1. Comply with manufacturer's written instructions.
2. Set escalators true to line and level, properly supported, and anchored to building structure. Use established benchmarks, lines, and levels to ensure dimensional coordination of the Work.
3. Adjust installed components for smooth, efficient operation, complying with required tolerances and free of hazardous conditions. Lubricate operating parts, including bearings, tracks, chains, guides, and hardware. Test operating devices, equipment, signals, controls, and safety devices. Install oil drip pans and verify that no oil drips outside of pans.
4. Repair damaged finishes so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

C. Field Quality Control
1. Acceptance Testing: On completion of escalator installation and before permitting use of escalators, perform acceptance tests as required and recommended by ASME A17.1 and by authorities having jurisdiction.
   a. For escalators specified to comply with requirements more stringent than those of ASME A17.1, perform tests for compliance with specified requirements. Test optional safety devices.
2. Advise Owner and authorities having jurisdiction in advance of dates and times tests are to be performed.

D. Demonstration
1. Train Owner's maintenance personnel to operate, adjust, and maintain escalators.
2. Check operation of escalators with Owner's personnel present and before date of Substantial Completion. Determine that operation systems and devices are functioning properly.
3. Check operation of escalators with Owner's personnel present not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

END OF SECTION 14310

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SECTION 14320 - MOVING WALKS

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for moving walks. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. This Section includes interior and exterior moving walks.

C. Definition
1. Defective Moving Walk Work: Operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

D. Performance Requirements
1. Rated Speed: 90 fpm (0.45 m/s) **OR** 100 fpm (0.5 m/s) **OR** 120 fpm (0.6 m/s) **OR** 130 fpm (0.66 m/s) **OR** 150 fpm (0.76 m/s), **as directed**.
2. Structural Performance of Balustrades, Deck Barricades, and Handrails: Provide components and assemblies capable of withstanding the effects of loads indicated in ASCE 7 for handrail assemblies and guardrail systems.

E. Submittals
1. Product Data: Include capacities, sizes, performances, safety features, finishes, and similar information.
2. Shop Drawings: Show plans, elevations, sections, and details indicating coordination with building structure and relationships with other construction. Indicate variations from specified requirements, maximum loads imposed on building structure at points of support, and power requirements. Indicate access and ventilation for moving walk machine space.
3. Samples: For exposed finishes, 3-inch- (75-mm-) square Samples of sheet materials, and 4-inch (100-mm) lengths of running trim members.
4. Manufacturer Certificates: Signed by manufacturer certifying that moving walk layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for moving walks being provided.
5. Operation and Maintenance Data: For moving walks to include in emergency, operation, and maintenance manuals.
6. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted use of moving walks.

F. Quality Assurance
1. Regulatory Requirements: Comply with ASME A17.1.

G. Delivery, Storage, And Handling
1. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging.
2. Store materials, components, and equipment off of ground, under cover, and in a dry location. Handle according to manufacturer's recommendations to prevent damage, deterioration, or soiling.

H. Warranty

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair, restore, or replace defective moving walk work within one year from date of Substantial Completion.

I. Maintenance Service
1. Initial Maintenance Service: Beginning at Substantial Completion, provide one years' full maintenance service by skilled employees of moving walk Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper moving walk operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

1.2 PRODUCTS

A. General
1. Provide preengineered pallet- or belt-type moving walks complying with requirements.

B. Materials
1. Stainless Steel: ASTM A 240/A 240M, Type 304 **OR** 316 **OR** 304, except use Type 316 for exterior moving walks, **as directed**.
   a. Satin Finish: No. 4 directional satin.
   b. Polished Finish: No. 8 mirror polish.
   c. Gold-Colored Satin Finish: No. 4 directional satin with gold-colored oxide or titanium nitride finish.
   d. Gold-Colored Mirror Finish: No. 8 mirror polish with gold-colored oxide or titanium nitride finish.
2. Satin Bronze Sheet: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal), fine satin finish, lacquered.
3. Satin Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (architectural bronze), fine satin finish, lacquered.
4. Steel Sheet: Cold-rolled steel sheet, ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
5. Clear Tempered Glass: ASTM C 1048, Condition A (uncoated surfaces), Type 1 (transparent glass, flat), Class 1 (clear), Quality q3 (glazing, select), Kind FT (fully tempered), 10.0 **OR** 12.0, **as directed**, mm thick.
6. Tinted Tempered Glass: ASTM C 1048, Condition A (uncoated surfaces), Type 1 (transparent glass, flat), Class 2 (tinted), Quality q3 (glazing, select), Kind FT (fully tempered), 10.0 **OR** 12.0, **as directed**, mm thick.
   a. Color: Bronze **OR** Gray **OR** Green, **as directed**.

C. Components
1. General: Unless otherwise indicated, provide standard components as indicated in manufacturers' publications and as required for a complete moving walk.
   a. Fabricate exposed metalwork, including deck covers, balustrade panels, and trim to provide surface flatness equivalent to stretcher-leveled standard of flatness and sufficient strength for indicated use; increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as necessary. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.
2. Opaque Balustrades: Manufacturer's standard profile or arrangement of moving handrails on fully paneled guide rail with interior balustrade panels, deck covers, skirts, trim, and accessories. Prepare for exterior finish below the deck covers, specified in another Section.
3. Transparent Balustrades: Manufacturer's standard profile or arrangement of moving handrails on guide rail that is supported by clear **OR** tinted, **as directed**, tempered glass panels, with deck covers, skirts, trim, and accessories. Prepare for exterior finish below the deck covers, specified in another Section.
4. Handrails: Smooth, jointless, reinforced neoprene.

a. Color: Black **OR** As selected from manufacturer's full range, **as directed**.

5. Deck Covers and Trim: Satin stainless steel **OR** Polished stainless steel **OR** Gold-colored satin stainless steel **OR** Gold-colored polished stainless steel **OR** Satin bronze, **as directed**.
6. Balustrade Interior Panels: Satin stainless steel **OR** Polished stainless steel **OR** Gold-colored satin stainless steel **OR** Gold-colored polished stainless steel **OR** Satin bronze, **as directed**.
7. Balustrade Exterior Panels: Satin stainless steel **OR** Polished stainless steel **OR** Gold-colored satin stainless steel **OR** Gold-colored polished stainless steel **OR** Satin bronze, **as directed**.
8. Skirt Panels, if Applicable: Polished stainless steel **OR** Satin stainless steel with exposed surface coated with clear PTFE **OR** Steel panels with exposed surface coated with PTFE, **as directed**.
   a. Clearance between skirt panels or overhanging balustrade panels and treadway shall not exceed 1/16 inch (1.6 mm).
9. Combs: Integrally colored structural plastic **OR** Cast aluminum **OR** Cast aluminum with powder-coated finish, **as directed**.
   a. Comb Color: Yellow **OR** Black **OR** Gray **OR** Red, **as directed**.
10. Floor Plates: Cast or extruded aluminum **OR** Stainless steel, **as directed**, with grooved or patterned surface and mill finish.
11. Abrasive-Surface Floor Plates: Cast or extruded aluminum **OR** Stainless steel, **as directed**, with grooved or patterned surface and with abrasive material embedded in or metallically bonded to floor-plate surface and having a coefficient of friction of 0.6 or higher when tested according to ASTM C 1028.
12. Operational Control: Provide moving walks designed and equipped to run equally in either direction. Provide key-operated switches for directional control and key-operated starter switches located on exterior deck above newel base at both ends of moving walks.

D. Features

1. Fault Indicator: Provide moving walks with a microprocessor unit that monitors safety devices, motor temperature, and moving walk speed and records in nonvolatile memory date, time, and device identification if a safety device is activated or moving walk malfunctions.
   a. Provide built-in or plug-in unit to display recorded information.
2. Reduced-Current Starting: Provide moving walk motors with wye-delta or solid-state starting.
3. Energy-Saving Feature: Provide moving walk motors and controls designed for motors to run on partial windings (at reduced power) when not under full load.
4. Brake-Saving Feature: Provide stopping mechanism that allows moving walks to coast to a stop before applying brakes, unless stopping is initiated by a safety device.
5. Equip pallet drive mechanism with automatic pallet drive-chain lubricators.
6. Oil Drip Pan: Provide metal pan under full width and length of moving walks to collect and hold oil and grease drippings from lubricated components. Design and fabricate drip pan to sustain a load of 250 lbf (1.1 kN) on a 1.0-sq. ft. (0.09-sq. m) area at any location without permanent deflection.
7. Direction Indicator Lights: Provide red and green indicator lights at least 2 inches (50 mm) in diameter in right-hand **OR** both, **as directed**, balustrade newels at both landings. Green light indicates entrance end, and red light indicates exit end. When moving walk is stopped, red lights are illuminated at both ends.
8. Combplate Lights: Provide recessed light fixtures with flush lenses mounted in interior balustrade panels at each side of combplates designed to illuminate treadway at combplate.
9. Comb-Step Impact Device: Activated if a horizontal force in direction of travel is applied exceeding 112 lbf (500 N) at either side or exceeding 225 lbf (1000 N) at center of front edge of combplate, or a resultant force in upward direction is applied exceeding 150 lbf (688 N) at center of front edge of combplate.

E. Exterior Moving Walks

1. Fabricate exposed components from stainless steel **OR** bronze, **as directed**, unless otherwise indicated.
2. Hot-dip galvanize moving walk trusses and other structural components to comply with ASTM A 123/A 123M. Use only stainless-steel or zinc-plated fasteners for assembly of moving walk components.

3. Fabricate oil drip pan from galvanized steel sheet. Provide drain and oil/water separator in oil drip pan.
4. Provide drains, weeps, and drips to prevent water accumulation on horizontal surfaces and to direct water away from electrical equipment and moving parts.
5. Provide enclosures complying with NEMA 250, Type 4 for electrical connections, switches, and equipment.
6. Provide totally enclosed fan-cooled motors complying with NEMA MG 1, Insulation Class B.
7. Equip pallet drive mechanism with automatic pallet drive-chain lubricators.
8. Provide electric heaters with integral thermostats in moving walk truss space to maintain temperature above 40 deg F (4.4 deg C).
9. Equip combplates with 400-W electric heaters to prevent ice and snow accumulation.

1.3 EXECUTION

A. Installation
1. Comply with manufacturer's written instructions.
2. Set moving walks true to line and level, or to indicated slope, properly supported, and anchored to building structure. Use established benchmarks, lines, and levels to ensure dimensional coordination of the Work.
3. Adjust installed components for smooth, efficient operation, complying with required tolerances and free of hazardous conditions. Lubricate operating parts, including bearings, tracks, chains, guides, and hardware. Test operating devices, equipment, signals, controls, and safety devices. Install oil drip pans and verify that no oil drips outside of pans.
4. Repair damaged finishes so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

B. Field Quality Control
1. Acceptance Testing: On completion of moving walk installation and before permitting use of moving walks, perform acceptance tests as required and recommended by ASME A17.1 and by authorities having jurisdiction.
2. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times tests are to be performed.

C. Demonstration
1. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, adjust, and maintain moving walks.

END OF SECTION 14320

Task	Specification	Specification Description
14390	14290	Electric Traction Elevators
14390	14240	Hydraulic Elevators
14390	14310	Escalators
14415	14420	Wheelchair Lifts

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SECTION 14420 - WHEELCHAIR LIFTS

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for wheelchair lifts. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section Includes:
a. Vertical and Private-residence, vertical platform lifts.
b. Inclined and Private-residence, inclined platform lifts.
c. Inclined and Private-residence, inclined stairway chairlifts.

C. Submittals
1. Product Data: For each type of product indicated.
2. Shop Drawings: For each lift. Include plans, elevations, sections, details, and attachments to other work.
a. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
b. Wiring Diagrams: For power, signal, and control wiring.
3. Samples: For each type of exposed finish required.
4. Manufacturer Certificates: Signed by lift manufacturer certifying that runway, ramp or pit, and dimensions as shown on Drawings and that electrical service as shown and specified are adequate for lift being provided.
5. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted use of lifts.
6. Operation and Maintenance Data: For each type of lift to include in operation and maintenance manuals.
7. Warranty: Sample of special warranty.
8. Continuing maintenance proposal.

D. Quality Assurance
1. Regulatory Requirements: In addition to requirements of authorities having jurisdiction, comply with ASME A18.1, "Safety Standard for Platform Lifts and Stairway Chairlifts."
2. Fire-Rated, Runway-Enclosure Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 **OR** UBC Standard 7-2 **OR** UL 10B, **as directed**.
a. Temperature-Rise Limit: Provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.

E. Warranty
1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lifts that fail in materials or workmanship within two **OR** Four **OR** Five, **as directed**, years from date of Substantial Completion.

F. Maintenance Service
1. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of lift Installer. Include quarterly preventive maintenance and repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as

required for proper lift operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.

2. Continuing Maintenance Proposal: From Installer to Owner, in the form of a standard yearly **OR** two-year **OR** five-year, **as directed**, maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.2 PRODUCTS

A. Materials

1. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
2. Steel Tubing: ASTM A 500.
3. Steel Pipe: ASTM A 53/A 53M; standard weight (Schedule 40) unless otherwise indicated or required by structural loads.
4. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel (CS), Type B, exposed, matte finish.
5. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel (CS), Type B, pickled.
6. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 (Z275) zinc coating,
7. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
   a. ASTM A 123/A 123M, for galvanizing steel and iron products.
   b. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
8. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required:
   a. Extruded Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.
   b. Aluminum Sheet: ASTM B 209 (ASTM B 209M), Alloy 5005-H15.
9. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
10. Stainless-Steel Tubing: ASTM A 554, Grade MT-304.
11. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.
12. Stainless-Steel Floor Plate: ASTM A 793.
13. Wood and Wood Panel Products: Comply with requirements in Division 06 Section "Interior Architectural Woodwork".
14. Wood and Wood Panel Products:
    a. Wood: Clear, vertical-grain, straight, kiln-dried wood, AWPA C20-02, Interior Type A, fire-retardant treated, **as directed**; of manufacturer's standard species.
    b. Wood Panels: Provide wood panels consisting of wood veneer and wood panel as follows:
       1) Wood Veneer: Laminated to core with moisture-resistant adhesive.
       2) Plywood: DOC PS 1.
       3) Particleboard: ANSI A208.1, made with binder containing no urea formaldehyde, **as directed**.
       4) Medium-Density Fiberboard: ANSI A208.2, made with binder containing no urea formaldehyde, **as directed**.
    c. Fire-Retardant-Treated Wood Panels: Provide wood panels consisting of wood veneer and AWPA C27-02 fire-retardant-treated wood panels. Panels shall have flame-spread index of 75 **OR** 25, **as directed**, or less and smoke-developed index of 450 or less per ASTM E 84.
       1) Wood Veneer: Laminated to core with moisture-resistant adhesive.
       2) Plywood: DOC PS 1.
       3) Particleboard: ANSI A208.1, made with binder containing no urea formaldehyde, **as directed**.
       4) Medium-Density Fiberboard: ANSI A208.2, made with binder containing no urea formaldehyde, **as directed**.

15. Fiberglass: Multiple laminations of glass-fiber-reinforced polyester resin with UV-light-stable, colorfast, nonfading, weather- and stain-resistant, colored polyester gel coat, and manufacturer's standard finish.
16. Glass:
    a. Comply with requirements in Division 08 Section "Glazing".
       OR
       As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**, and complying with ASME A18.1.
       1) Safety Glazing Products: Comply with testing requirements in 16 CFR 1201, Category II.
       2) Safety Glass Marking: Glass permanently marked with certification label of SGCC or another certification agency or manufacturer acceptable to authorities having jurisdiction.
17. Acrylic Glazing: ASTM D 4802, Category A-1 (cell-cast) or Category A-2 (continuous cast), Finish 1 (smooth or polished), clear or tinted as indicated.
18. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing structural members, guide rails, machines, and other lift components where installation of devices is specified in another Section.
19. Expansion Anchors: Anchor-bolt-and-sleeve assembly of material indicated below with capability to sustain a load equal to 10 times the load imposed as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
    a. Material:
       1) Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
          OR
          Group 1, Alloy 304 or Alloy 316, stainless-steel bolts and nuts complying with ASTM F 593 (ASTM F 738M) and ASTM F 594 (ASTM F 836M).
20. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107.

B. Vertical Platform Lifts
1. Private-Residence, **as directed**, Vertical Platform Lifts: Manufacturer's standard preengineered lift systems as indicated.
2. Platform Size: 34 by 54 inches (864 by 1372 mm) **OR** 35 by 48 inches (889 by 1220 mm) **OR** 35 by 51 inches (889 by 1295 mm) **OR** 36 by 56 inches (914 by 1422 mm) **OR** 36 by 60 inches (914 by 1524 mm), **as directed**.
3. Door Operation and Clear Opening Width: Low-energy, power-operated doors that remain open for 20 seconds minimum; end door with minimum 32-inch (815-mm) and side door with minimum 42-inch (1065-mm) clear opening width.
4. Rated Speed: 8 fpm (0.04 m/s)\ **OR** 10 fpm (0.05 m/s) **OR** 12 fpm (0.06 m/s) **OR** 15 fpm (0.08 m/s) **OR** 20 fpm (0.10 m/s) **OR** 22 fpm (0.11 m/s) **OR** 30 fpm (0.15 m/s), **as directed**.
5. Power Supply: 208 V, 60 Hz, 3 phase **OR** 240 V, 60 Hz, 1 phase **OR** 120 V, 60 Hz, 1 phase, **as directed**.
6. Emergency Operation: Provide emergency manual operation and emergency battery power system **OR** connection to indicated standby (emergency) power, **as directed**, to raise or lower units in case of malfunction or power loss.
7. Attendant Operation: Provide attendant operation at location shown.
8. Self-Supporting Units: Support vertical loads of units only at base, with lateral support only at landing levels.
9. Partial, **as directed**, Runway Enclosure: Manufacturer's standard weather-resistant, **as directed**, enclosure assembly.
   a. Runway Enclosure: One of the following, **as directed.**
      1) Rectangular steel-tube frame with flush steel-sheet panels.
      2) Rectangular hot-dip-galvanized steel-tube frame with flush galvanized-steel-sheet panels.
      3) Extruded-aluminum frame with flush galvanized-steel-sheet panels.

4) Extruded-aluminum frame with flush aluminum-sheet panels; with hot-dip-galvanized steel-tube frame for structural framing that cannot be aluminum.
5) Rectangular steel-tube frame with wood panels and trim.
6) Rectangular wood frame with wood panels and trim.
7) Rectangular steel-tube frame with fiberglass panels.

b. Glazed Runway Enclosure: Rectangular structure of glazed extruded-aluminum framing with a tinted, acrylic dome roof.
1) Glazing:
a) Bronze-tinted acrylic glazing, 6.0 mm thick.
OR
Bronze-tinted, float glass **OR** tempered safety **OR** laminated safety, **as directed**, glass, 6.0 mm thick, where indicated.

c. Runway-Enclosure Doors: One of the following, **as directed**:
1) Rectangular steel-tube frames with flush steel-sheet panels.
2) Rectangular steel-tube frames glazed with 6.0-mm-thick, clear acrylic glazing and with 12-inch- (300-mm-) high, steel kick panels.
3) Wide-stile aluminum entrance doors glazed with bronze-tinted tempered safety glass, 6.0 mm thick.
4) Enclosure doors matching appearance of adjacent glass-supported railings, complying with Division 05 Section "Ornamental Railings".

d. Fire-Rated Runway-Enclosure Door: Provide fire-rated runway-enclosure door where shown **OR** at upper landing **OR** at lower landing, **as directed**.
1) Fire-Protection Rating: 1-1/2 hours.
2) Equip door with wired glass vision panel, delay-action door closer, dead latch, dummy trim door handle, and electric strike.

10. Platform: One of the following, **as directed:**
a. Galvanized-steel sheet with black rubber flooring.
b. Stainless-steel floor plate with checkered texture.
c. Aluminum floor plate with nonskid surface texture.

11. Platform Low-Profile Carriage: Fabricate platform floor assembly to total thickness not exceeding 1-1/2 inches (38 mm).

12. Platform Enclosure and Door: One of the following, **as directed:**
a. Rectangular steel-tube frame with flush steel-sheet panels.
b. Rectangular hot-dip-galvanized steel-tube frame with flush galvanized-steel-sheet panels.
c. Extruded-aluminum frame with flush galvanized-steel-sheet panels.
d. Extruded-aluminum frame with flush aluminum-sheet panels; with hot-dip-galvanized steel-tube frame for structural framing that cannot be aluminum.
e. Rectangular steel-tube frame with wood panels and trim.
f. Rectangular steel-tube frame with fiberglass panels.
g. Enclosure walls and doors matching appearance of adjacent glass-supported railings, complying with Division 05 Section "Ornamental Railings".

13. Platform Top: Provide a non-load-bearing top, matching construction of enclosure walls. Permanently mark top to indicate that it cannot sustain a load.

14. Fixed Ramp: Provide fixed ramp matching platform to provide transition from floor to lift platform at bottom landing.

15. Retractable Ramp: Provide ramp matching platform to provide transition from lower floor to lift platform. Ramp lowers to floor automatically when lifts reach lower landing and door opens. Ramp rises automatically when lift control is activated for lift to leave lower landing.
a. Ramp Size: End ramps a minimum of 32 inches (815 mm) and side ramps a minimum of 42 inches (1065 mm) wide; length as required for slope.
b. Ramp Slope: As indicated **OR** Maximum 1:12, **as directed**.
c. Ramp Finish: Finish ramps to match lift platform **OR** Ramp finish is specified elsewhere as indicated, **as directed**.

16. Accessories: Provide units with the following accessories:
a. Fold-down seat with armrests and safety belt.

b. Forced Ventilation System: Minimum 1 air change per minute, continuously operating **OR** thermostatically controlled to activate at 90 deg F (32.22 deg C) , **as directed**, and with auxiliary power source to operate ventilation for 1 hour in case of power failure.
c. Lighting system within lift enclosures as indicated on Drawings **OR** selected from manufacturer's available products, **as directed**.

C. Inclined Platform Lifts
1. Private-Residence, **as directed**, Inclined Platform Lifts: Manufacturer's standard preengineered lift systems as indicated.
2. Platform Size: 29 by 33 inches (737 by 838 mm) **OR** 28 by 35 inches (711 by 889 mm) **OR** 30 by 35 inches (760 by 889 mm) **OR** 30 by 36 inches (760 by 914 mm) **OR** 31 by 39 inches (787 by 991 mm) **OR** 30 by 41 inches (760 by 1041 mm) **OR** 30 by 42 inches (760 by 1067 mm) **OR** 31 by 43 inches (787 by 1092 mm) **OR** 30 by 48 inches (760 by 1220 mm), **as directed**.
3. Door Operation and Clear Opening Width: Low-energy, power-operated doors that remain open for 20 seconds minimum; end door with minimum 32-inch (815-mm) and side door with minimum 42-inch (1065-mm) clear opening width.
4. Rated Speed: 20 fpm (0.10 m/s) **OR** 22 fpm (0.11 m/s) **OR** 25 fpm (0.13 m/s) **OR** 30 fpm (0.15 m/s), **as directed**.
5. Minimum Headroom Clearance during Travel: Minimum of 80 inches (2032 mm) above any point on platform floor.
6. Power Supply: 208 V, 60 Hz, 3 phase **OR** 240 V, 60 Hz, 1 phase **OR** 120 V, 60 Hz, 1 phase, **as directed**.
7. Emergency Operation: Provide emergency manual operation and emergency battery power system **OR** connection to indicated standby (emergency) power, **as directed**, to raise or lower units in case of malfunction or power loss.
8. Attendant Operation: Provide attendant operation at location shown.
9. Platform: One of the following, **as directed:**
   a. Galvanized-steel sheet with black rubber flooring.
   b. Stainless-steel floor plate with checkered texture.
   c. Aluminum floor plate with nonskid surface texture.
10. Automatic Folding Platforms: When not in use, platforms automatically fold up against wall to minimize projection into stairway.
11. Manual Folding Platforms: When not in use, platforms can be folded up against wall to minimize projection into stairway.
12. Platform Guarding: Guard platform with passenger restraining arms **OR** enclosure, **as directed**.
    a. Passenger Restraining Arms: Steel **OR** Galvanized-steel **OR** Stainless-steel, **as directed**, tubing, manually **OR** power, **as directed**, operated.
    b. Platform Enclosure (Side Walls and Self-Closing Door): One of the following, **as directed**:
       1) Rectangular steel-tube frame with flush steel-sheet panels.
       2) Enclosure walls and doors matching appearance of adjacent glass-supported railings, complying with Division 05 Section "Ornamental Railings".
13. Platform Guarding: Guard platform with automatically **OR** manually, **as directed**, actuated, retractable metal guard on lower access end of platform.
14. Fixed Ramp: Provide fixed ramp matching platform to provide transition from floor to lift platform at bottom landing.
15. Retractable Ramp: Provide ramp matching platform to provide transition from floor to lift platform. Ramp lowers to floor automatically when lifts reach landing and enclosure door opens. Ramp rises automatically when lift control is activated for lift to leave landing.
    a. Ramp Size: End ramps a minimum of 32 inches (815 mm) and side ramps a minimum of 42 inches (1065 mm) wide; length as required for slope.
    b. Ramp Slope: As indicated **OR** Maximum 1:12, **as directed**.
    c. Ramp Finish: Finish ramps to match lift platform **OR** Ramp finish is specified elsewhere as indicated, **as directed**.
16. Supporting Structure: Provide framing to support vertical loads from floor or stair treads and only lateral loads from walls. Fabricate framing from steel **OR** stainless-steel, **as directed**, rectangular tubing, plates, shapes, and bars.

17. Guide Rails: Fabricate from steel **OR** stainless-steel, **as directed**, tubing.
18. Accessories: Provide units with the following accessories:
    a. Fold-down seat with armrests and safety belt.
    b. Caution sign as required by ASME A18.1.

D. Inclined Stairway Chairlifts
1. Private-Residence, **as directed**, Inclined Stairway Chairlifts: Manufacturer's standard preengineered lift systems as indicated.
2. Systems and Machinery: Manufacturer's standard preengineered lift systems as indicated in published product literature and as follows:
    a. Rated Capacity: Minimum 250 lb (113 kg) **OR** 400 lb (181 kg), **as directed**.
    b. Rated Speed: 18 fpm (0.09 m/s) **OR** 20 fpm (0.10 m/s) **OR** 22 fpm (0.11 m/s) **OR** 25 fpm (0.13 m/s), **as directed**.
3. Power Supply: 120 V, 60 Hz, 1 phase.
4. Battery Operation: Provide battery-operated drive with automatic charging system.
5. Manual Lowering: Provide means to manually lower units in case of malfunction or power loss.
6. Folding Units: Provide units that can be folded up against wall when not in use, to minimize projection into stairway.
7. Supporting Structure: Provide brackets to support vertical loads from floor or stair treads and to support lateral loads from walls. Fabricate brackets from steel plates, shapes, or bars.
8. Accessories: Provide units with the following accessories:
    a. Tubular-steel, manually operated safety arms designed to restrain and provide grab bar for occupant.
    b. Retractable seat belt.
    c. Seat with back and two handgrips or arms.

E. General Finish Requirements
1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
2. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
3. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

F. Finishes
1. Steel and Galvanized-Steel Factory Finish:
    a. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard 2-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil (0.025 mm) for topcoat.
    b. Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard, thermosetting polyester or acrylic urethane powder coating with a cured film thickness not less than 1.5 mils (0.04 mm).
    c. Color and Gloss: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
2. Stainless-Steel Finishes:
    a. Floor Plate Finish: Mill **OR** Abrasive blasted, **as directed**.
    b. Grab Rail Finish: As selected from manufacturer's full range **OR** Directional satin finish No. 4, **as directed**.
3. Aluminum Finishes:
    a. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm **OR** AA-M12C22A31, Class II, 0.010 mm, **as directed**, or thicker.
    b. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm **OR** AA-M12C22A32/A34, Class II, 0.010 mm, **as directed**, or thicker.
        1) Color: As selected from full range of industry colors and color densities.

c. Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard, thermosetting polyester or acrylic urethane powder coating with a cured film thickness not less than 1.5 mils (0.04 mm).
   1) Color and Gloss: As selected from manufacturer's full range.

4. Wood Finish:
   a. As specified in Division 09 Section "Wood Stains And Transparent Finishes".
      OR
      As selected from manufacturer's full range, as follows:
      1) Type: Transparent finish **OR** Transparent finish over stain, **as directed**, over wood variety indicated.
5. Fiberglass Color and Gloss: As selected from manufacturer's full range.

1.3 EXECUTION

A. Installation
1. Wiring Method: Conceal conductors and cables within housings of units or building construction. Do not install conduit exposed to view in finished spaces. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
2. Coordinate runway doors with platform travel and positioning, for accurate alignment and minimum clearance between platforms, runway doors, sills, and door frames.
3. Position sills accurately and fill space under sills solidly with nonshrink, nonmetallic grout.
4. Coordinate platform doors with platform travel and positioning.
5. Adjust stops for accurate stopping and leveling at each landing, within required tolerances.
   a. Leveling Tolerance: 1/4 inch (6 mm) up or down, regardless of load and direction of travel.
6. Adjust retractable ramps to meet maximum allowable slope and change-in-elevation requirements, and to lie fully against landing surfaces.
7. Lubricate operating parts of lift, including drive mechanism, guide rails, hinges, safety devices, and hardware.
8. Test safety devices and verify smoothness of required protective enclosures and fascias

B. Field Quality Control
1. Acceptance Testing: On completion of lift installation and before permitting use of lifts, perform acceptance tests as required and recommended by ASME A18.1 and authorities having jurisdiction.
2. Operating Test: In addition to above testing, load lifts to rated capacity and operate continuously for 30 minutes between lowest and highest landings served. Readjust stops, signal equipment, and other devices for accurate stopping and operation of system.
3. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times tests are to be performed on lifts.

C. Demonstration
1. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lifts. Include a review of emergency systems and emergency procedures to be followed at time of operational failure and other building emergencies.

END OF SECTION 14420

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SECTION 14610 - MATERIAL HANDLING HOISTS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of material handling hoists. Products shall match existing materials and/or shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Submittals

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

1.2 PRODUCTS

A. Electric Chain Hoists

1. Hoist motors shall be H4 duty classification. Class F insulation shall be used in hoist motor for 30 minute operation. Load chain shall be grade 80 alloy, case hardened and zinc plated sized for the intended load. Hoists shall employ AC motor brakes employing single or multiple all-steel disks. Controls shall be hand-held, low voltage electrical, with emergency shut off and enclosed in NEMA 3R rated weatherproof enclosure. Hoist shall include fail safe limit switches in the hoist enclosure. Hoist shall meet requirements of ANSI B30.16 standard. Load hook shall be heavy-duty drop forged with safety latch. Hoist shall have swivel top and bottom hooks.

B. Manual Chain Hoists

1. Load capacity of hoist shall be as specified. Load chain shall be grade 80 alloy, case hardened and zinc plated sized for the intended load. Load hook shall be heavy-duty drop forged with safety latch. Hoist mechanism shall be double pawl ratchet system with Weston type brake using a non-asbestos friction disk. Hoist shall have swivel top and bottom hooks. Hoist shall require between 50 and 80 pounds effort to move load.

C. Electric Wire Rope Hoists

1. Hoist motors shall be H4 duty classification. Class F insulation shall be used in hoist motor for 30 minute operation. Lift range shall be between 20 and 150 feet. Lifting cable shall be pre-formed wire rope, of hoisting service construction, made of extra improved steel (XIP) with an independent wire rope center. Load hook shall be heavy-duty drop forged with safety latch. Hoist shall have swivel top and bottom hooks. Controls shall be hand held, low voltage electrical, with emergency shut off and enclosed in NEMA 3R rated weatherproof enclosure. Hoist shall include fail-safe limit switches in the hoist enclosure. Hoist shall meet requirements of ANSI B30.16 standard.

1.3 EXECUTION

A. Installation

1. The Contractor shall complete the assembly of any equipment furnished partially assembled and place the items in position as directed. The hoists shall be assembled and securely bolted in position, hoisting chain or wire rope installed, and the hoist made ready for regular operation. The Contractor shall furnish all miscellaneous hardware items required to complete the installation of all equipment and components. Equipment shall be primed and finish painted with a suitable corrosion-resistant paint on all parts and components not made of corrosion-resistant materials or otherwise protected.

END OF SECTION 14610

SECTION 14610a - MONORAILS WITH ELECTRIC POWERED HOISTS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for monorails with electric powered hoists. Products shall match existing materials and/or shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. System Description

1. Provide a monorail system with electric powered hoist(s) and plain type (hand operated) **OR** hand chain operated **OR** electric powered, **as directed**, trolley(s) complete, tested and ready for operation. Monorails, hoist(s), trolley(s), equipment, materials, installation, examination, inspection, and workmanship shall be in accordance with the applicable requirements of NFPA 70, ASME/ANSI B30.11, ASME/ANSI B30.16, ASME HST-1M, ANSI/ASME HST-4M, and MMA MH27.1, with modifications specified herein. Reference in these publications to the "authority having jurisdiction" shall be interpreted to mean the "the Owner."

C. Submittals

1. Shop Drawings: Monorail system
2. Product Data: Monorail track system including switches, suspension system and other components; Electric wire rope hoist; Electric chain hoist; Trolley; Pendant pushbutton station; Electrification.
3. Design Data: Load and sizing calculations.
4. Test Reports
5. Certificates
6. Operation and Maintenance Data

D. Delivery, Storage, and Handling

1. Delivery and Storage: Inspect materials delivered to site for damage; unload and store with minimum handling. Store materials on-site in enclosures or under protective coverings. Protect materials not suitable for outdoor storage to prevent damage during periods of inclement weather, including subfreezing temperatures, precipitation, and high winds. Store materials susceptible to deterioration by direct sunlight under cover and avoid damage due to high temperatures. Do not store materials directly on ground. When special precautions are required, prominently and legibly stencil instructions for such precautions on outside of equipment or its crating.
2. Handling: Handle materials in such a manner as to ensure delivery to final location in undamaged condition. Make repairs to damaged materials at no cost to Owner.

E. Quality Assurance

1. Certificates: Overload Test Certificate: Submit a statement that the monorail system can be periodically load tested to 125 percent (plus 5 minus 0) of rated load.
2. Drawings: Monorail System: Show the general arrangement of all components, clearances and principal dimensions, assemblies of hoist, trolley, track, track suspension system, and electrical schematic drawings.
3. Design Data: Load and Sizing Calculations: Submit calculations verifying the sizing of any track, track suspension device and additional supports which are not the monorail system manufacturer's standard cataloged product.

1.2 PRODUCTS

A. Overhead Monorail System: Provide overhead monorail system conforming to MMA MH27.1, Class C, for indoor **OR** outdoor, **as directed**, service, with an electric wire rope or chain hoist mounted on a movable trolley. Trolley shall be plain type (hand operated) **OR** hand chain operated **OR** motor operated, **as directed**. Monorail system shall operate on AC voltage as required to meet project requirements, 60 Hz, single **OR** three, **as directed**, phase power source.
   1. Capacity: The monorail system shall have a minimum rated capacity as required to meet project requirements. Mark the hoist capacity in pounds (kg) on both sides of the hoist or load block.
   2. Speeds: The hoist shall have two operating speeds, **unless directed otherwise,** and shall be capable of hoisting and lowering the rated load at a high speed of 20 feet per minute (fpm) (100 mm/s). The trolley shall have two operating speeds, **unless directed otherwise,** and shall be capable of moving the rated load at a high speed of 50 fpm **OR** 100 fpm, **as directed**, (250 mm/s **OR** 500 mm/s, **as directed**,). Low speed(s) shall be one quarter to one third of high speed(s). Actual speed(s) shall be within plus or minus 15 percent of those specified.
   3. Material Limitations: Shafts, keys, couplings, sprockets, and chains shall be steel. All gears shall be steel except for worm gears, which shall be bronze or steel. Cast iron and aluminum used to support components of the hoist power transmission train shall be ductile.
   4. Safety: Comply with the mandatory and advisory safety requirements of ASME/ANSI B30.11, ASME/ANSI B30.16, and 29 CFR 1910.179.

B. Monorail Track System: MMA MH27.1. Track beams shall be patented track sections fabricated by a manufacturer regularly engaged in production of this type of beam.
   1. Track Suspension System: Monorail suspension shall be flexible **OR** rigid, **as directed**, type. Make bolted connections to supporting structure, excluding hanger rods, with ASTM A 325/A 325M bolts, ASTM A 563/A 563M nuts, and ASTM F 959/F 959M load indicator washers. ASTM A 325/A 325M bolts shall be fully pre-tensioned in accordance with AISC S329. Support monorail track system from the structural members shown. Provide additional supports as required to carry monorail track system loads to the structural members shown. Materials for additional supports shall conform to the material requirements contained in Division 05 Section "Structural Steel".

C. Electric Wire Rope Hoist: ANSI/ASME HST-4M, Class H3, except as modified herein. Hoist shall be double reeved, **unless directed otherwise**.
   1. Hoisting Ropes: FS RR-W-410, improved or extra improved plow steel, regular lay, uncoated, 6 by 37 class construction, with an independent wire rope core. Provide proof of wire rope breaking strength test report.
   2. Sheaves: Sheaves shall be steel or ductile cast iron. Pitch diameter of running sheaves shall not be less than 16 times the rope diameter. Pitch diameter of non running sheaves shall not be less than 12 times the rope diameter.
   3. Drum: Drum shall be steel or ductile cast iron. Pitch diameter of the drum shall not be less than 18 times the rope diameter. Not less than two dead wraps of the hoisting rope shall remain on each anchorage when the hook is in its extreme low position.

D. Electric Chain Hoist: ASME HST-1M, Class H3, except as modified herein. Provide load chain proof test.

E. Trolley: Trolley shall meet all applicable requirements of MMA MH27.1, ASME HST-1M and ANSI/ASME HST-4M. Trolley shall have elastomeric bumpers to engage runway stops.

F. Motors: NEMA MG 1. Hoist motor shall be single **OR** two, **as directed**, speed AC squirrel cage induction type. Trolley motor shall be single **OR** two, **as directed**, speed AC squirrel cage induction type. Motor insulation shall be Class B minimum. Provide totally enclosed non-ventilated (TENV) motor enclosures. Maximum motor speed shall not exceed 1800 RPM.

G. Controls: Provide single **OR** two, **as directed**, speed magnetic control for the hoist. Provide single **OR** two, **as directed**, speed magnetic controls for the trolley. Provide reduced voltage starting, acceleration and deceleration for the trolley drive.

H. Limit Switches: Provide upper and lower limit switches which de-energize the hoist motor.

I. Brakes: Provide hoist with an electro-mechanical holding brake and a mechanical load brake, each capable of holding 130 percent of the rated hoist capacity. Hoist holding brake shall be capable of being released to test the load brake. Provide trolley with an electro-mechanical brake. Provide trolley brake with a minimum torque rating of 100 percent (for outdoor monorails) or 50 percent (for indoor monorails) of the drive motor rated torque. Trolley brake torque shall be adjustable down to 85 percent of its torque rating.

J. Load Block And Hook: Construct load blocks of steel. Provide forged steel, swivel type hook, with hook nut keyed to hook shank by means of a setscrew installed in a plane parallel to the longitudinal axis of the hook shank, or other similar easily removable securing device. Hook throat opening shall not be less than as required to meet project requirements. Provide hook with spring loaded steel safety latch for closing the hook throat opening. The hook and hook nut shall be unpainted. Permanently mark hook and hook nut with an identification number.
   1. Hook and Hook Nut Magnetic Particle Inspection: Magnetic particle inspect the hook and nut over the entire area in accordance with ASTM A 275/A 275M. Acceptance standard shall be no defects. A defect is defined as a linear indication that is greater than 1/8 inch (3 mm) long whose length is equal to or greater than three times it width.

K. Bearings: All bearings except those subject to a small rocker motion shall be anti-friction type. Bearings not considered lifetime lubricated by the manufacturer shall be provided with a means for lubrication.

L. Pendant Pushbutton Station: Hoist and trolley, **unless directed otherwise,** shall be controlled from a pendant pushbutton station. Arrange pushbuttons in accordance with ASME/ANSI B30.11recommendations. Locate station 4 feet (1.2 m) above the finished floor

M. Electrification: Runway electrification shall be of the flat festooned type **OR** enclosed safety bar type, **as directed**, with four continuous copper conductors. Provide electrical work for the monorail system in accordance with NFPA 70.

N. Identification Plates: Provide identification plates of noncorrosive metal with clearly legible permanent lettering giving the manufacturer's name, model number, capacity in pounds, and other essential information or identification.

O. Painting System: Painting shall be manufacturers standard. Provide a primer and a finish coat. For outdoor monorail systems, blast clean all components prior to painting and prime with inorganic zinc type primer; finish coat shall be an epoxy formulated for marine environments. Paint coats shall be smooth and even, free of runs, sags, orange peel, or other defects.

1.3 EXECUTION:

A. Erection And Installation: Erect and install the monorail system, complete in accordance with the approved submittals and in condition to perform the operational and acceptance tests.

B. Erection Services: Provide supervisory erection services from the monorail system manufacturer.

C. Field Quality Control
   1. Post-Erection Inspection: After erection, the Contractor and the the Owner shall jointly inspect the monorail and hoist systems and components to determine compliance with specifications and

approved submittals. The Contractor shall notify the the Owner 3 days before the inspection. Provide a report of the inspection indicating the monorail system is considered ready for operational tests

2. Operational Tests: After erection and inspection, test the hoist, and trolley as specified herein. Test the systems in service to determine that each component of the system operates as specified, is properly installed and adjusted, and is free from defects in material, manufacturer, installation, and workmanship. Rectify all deficiencies disclosed by testing and retest the system or component to prove the monorail system is operational. The Contractor shall furnish loads for testing, operating personnel, instruments, and all other necessary apparatus. The the Owner will furnish loads for testing; the Contractor shall receive and transport the loads from a location not more than 100 miles (161 km) from the job site and shall return them to that location after the tests have been completed.
3. Test Data: Record test data on appropriate test record forms suitable for retention for the life of the monorail system. Record operating and startup current measurements for electrical equipment (motors and coils) using appropriate instrumentation (i.e., clamp-on ammeters). Compare recorded values with design specifications or manufacturer's recommended values; abnormal differences (i.e., greater than 10 percent from manufacturer's or design values) shall be justified or appropriate adjustments performed. In addition, high temperatures or abnormal operation of any equipment or machinery shall be noted, investigated, and corrected. Record hoist and trolley speeds during each test cycle.
4. Hook Test: Measure hook for hook throat spread before and after load test. Establish a throat dimension base measurement by installing two tram points and measuring the distance between these tram points (plus or minus 1/64 inch (0.4 mm)). Record this base dimension. Measure the distance between tram points before and after load test. An increase in the throat opening by more than 5 percent from the base measurement shall be cause for rejection.
5. No-Load Test
   a. Hoist: Raise the load hook the full operating lift distance and verify satisfactory operation of hoist, upper limit switch, lower limit switch, and the hoisting and lowering speeds. Operate the hoist at low and high speed in both directions.
   b. Trolley: Operate trolley assembly the full length of the monorail in both directions. Operate trolley at low and high speed in each direction. Verify satisfactory operation and verify trolley speed. Operate all rail switches.
6. Load Test: 125 Percent (plus 5 percent minus 0) of rated capacity
   a. Hoist Static Test: Raise test load approximately one foot above the floor and hold for 10 minutes. Observe load lowering that may occur which will indicate malfunction of hoisting component or brake. Lower the test load to the floor until the hoist line is slack.
   b. Hoist Dynamic Test: Raise the test load to approximately 5 feet (1.5 m) above the floor using both speed points in the process. Lower the load back to the floor using both speed points. Stop the test load at least once while lowering at high speed and observe proper brake operation. Wait 5 minutes, then repeat the above cycle.
   c. Load Brake Test: Raise test load approximately 5 feet (1.5 m). With the hoist controller in the neutral position, release the holding brake. The load brake should hold the test load. Again with the holding brake in the released position, start the test load down at low speed and return the controller to off position as the test load lowers. The load brake should prevent the test load from accelerating. NOTE: It is not necessary for the load brake to halt the downward motion of the test load.
   d. Loss of Power Test: Raise the test load approximately 3 feet (1 m) and while lowering test load at low speed, cut main power to hoist. Load should stop.
   e. Trolley Test: With test load hoisted to a height of one foot (300 mm) above the floor, operate trolley the full distance of the monorail in both directions using both speed points in the process. Observe for any malfunctioning of the trolley assembly and monorail system. Operate all rail switches.
   f. Rated Load Speed Test: With the hoist loaded to rated capacity, raise and lower the load verifying that the hoisting and lowering speeds are provided as specified. With the hoist loaded to rated capacity, operate trolley along the monorail beam verifying that the trolley

speed is provided as specified. Further, verify that the trolley stops in each direction within a distance (in feet) equal to 10 percent of rated capacity high speed (in feet per minute) when initially travelling at high speed and carrying the rated capacity load. Record voltage, amperage, hoisting and lowering speeds, trolley travel speed, and motor speed for each motor.

END OF SECTION 14610a

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SECTION 14610b - MONORAILS WITH MANUAL HOIST

1.1 GENERAL

A. Description Of Work
   1. This specification covers the furnishing and installation of materials for monorails with manual hoist. Products shall match existing materials and/or shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Verification Of Dimensions:
   1. The Contractor shall verify all building dimensions that relate to fabrication of the monorail system, and shall notify the the Owner of any discrepancy before the order to the monorail manufacturer is finalized.

C. Submittals
   1. Shop Drawings: Submit drawings showing the general arrangement of the track beam system, including curves and switches, clearances, principal dimensions, details of structural connections, and all component details. Manufacturer's catalog data will suffice for items of standard manufacturer.
   2. Design Data: Structural design calculations.
   3. Test Reports
      a. Hook and hook nut magnetic-particle tests.
      b. Monorail system load tests
   4. Certificates: Manual hoist load chain
   5. Operation and Maintenance Data
      a. Track beam system
      b. Hoist and trolley

D. Quality Assurance
   1. Certifications: Submit factory certification of load chain rated capacity.
   2. Design Data: Submit design calculations verifying the size of structural members, structural support fittings, rods, brackets, components, and lifting beams for the track beam system. The calculations shall include stress and loading diagrams. Submit calculations with monorail drawings.

1.2 PRODUCTS

A. Fabrication And Construction: Provide manual hoist and trolley, ANSI/ASME HST-2M, ANSI/ASME HST-3M, trolley suspension. Trolley and wheels shall be suitable for operation on the steel monorail track beam provided, and shall have not less than four wheels.
   1. Capacity: The hoist shall have a minimum rated capacity as required to meet project requirements. The monorail system shall have a minimum rated capacity as required to meet project requirements.
   2. Hook Lift: Shall be the manufacturer's standard. The hoist lift shall be at its highest point a minimum of 8 feet (2400 mm) above the finished floor and at its lowest point a minimum of 2 feet (600 mm) below the finished floor.
   3. Hooks: Shall be of the safety type with hook nuts keyed to hook shanks by means of a setscrew installed in a plane parallel to the longitudinal axis of the hook shank, or by any other similar easily removable securing device. All hook components shall be magnetic-particle inspected over the entire area in accordance with ASTM A 275/A 275M. The acceptance standard shall be one of no defects. A defect is defined as a linear indication revealed by magnetic-particle

inspection that is greater than 1/8 inch (3 mm) long whose length is equal to or is greater than three times its width.

4. Trolley: Shall be designed to operate from track beam section. Where two or more hoists are located on the same monorail beam, the trolleys shall be equipped with rubber bumper devices designed to prevent contact of any part or parts of the hoists.
5. Load Chain: High strength steel links, flexible; minimum safety factor of 5 to 1 based on ratio of minimum chain breaking load to the calculated load on the chain when the hoist is assumed loaded to rated capacity. Certification from hoist manufacturer of provided chain's breaking strength shall be submitted to the Owner and approved prior to final acceptance of hoist. Do not paint or coat the load chain.
6. Load Hooks and Load Hook Components
   a. Hook: Forged steel; complete with spring-loaded steel throat opening safety device. The hook shall be carried on suitably sealed or shielded anti-friction thrust bearings and shall swivel freely through 360 degrees rotation with full load without twisting chain.
      1) Disassembly. Hook and hook nut shall be capable of complete disassembly that enables access to all surfaces of the hook, including shank and hook nut for inspection purposes. Provision shall be made for the hook nut, or other hook-to-block fastener, to be keyed to hook shank by means of a set screw or similar, easily removable, securing device.
      2) Hook Non-Destructive Test. Each hook, including shank and hook nut, shall be inspected over the entire surface areas by magnetic particle inspection. If hook nut is not used, any device that functions the same as the hook nut shall be inspected by magnetic particle inspection.
         a) Procedure: Magnetic particle inspection shall be conducted in accordance with ASTM A 275/A 275M. This inspection shall be conducted at the factory of the hook manufacturer or hoist manufacturer. Alternately, a recognized independent testing lab may conduct the inspections if equipped and competent to perform such a service, and if approved by the the Owner.
         b) Acceptance Criteria: Defects found on the hook or hook nut shall result in rejection of defective items for use on furnished hoist. For this inspection, a defect is defined as a linear or non-linear indication for which the largest dimension is greater than 1/8 inch (3 mm). Weld repairs for defects on hook or hook nut will not be permitted.
         c) Test Report: A test report of the magnetic particle inspection of each hook and hook nut provided shall be submitted to and approved by the the Owner prior to final acceptance of hoist installation. Test reports shall be certified by the testing organization.

B. Monorail Track Beam System: Comply with MMA MH27.1 except as modified and supplemented herein.
   1. Patented Track: Provide specially designed trackage, e.g., patented track beam, curves, and switches constructed from welded steel components. The lower flange of the track section shall have flat wheel treads; minimum lower flange width of 3.25 inches (80 mm); chemical composition of 0.45 to 0.60 percent carbon content, 0.60 to 1.1 percent manganese content; and wheel treads shall be hardened to a minimum Brinell Hardness Number of 225. Upper flange and web of the track section shall be steel, continuously welded together or provided as one monolithic piece.
   2. Track Suspension: Provide means of suspending the monorail track system, including curves and switches from the structural supports. The suspension system shall be the sole responsibility of the track supplier; however, design shall be subject to the requirements specified herein.
      a. Cataloged Products: If possible, provide track manufacturer's standard cataloged devices for connection of the track to the indicated supporting structures. If track manufacturer's cataloged devices are not provided for this suspension system, complete shop drawings and calculations for the custom suspension device shall be submitted for review and approval by the the Owner. Track suspension devices which are not the track

manufacturer's cataloged products shall meet the additional requirements specified in Division 05 Section "Metal Fabrications".

b. Design: The suspension system shall be designed and constructed to ensure no impairment of the strength of track or the structural support. A hanger or suspension shall be located at each rack splice joint. Provide bracing to hold track sections in rigid alignment at all joints.

c. Suspension of Curves and Switches: Provide steel framing (structural supports), in addition to that indicated, as required by monorail curve and switch manufacturer to support curves and switches. The additional steel framing shall be the sole responsibility of the monorail supplier. Submit shop drawings and framing design calculations to the the Owner for approval.

d. Sway Bracing: Where the track is suspended from hanger rods, track shall be braced laterally and longitudinally to prevent sway.

e. Lock Nuts: Where the track is suspended from hanger rods, lock nuts or other means shall be provided to prevent the nuts from backing off the rods.

f. Multiple Suspension Devices: Where more than one suspension device attached to the track at a single point, the suspension devices shall be provided so that the loads shall be induced in each in proportion to the device's size.

3. Identification Plates: Provide identification plates of noncorrosive metal. Information and data on the plates shall include, in clearly legible permanent lettering, the manufacturer's name, model number, capacity rating, and other essential information. In addition, the monorail track beam system shall be furnished with identification plates showing the capacity of the system, which shall be legible from the floor and from either side of the monorail track beam.

C. Painting Of System: Provide manufacturer's standard painting or shop painting of components specified in this section; comply with the requirements specified in Division 07. Do not paint, coat, or galvanize load chain, load, hook nut, or load chain sheave.

1.3 EXECUTION

A. Erection And Installation: The Contractor shall erect and install the hoist trolley and monorail system in accordance with manufacturers written instructions, MMA MH27.1, and the contract drawings. The monorail supplier shall provide supervisory erection services. Welding new sections of monorail track to existing shall conform to AWS D1.1.

B. Field Inspection And Tests

1. Pre-Erection Inspection: Before erection, the Contractor and the manufacturer's representative shall jointly inspect the monorail and hoist systems and components at the job site to determine compliance with specifications and manufacturer's data and shop drawings as approved. The Contractor shall notify the the Owner 3 days before the inspection.

2. Operational Inspection and Load Tests: Upon completion, and before final acceptance, the hoist, trolley, and monorail shall be given the rated load test specified in ASME/ANSI B30.11, carrying 125 percent (plus 5 percent, minus 0 percent) of the rated capacity, and with the units spaced to obtain maximum possible loads in the monorail track beam systems. Hoists shall hold a static, as well as control a dynamic, 125 percent rated load. The systems shall be thoroughly tested in service to determine that each component of the system operates as specified, is properly installed and adjusted, and is free from defects in material, manufacture, installation, and workmanship. The Contractor shall furnish test loads, operating personnel, instruments, and all other necessary apparatus at no additional cost to the Owner. The test and final adjustments of the equipment will be under the supervision of the the Owner. The Contractor shall rectify any deficiencies found and completely retest work affected by such deficiencies.

END OF SECTION 14610b

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Task	Specification	Specification Description
14695	14610	Material Handling Hoists

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JOB ORDER CONTRACT

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05120	Structural Steel
05140	Structural Aluminum
05410	Cold-Formed Metal Framing
05500	Metal Fabrications
05510	Metal Stairs
05510a	Fabricated Spiral Stairs
05521	Pipe And Tube Railings
05530	Gratings
05720	Ornamental Metal
05720a	Miscellaneous Ornamental Metals
05720b	Ornamental Railings
05730	Ornamental Formed Metal
05805	Architectural Joint Systems

06 Wood And Plastic

06110	Rough Carpentry
06110a	Rough Carpentry Renovation
06130	Heavy Timber Construction
06150	Exterior Rough Carpentry
06150a	Wood Decking
06160	Sheathing
06170	Metal-Plate-Connected Wood Trusses
06180	Timber Bridge Components

06180a Structural Glued-Laminated Timber
06410 Residential Cabinets
06415 Stone Countertops
06415a Solid Polymer Fabrications
06420 Paneling
06420a Plastic Paneling
06450 Exterior Architectural Woodwork
06510 Plastic Lumber
06510a Composite Plastic Lumber
06510b Structural Plastic Lumber
06520 Pultruded Fiberglass Structural Shapes
06520a Pultruded Fiberglass Industrial Grating

07 Thermal And Moisture Protection

07110 Bituminous Dampproofing
07110a Cold Fluid-Applied Waterproofing
07110b Hot Fluid-Applied Rubberized Asphalt Waterproofing
07130 Bituminous Waterproofing
07130a Self-Adhering Sheet Waterproofing
07130b Elastomeric Sheet Waterproofing
07160 Modified Cement Waterproofing
07160a Crystalline Waterproofing
07160b Metal-Oxide Waterproofing
07170 Bentonite Waterproofing
07190 Water Repellents
07210 Building Insulation
07212 Built-Up Asphalt Roofing
07212a Built-Up Coal-Tar Roofing
07212b EPDM Membrane Roofing
07212c CSPE Membrane Roofing
07212d APP-Modified Bituminous Membrane Roofing
07212e SBS-Modified Bituminous Membrane Roofing
07212f Modified Bitumous Protected Membrane Roofing
07213 Fluid-Applied Protected Membrane Roofing
07240 Polymer-Based Exterior Insulation And Finish System (EIFS)
07240a Water-Drainage Exterior Insulation and Finish System (EIFS)
07310 Asphalt Shingles
07310a Metal Shingles
07310b Slate Shingles
07310c Wood Shingles And Shakes
07310d Composite Rubber Shingles
07310e Clay Roof Tiles
07322 Concrete Roof Tiles
07410 Metal Roof Panels
07410a Sheet Metal Roofing
07460 Metal Wall Panels
07460a Insulated-Core Metal Wall Panels
07460b Metal Plate Wall Panels
07460c Siding
07501 Preparation for Re-Roofing
07533 Polyvinyl-Chloride (PVC) Roofing
07533a Thermoplastic Polyolefin (TPO) Roofing
07620 Sheet Metal Flashing And Trim
07631 Manufactured Roof Specialties
07670 Roof Accessories
07714 Roof Expansion Assemblies
07810 Sprayed Fire-Resistive Materials
07820 Board Fire Protection
07840 Through-Penetration Firestop Systems
07840a Fire-Resistive Joint Systems
07840b Firestopping
07920 Joint Sealants

08 Doors And Windows

08110	Steel Doors And Frames
08110a	Stainless Steel Doors And Frames
08110b	Flush Wood Doors
08210	Wood Doors
08210a	Stile And Rail Wood Doors
08220	Steel Entry Doors
08220a	Fiberglass Reinforced Plastic (FRP) Doors and Frames
08220b	Insulated Fiberglass Doors and Frames
08220c	Fiberglass Reinforced Polyester (FRP) Flush Doors
08305	Access Doors And Frames
08310	Sliding Metal Fire Doors
08320	Security Window Screens and Doors
08320a	Detention Doors And Frames
08320b	Security Grilles
08330	Overhead Coiling Doors
08332	Overhead Coiling Grilles
08332a	Side Coiling Grilles
08350	Folding Doors
08354	Sound Control Doors
08361	Sectional Overhead Doors
08370	Sliding Aluminum-Framed Glass Doors
08370a	Sliding Wood-Framed Glass Doors
08381	Flexible Doors
08390	Aluminum Storm Doors
08390a	Steel Storm Doors
08510	Steel Windows
08520	Aluminum Windows
08520a	Aluminum Replacement Windows
08550	Wood Windows
08560	Vinyl Windows
08580	Security Windows
08620	Unit Skylights
08630	Metal-Framed Skylights
08710	Door Hardware
08710a	Detention Door Hardware
08716	Automatic Door Operators
08810	Glazing
08830	Mirrors
08840	Plastic Glazing
08860	Security Glazing
08861	Fragment Retention Film For Glass
08912	Glazed Aluminum Curtain Walls
08912a	Structural-Sealant-Glazed Curtain Walls
08912b	Sloped Glazing Assemblies
08950	Structured-Polycarbonate-Panel Assemblies
08950a	Fiberglass-Sandwich-Panel Assemblies

09 Finishes

09110	Non-Load-Bearing Steel Framing
09205	Gypsum Veneer Plaster
09205a	Portland Cement Plaster
09205b	Gypsum Board Renovation
09205c	Lath and Plaster Renovation
09210	Gypsum Plaster
09250	Gypsum Board
09250a	Gypsum Board Shaft-Wall Assemblies
09310	Ceramic Tile
09410	Portland Cement Terrazzo Flooring
09430	Resinous Matrix Terrazzo Flooring
09511	Acoustical Panel Ceilings
09512	Acoustical Tile Ceilings
09513	Acoustical Metal Pan Ceilings
09513a	Linear Metal Ceilings
09620	Resilient Floor Tile

09640 Wood Flooring
09640a Wood Sports-Floor Assemblies
09650 Resilient Wall Base And Accessories
09650a Linoleum Floor Coverings
09650b Resinous Flooring
09660 Static-Control Resilient Floor Coverings
09680 Carpet
09680a Carpet Tile
09720 Wall Coverings
09725 Fabric-Wrapped Panels
09835 Acoustical Wall Panels
09900 Painting Restoration
09910 Exterior Painting
09910a Wood Stains and Transparent Finishes
09910b High-Temperature-Resistant Coatings
09920 Interior Painting
09920a Multicolored Interior Coatings
09930 Floor Treatment Refinishing Wood Floors
09930a High-Performance Coatings
09949 Gilding

10 Specialties

10110 Visual Display Surfaces
10160 Toilet Compartments
10170 Solid Surface Material Toilet Compartments
10185 Shower and Dressing Compartments
10185a Cubicle Curtains and Tracks
10210 Louvers And Vents
10261 Impact-Resistant Wall Protection
10271 Access Flooring
10292 Oriented Flexible Netting Bird Barrier
10351 Flagpoles
10431 Signage
10454 Turnstiles
10503 Metal Lockers
10505 Solid Plastic Lockers
10506 Wire Basket Lockers
10521 Fire Extinguisher Cabinets
10522 Fire Extinguishers
10531 Extruded Aluminum Walkway Cover
10535 Awnings
10552 Postal Specialties
10810 Toilet And Bath Accessories
10810a Detention Toilet Accessories
10811 Bath Accessories

11 Equipment

11132 Projection Screens
11161 Loading Dock Equipment
11191 Detention Furniture
11410 Food Service Equipment
11415 Unit Kitchens
11421 Residential Appliances
11475 Residential Casework
11910 Refrigerators
11910a Gas Ranges
11910b Electric Ranges
11910c Range Hoods

12 Furnishings

12201	Draperies and Tracks
12210	Horizontal Louver Blinds
12210a	Vertical Louver Blinds
12210b	Roller Shades
12210c	Pleated Shades
12315	Kitchen Casework, Stainless Steel Cabinets
12480	Floor Mats And Frames
12480a	Foot Grilles
12610	Fixed Audience Seating

13 Special Construction

13121	Metal Building Systems
13281	Removal Of Friable Asbestos-Containing Materials
13281a	Removal Of Nonfriable Asbestos-Containing Materials
13281b	Encapsulation (Lock-Down) Of Asbestos-Containing Materials
13283	Mold Remediation
13285	Removal And Disposal Of Lead-Containing Paint
13285a	Lead Paint Related Abatement Procedures
13285b	XRF Testing For Lead-Based Paint
13285c	Lead Dust Wipe, Air And Tclp Sampling And Analysis
13287	Bird And Bird Waste Abatement
13650	Photovoltaic Energy Equipment
13700	Security Access
13720	Perimeter Security
13720a	Intrusion Detection
13740	Video Surveillance
13810	Clock And Program Control
13852	Digital, Addressable Fire-Alarm System
13852a	Zoned (DC Loop) Fire-Alarm System
13920	Electric-Drive, Centrifugal Fire Pumps
13920a	Diesel-Drive, Centrifugal Fire Pumps
13920b	Pressure-Maintenance Pumps
13920c	Controllers for Fire-Pump Drivers
13930	Wet-Pipe Fire-Suppression Sprinklers
13935	Dry-Pipe Fire-Suppression Sprinklers
13955	Foam Fire Extinguishing
13965	Clean-Agent Extinguishing Systems
13975	Fire-Suppression Standpipes

14 Conveying Systems

14240	Hydraulic Elevators
14240a	Hydraulic Freight Elevators
14290	Electric Traction Elevators
14310	Escalators
14320	Moving Walks
14420	Wheelchair Lifts
14610	Material Handling Hoists
14610a	Monorails With Electric Powered Hoists
14610b	Monorails With Manual Hoist

15 Mechanical

15010	Commissioning of HVAC
15041	Sequence Of Operation
15042	Identification for Plumbing Piping and Equipment
15042a	Identification for HVAC Piping and Equipment

15043	Testing, Adjusting, And Balancing
15048	Air Duct Cleaning
15061	Domestic Water Piping
15061a	Sanitary Waste And Vent Piping
15061b	Storm Drainage Piping
15061c	Hydronic Piping
15061d	Steam And Condensate Piping
15061e	Refrigerant Piping
15061f	Facility Fuel-Oil Piping
15061g	General-Service Compressed-Air Piping
15063	Compressed-Air Piping For Laboratory And Healthcare Facilities
15063a	Vacuum Piping For Laboratory And Healthcare Facilities
15063b	Gas Piping For Laboratory And Healthcare Facilities
15064	Radiant Heating Piping
15080	Meters and Gages for Plumbing Piping
15080a	Meters and Gages for HVAC Piping
15083	Hydronic Pumps
15094	Hangers and Supports for Plumbing Piping and Equipment
15094a	Hangers and Supports for HVAC Piping and Equipment
15101	General-Duty Valves for Plumbing Piping
15101a	General-Duty Valves for HVAC Piping
15110	Storm Drainage Piping Specialties
15143	Electric-Drive, Vertical-Turbine Fire Pumps
15143a	Diesel-Drive, Vertical-Turbine Fire Pumps
15145	Sump Pumps
15161	Vibration And Seismic Controls For Fire-Suppression Piping And Equipment
15161a	Vibration And Seismic Controls For Plumbing Piping And Equipment
15161b	Vibration And Seismic Controls For HVAC Piping And Equipment
15162	Expansion Fittings and Loops for Plumbing Piping
15162a	Expansion Fittings and Loops for HVAC Piping
15182	Fire-Suppression Systems Insulation
15182a	Plumbing Insulation
15190	HVAC Insulation
15230	Water Distribution Pumps
15230a	Packaged Booster Pumps
15253	Water Softeners
15262	HVAC Water Treatment
15310	Packaged Sewage Pumping Stations
15310a	Lift Station
15310b	Sewage Pumps
15320	Interceptors
15341	Chemical-Waste Systems for Laboratory and Healthcare Facilities
15424	Electric, Domestic Water Heaters
15424a	Fuel-Fired, Domestic Water Heaters
15425	Domestic Water Heat Exchangers
15428	Oil/Water Separator
15451	Plumbing Fixtures
15451a	Medical Plumbing Fixtures
15451b	Security Plumbing Fixtures
15453	Drinking Fountains And Water Coolers
15622	Fire-Tube Boilers
15624	Condensing Boilers
15624a	Water-Tube Boilers
15639	Cast-Iron Boilers
15642	Feedwater Equipment
15642a	Deaerators
15655	Centrifugal Water Chillers
15655a	Rotary-Screw Water Chillers
15661	Condensing Units
15661a	Air-Cooled Condensers
15661b	Split-System Air-Conditioning Units
15671	Scroll Water Chillers
15672	Reciprocating Water Chillers
15675	Fan-Coil Units
15676	Indirect-Fired Absorption Water Chillers
15676a	Direct-Fired Absorption Water Chillers
15680	Cooling Towers
15699	Refrigerant Detection And Alarm
15720	Steam Condensate Pumps
15732	Heat Exchangers

15734	Air-To-Air Energy Recovery Units
15745	Radiant Heating and Cooling Units
15745a	Radiant-Heating Electric Panels
15750	Air Coils
15760	Fuel-Fired Unit Heaters
15760a	Unit Heaters
15770	Direct-Fired, Makeup Air Units
15770a	Indirect-Fired, Packaged H&V Units
15770b	Self-Contained Air-Conditioners
15773	Computer-Room Air-Conditioners
15781	Humidifiers
15811	Furnaces
15821	Centrifugal Fans
15826	Air Curtains
15827	Axial Fans
15828	Packaged, Outdoor, Central-Station Air-Handling Units
15828a	Intake and Relief Ventilators
15834	Modular Indoor Central-Station Air-Handling Units
15840	Metal Ducts
15840a	Nonmetal Ducts
15840b	HVAC Casings
15855	Breechings, Chimneys, And Stacks
15860	Duct Accessories
15861	Draft Control Devices
15867	Diffusers, Registers, And Grilles
15869	Air Terminal Units
15880	Air Filters
15880a	Gas-Phase Air Filtration
15880b	Electronic Air Cleaners
15883	High-Efficiency Particulate Filtration
15910	HVAC Instrumentation And Controls
15910a	Enclosed Controllers
15915	General-Service Packaged Air Compressors and Receivers

16 Electrical

16101	Electrical Identification
16112	Enclosed Bus Assemblies
16113	Underfloor Raceways For Electrical Systems
16120	Common Work Results for Electrical
16120a	Common Work Results for Communications
16120b	Common Work Results for Electronic Safety and Security
16120c	Conductors And Cables
16120d	Undercarpet Cables
16120e	Control-Voltage Electrical Power Cables
16120f	Medium-Voltage Cables
16120g	Communications Equipment Room Fittings
16120h	Communications Backbone Cabling
16120i	Communications Horizontal Cabling
16120j	Conductors and Cables for Electronic Safety and Security
16130	Raceways And Boxes
16131	Electrical Renovation
16139	Cable Trays
16140	Wiring Devices
16181	Fuses
16190	Hangers And Supports For Electrical Systems
16190a	Vibration And Seismic Controls For Electrical Systems
16220	Packaged Engine Generators
16251	Enclosed Switches And Circuit Breakers
16251a	Transfer Switches
16265	Static Uninterruptible Power Supply
16265a	Central Battery Inverters
16330	Medium-Voltage Transformers
16330a	Low-Voltage Transformers
16350	Switchgear
16430	Overhead Electrical Distribution
16452	Lightning Protection
16452a	Grounding And Bonding

16470	Electricity Metering
16470a	Switchboards
16471	Panelboards
16480	Power Distribution Units
16501	Removal of Fluorescent Light Ballasts/Capacitors and Fluorescent Light Tubes
16521	Exterior Lighting
16526	Sports Lighting
16555	Stage Lighting
16622	Nurse Call
16622a	Public Address and Mass Notification Systems
16651	Transient Voltage Suppression
16720	Intercommunications and Program Systems
16730	Educational Intercommunications and Program Systems
16795	Loose-Tube Gel-Filled Fiber Optic Cables
16900	Electrical Power Monitoring And Control
16920	Power Factor Correction Capacitors
16920a	Motor-Control Centers
16930	Lighting Controls
16930a	Lighting Control Devices
16930b	Central Dimming Controls
16930c	Modular Dimming Controls

SECTION 15010 - COMMISSIONING OF HVAC

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for commissioning of HVAC. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment.

C. Definitions
1. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
2. CxA: Commissioning Authority.
3. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.
4. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

D. Contractor's Responsibilities
1. Perform commissioning tests at the direction of the CxA.
2. Attend construction phase controls coordination meeting.
3. Attend testing, adjusting, and balancing review and coordination meeting.
4. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
5. Provide information requested by the CxA for final commissioning documentation.
6. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

E. CxA'S Responsibilities
1. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
2. Direct commissioning testing.
3. Verify testing, adjusting, and balancing of Work are complete.
4. Provide test data, inspection reports, and certificates in Systems Manual.

F. Commissioning Documentation
1. Provide the following information to the CxA for inclusion in the commissioning plan:
   a. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
   b. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
   c. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
   d. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
   e. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
   f. Test and inspection reports and certificates.

g. Corrective action documents.
h. Verification of testing, adjusting, and balancing reports.

G. Submittals
1. Certificates of readiness.
2. Certificates of completion of installation, prestart, and startup activities.

1.2 PRODUCTS (Not Used)

1.3 EXECUTION

A. Testing Preparation
1. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
2. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
3. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
4. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
5. Inspect and verify the position of each device and interlock identified on checklists.
6. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
7. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

B. Testing And Balancing Verification
1. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.
2. Notify the CxA at least 10 days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.
3. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.
   a. The CxA will notify testing and balancing Contractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
   b. The testing and balancing Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
   c. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
   d. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

C. General Testing Requirements
1. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
2. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.

3. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
4. The CxA along with the HVAC&R Contractor, testing and balancing Contractor, and HVAC&R Instrumentation and Control Contractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.
5. Tests will be performed using design conditions whenever possible.
6. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
7. The CxA may direct that set points be altered when simulating conditions is not practical.
8. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
9. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
10. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

D. HVAC&R Systems, Subsystems, And Equipment Testing Procedures
1. Boiler Testing and Acceptance Procedures: Testing requirements are specified in Division 15. Provide submittals, test data, inspector record, and boiler certification to the CxA.
2. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Division 15 Section(s) "Hvac Instrumentation And Controls" AND "Sequence Of Operation". Assist the CxA with preparation of testing plans.
3. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in Division 15. HVAC&R Contractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:
   a. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
   b. Description of equipment for flushing operations.
   c. Minimum flushing water velocity.
   d. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.
4. Energy Supply System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of oil, gas, coal, steam, hot-water, and solar systems and equipment at the direction of the CxA. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.
5. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of chillers, cooling towers, refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.
6. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.
7. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.

END OF SECTION 15010

SECTION 15041 - SEQUENCE OF OPERATION

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for sequence of operation. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. This Section includes control sequences for HVAC systems, subsystems, and equipment.

C. Definitions
1. DDC: Direct digital control.
2. VAV: Variable air volume.

D. Heating Control Sequences
1. Heating-Water Supply Temperature Control:
a. Input Device: Thermostat **OR** Thermistor temperature sensor **OR** Resistance temperature sensor, **as directed**.
b. Output Device: Control valve.
c. Action: Modulate control valve to maintain heating-water supply temperature.
d. Display:
1) Heating-water supply temperature.
2) Heating-water supply temperature set point.
3) Control-valve position.
2. Heating-Water Supply Temperature Reset:
a. Input Device: Electric, outdoor-air-reset controller **OR** Outdoor-air sensor, **as directed**.
b. Output Device: Unitary controller **OR** DDC system software, **as directed**.
c. Action: Reset heating-water supply temperature in straight-line relationship with outdoor-air temperature for the following conditions:
1) 195 deg F (90 deg C) heating water when outdoor-air temperature is minus 30 deg F (minus 35 deg C).
2) 130 deg F (54 deg C) heating water when outdoor-air temperature is 75 deg F (24 deg C).
3) 150 deg F (65 deg C) minimum, heating-water temperature.
d. Display:
1) Outdoor-air temperature.
2) Heating-water supply temperature.
3) Heating-water supply temperature set point.
3. Control Primary Circulating Pump(s):
a. Input Device: Thermostat **OR** DDC system, **as directed**.
b. Output Device: Starter **OR** DDC system command to starter, **as directed**, relay.
c. Action: Energize pump(s) at outdoor-air temperatures below 65 deg F (18 deg C).
d. Display:
1) Outdoor-air temperature.
2) Operating status of primary circulating pump(s).

E. Central Refrigeration Equipment Sequences
1. Start and Stop Condenser-Water Pump(s):
a. Enable: Allow pump to start when water is in cooling tower:
1) Input Device: Water pressure transducer.

2) Output Device: Hard wired through motor starter; DDC system binary output, **as directed**.
3) Action: Confirm water in cooling-tower sump.

b. Enable: When outdoor-air temperature conditions are met:
1) Input Device: Space thermostat **OR** DDC system outdoor-air temperature, **as directed**.
2) Output Device: Hard wired through motor starter; DDC system binary output, **as directed**.
3) Action: Confirm outdoor-air temperature is above 50 deg F (10 deg C).

c. Enable: When demand conditions are met:
1) Input Device: DDC system software demand.
2) Action: Confirm cooling demand from ventilation system(s).

d. Initiate:
1) Input Device: Time clock **OR** DDC system time schedule, **as directed**.
2) Output Device: Time clock **OR** Binary output, **as directed**.
3) Action: Energize pump(s).

e. Display:
1) Low-level cooling-tower sump alarm.
2) Outdoor-air temperature.
3) Cooling (software) demand indication.
4) Time and time schedule.
5) Condenser-water pump(s) on-off status.
6) Condenser-water pump(s) on-off indication.

2. Start and Stop Chilled-Water Pump(s):
a. Input Device: Flow switch in condenser-water circuit.
b. Output Device: Starter **OR** DDC system command to starter, **as directed**, relay.
c. Action: Energize pump(s).
d. Display:
1) Chilled-water flow indication.
2) Chilled-water pump(s) on-off status.
3) Chilled-water pump(s) on-off indication.

3. Start and Stop Cooling-Tower Fans(s):
a. Input Device: Flow switch in condenser-water circuit.
b. Output Device: Starter **OR** DDC system command to starter, **as directed**, relay.
c. Action: Energize fan(s).
d. Display:
1) Condenser-water flow indication.
2) Cooling-tower fan(s) on-off indication.

4. Start and Stop Refrigeration Machine(s):
a. Input Device: Flow switch in condenser-water circuit. Flow switch in chilled-water circuit, **as directed**.
b. Output Device: Refrigeration **OR** DDC system command to refrigeration, **as directed**, machine terminal strip.
c. Action: Energize refrigeration machine(s) internal control circuit.
d. Display:

e. Condenser-water flow indication.
f. Chilled-water flow indication.
g. Refrigeration machine on-off indication.
h. Chilled-water supply and return temperature.
i. Chilled-water temperature control-point adjustment.

5. Start and Stop Chiller(s):
a. Input Device: Flow switches in condenser-water and chilled-water circuit.
b. Output Device: Chiller **OR** DDC system command to chiller, **as directed**, terminal strip.
c. Action: Energize chiller internal control circuit.

d. Display:
   1) Condenser-water flow indication.
   2) Chilled-water flow indication.
   3) Chiller(s) on-off status.
   4) Chiller(s) on-off indication.
   5) Chilled-water supply and return temperature.
   6) Chilled-water temperature control-point adjustment.

6. Alternate Chiller(s):
   a. Input Device: Electric alternator **OR** DDC system software, **as directed**.
   b. Output Device: Chiller **OR** DDC system command to chiller, **as directed**, terminal strip.
   c. Action: Operate chiller(s) on lead-lag, alternating each startup.
      OR
      Action: Adding and dropping chiller(s) as follows: <**Insert sequence and parameters**.>
   d. Display: Chiller(s) on-off indication.
7. Alarm Chiller(s) Start Failure:
   a. Input Device: Chiller control panel terminal strip contact **OR** software signal, **as directed**.
   b. Output Device: Analog control panel **OR** DDC system alarm, **as directed**.
   c. Action: Signal alarm.
   d. Display: Chiller "failure-to-start" indication.
8. Chilled-Water Level:
   a. Input Device: Expansion tank level switch **OR** liquid sensor, **as directed**.
   b. Output Device: Electric relay signal to alarm panel **OR** DDC system alarm, **as directed**.
   c. Action: Signal alarm.
   d. Display: Expansion tank low-level alarm.
9. Chilled-Water Supply Temperature:
   a. Input Device: Temperature sensor **OR** transmitter, **as directed**, in common chilled-water supply piping.
   b. Output Device: Integral chiller controls **OR** DDC system signal to chiller control panel, **as directed**.
   c. Action: Maintain constant leaving chilled-water temperature reset according to highest cooling demand, **as directed**.
      1) Display: Chilled-water supply temperature.
10. Condenser-Water Temperature:
   a. Input Device: Temperature sensor **OR** transmitter, **as directed**, in cooling-tower sump.
   b. Output Device: Bypass control valve **OR** Cooling-tower fan starter relay **OR** DDC system command to cooling-tower fan starter relay, **as directed**.
   c. Action: Modulate control valve open to cooling tower and closed to bypass and cycle tower fan(s) on and off **OR** and to low speed and then to high speed, **as directed**, to maintain 65 deg F (18 deg C) **OR** 70 deg F (21 deg C), **as directed**, sump temperature. Close valve when unoccupied, **as directed**.
   d. Display:
      1) Condenser-water sump (return) control-point temperature.
      2) Condenser-water sump (return) temperature.
      3) Control-valve position.
      4) Cooling-tower fan(s) on-off indication.
      5) Condenser-water supply temperature.
11. Cooling-Tower Sump Heater:
   a. Input Device: Sump temperature sensor **OR** transmitter, **as directed**.
   b. Output Device: Electric relay **OR** DDC system command to electric relay**,** as directed**,** and solenoid valve, **as directed**.
   c. Action: Energize sump heater; drain sump on low temperature, **as directed**.
   d. Display:
      1) Cooling-tower sump temperature.
      2) Cooling-tower sump heater on-off indication.
      3) Cooling-tower dump indication.
12. Operator Station Display: Indicate the following on operator workstation display terminal:

a. DDC system graphic.
b. DDC system status, on-off.
c. Low-level cooling-tower sump alarm.
d. Outdoor-air temperature.
e. Cooling (software) demand indication.
f. Time and time schedule.
g. Condenser-water pump(s) on-off status.
h. Condenser-water pump(s) on-off indication.
i. Condenser-water flow indication.
j. Chilled-water pump(s) on-off status.
k. Chilled-water pump(s) on-off indication.
l. Cooling-tower fan(s) on-off indication.
m. Chilled-water flow indication.
n. Refrigeration machine on-off indication.
o. Chilled-water supply temperature.
p. Chilled-water return temperature.
q. Chilled-water temperature control-point adjustment.
r. Chiller(s) on-off status.
s. Chiller(s) on-off indication.
t. Chiller "failure-to-start" indication.
u. Expansion tank low-level alarm.
v. Condenser-water sump (return) control-point temperature.
w. Condenser-water sump (return) temperature.
x. Condenser-water control-valve position.
y. Cooling-tower fan(s) on-off indication.
z. Condenser-water supply temperature.
aa. Cooling-tower sump temperature.
bb. Cooling-tower sump heater on-off indication.
cc. Cooling-tower dump indication.
dd. Chilled-water pressure drop through chiller.
ee. Entering condenser-water temperature.
ff. Leaving condenser-water temperature.
gg. Condenser-water pressure drop through chiller.
hh. Chiller condenser-water supply and return temperature.
ii. Chiller chilled-water supply and return temperature.
jj. System capacity in tons.

F. Air-Handling-Unit Control Sequences
1. Start and Stop Supply Fan(s):
a. Enable: Freeze Protection:
1) Input Device: Duct-mounted averaging element thermostat, located before supply fan.
2) Output Device: Hard wired through motor starter; analog alarm panel **OR** DDC system alarm, **as directed**.
3) Action: Allow start if duct temperature is above 37 deg F (3 deg C); signal alarm if fan fails to start as commanded.
b. Enable: High-Temperature Protection:
1) Input Device: Duct-mounted thermostat, located in return air.
2) Output Device: Hard wired through motor starter; analog alarm panel **OR** DDC system alarm, **as directed**.
3) Action: Allow start if duct temperature is below 300 deg F (150 deg C).
c. Enable: Smoke Control:
1) Input Device: Duct-mounted smoke detector, located in return **OR** supply, **as directed**, air.

2) Output Device: Hard wired through motor starter; analog alarm panel **OR** DDC system alarm, **as directed**.
3) Action: Allow start if duct is free of products of combustion.

d. Initiate: Occupied Time Schedule:
1) Input Device: Time clock **OR** DDC system time schedule, **as directed**.
2) Output Device: Time clock **OR** Binary output, **as directed**, to motor starter.
3) Action: Energize fan(s).

e. Initiate: Unoccupied Time Schedule:
1) Input Device: Room thermostat **OR** DDC system demand, **as directed**.
2) Output Device: Room thermostat **OR** Binary output, **as directed**, to motor starter.
3) Action: Energize fan(s).

f. Unoccupied Ventilation:
1) Input Device: Time clock and room thermostat **OR** DDC system time schedule and output, **as directed**.
2) Output Device: Room thermostat **OR** DDC system binary output, **as directed**, to motor starter.
3) Action: Cycle fan(s) during unoccupied periods.

g. Display: Supply-fan on-off indication.

2. Supply Fan(s) Variable-Volume Control:

a. Occupied Time Schedule:
1) Input Device: Time clock **OR** DDC system time schedule, **as directed**.
2) Output Device: Time clock **OR** Binary output, **as directed**.
3) Action: Enable control.

b. Volume Control (for fans equipped with variable inlet vanes):
1) Input Device: Static-pressure transmitter **OR** Differential-pressure switch, **as directed**, sensing supply-duct static pressure referenced to conditioned-space static pressure.
2) Output Device: Receiver controller **OR** DDC system analog output **OR** DDC system analog output to digital-to-pneumatic transducer, **as directed**, to modulating damper actuator. Set inlet guide vanes to minimum **OR** closed, **as directed**, position when fan is stopped.
3) Action: Maintain constant supply-duct static pressure.

c. Volume Control (for fans equipped with variable-speed drives):
1) Input Device: Static-pressure transmitter **OR** Differential-pressure switch, **as directed**, sensing supply-duct static pressure referenced to conditioned-space static pressure.
2) Output Device: Receiver controller **OR** DDC system analog output, **as directed**, to motor speed controller. Set variable-speed drive to minimum speed when fan is stopped.
3) Action: Maintain constant supply-duct static pressure.

d. High Pressure:
1) Input Device: Static-pressure transmitter sensing supply-duct static pressure referenced to static pressure outside the duct.
2) Output Device: Receiver controller **OR** DDC system binary output, **as directed**, to alarm panel **OR** motor starter, **as directed**.
3) Action: Stop fan and signal alarm when static pressure rises above excessive-static-pressure set point.

e. Display:
1) Supply-fan-discharge static-pressure indication.
2) Supply-fan-discharge static-pressure set point.
3) Supply-fan airflow rate.
4) Supply-fan inlet vane position **OR** speed, **as directed**.

3. Start and Stop Return Fan(s):

a. Initiate: Occupied Time Schedule:
1) Input Device: Time clock **OR** DDC system time schedule, **as directed**.
2) Output Device: Time clock **OR** Binary output, **as directed**, to motor starter.

3) Action: Energize fans when supply fans are energized.

b. Initiate: Unoccupied Time Schedule:
1) Input Device: Room thermostat **OR** DDC system demand, **as directed**.
2) Output Device: Room thermostat **OR** Binary output, **as directed**, to motor starter.
3) Action: Energize fans when supply fans are energized.

c. Unoccupied Ventilation:
1) Input Device: Time clock and room thermostat **OR** DDC system time schedule and output, **as directed**.
2) Output Device: Room thermostat **OR** DDC system binary output, **as directed**, to motor starter.
3) Action: Cycle fan(s) during unoccupied periods.

d. Display: Return-fan on-off indication.

4. Return Fan(s) Variable-Volume Control:

a. Occupied Time Schedule:
1) Input Device: Time clock **OR** DDC system time schedule, **as directed**.
2) Output Device: Time clock **OR** Binary output, **as directed**.
3) Action: Enable control.

b. Volume Control (for fans equipped with variable inlet vanes):
1) Input Device: Static-pressure transmitter **OR** Differential-pressure switch, **as directed**, sensing building static pressure referenced to outdoor static pressure.
2) Output Device: Receiver controller **OR** DDC system analog output **OR** DDC system analog output to digital-to-pneumatic transducer, **as directed**, to modulating damper actuator. Set inlet guide vanes to minimum **OR** closed, **as directed**, position when fan is stopped.
3) Action: Maintain constant building static pressure.

c. Volume Control (for fans equipped with variable-speed drives):
1) Input Device: Static-pressure transmitter **OR** Differential-pressure switch, **as directed**, sensing building static pressure referenced to outdoor static pressure.
2) Output Device: Receiver controller **OR** DDC system analog output, **as directed**, to motor speed controller. Set variable-speed drive to minimum speed when fan is stopped.
3) Action: Maintain constant building static pressure.

d. Display:
1) Return-air static-pressure indication.
2) Return-air static-pressure set point.
3) Return-fan airflow rate.
4) Return-fan inlet vane position **OR** speed, **as directed**.
5) Building static-pressure indication.
6) Building static-pressure set point.

5. Return Fan(s) Variable-Volume Control:

a. Occupied Time Schedule:
1) Input Device: Time clock **OR** DDC system time schedule, **as directed**.
2) Output Device: Time clock **OR** Binary output, **as directed**.
3) Action: Enable control.

b. Volume Control (for fans equipped with variable inlet vanes):
1) Input Device: Static-pressure transmitter **OR** Differential-pressure switch, **as directed**, sensing building static pressure referenced to outdoor static pressure.
2) Output Device: Receiver controller **OR** DDC system analog output **OR** DDC system analog output to digital-to-pneumatic transducer, **as directed**, to modulating damper actuator. Set inlet guide vanes to minimum **OR** closed, **as directed**, position when fan is stopped.
3) Action: Maintain constant building static pressure.

c. Volume Control (for fans equipped with variable-speed drives):
1) Input Device: Static-pressure transmitter **OR** Differential-pressure switch, **as directed**, sensing building static pressure referenced to outdoor static pressure.

2) Output Device: Receiver controller **OR** DDC system analog output, **as directed**, to motor speed controller. Set variable-speed drive to minimum speed when fan is stopped.
3) Action: Maintain constant building static pressure.

d. Display:
1) Return-fan-discharge static-pressure indication.
2) Return-fan-discharge static-pressure set point.
3) Return-fan airflow rate.
4) Return-fan inlet vane position **OR** speed, **as directed**.

6. Preheat Coil:
a. Freeze Protection:
1) Input Device: Duct-mounted averaging element thermostat, located after preheat coil.
2) Output Device: Hard wired through motor starter; analog alarm panel **OR** DDC system alarm, **as directed**.
3) Action: Allow start if duct temperature is above 33 deg F (1 deg C).

b. Occupied Time Schedule:
1) Input Device: Time clock **OR** DDC system time schedule, **as directed**.
2) Output Device: Time clock **OR** Binary output, **as directed**, to motor starter.
3) Action: Energize coil circulating pump(s).

c. Supply **OR** Discharge, **as directed**,-Air Temperature:
1) Input Device: Time clock and duct-mounted thermostat **OR** DDC system time schedule and electronic temperature sensor, **as directed**.
2) Output Device: Modulating control valve.
3) Action: Maintain air temperature set point of 55 deg F (13 deg C).

d. Unoccupied Time Schedule:
1) Input Device: Time clock and duct-mounted thermostat mounted in outdoor air **OR** DDC system time schedule and outdoor-air temperature, **as directed**.
2) Output Device: Time clock **OR** Binary output, **as directed**, to motor starter.
3) Action: Energize coil circulating pump(s) when outdoor-air temperature falls below 35 deg F (2 deg C).

e. Display:
1) Preheat-coil air-temperature indication.
2) Preheat-coil air-temperature set point.
3) Preheat-coil pump operation indication.
4) Preheat-coil control-valve position.

7. Mixed-Air Control:
a. Occupied Time Schedule:
1) Input Device: Time clock **OR** DDC system time schedule, **as directed**.
2) Output Device: Pneumatic relay **OR** DDC system output, **as directed**.
3) Action: Enable control.

b. Minimum Position:
1) Input Device: Time clock **OR** DDC system time schedule, **as directed**.
2) Output Device: Receiver controller **OR** DDC system analog output **OR** DDC system analog output to digital-to-pneumatic transducer, **as directed**, to modulating damper actuator(s).
3) Action: Open minimum outdoor-air dampers **OR** outdoor-air dampers to minimum position, **as directed**.

c. Heating Reset:
1) Input Device: Room thermostat **OR** DDC system software, **as directed**.
2) Output Device: Receiver controller **OR** DDC system analog output **OR** DDC system analog output to digital-to-pneumatic transducer, **as directed**, to modulating damper actuator(s).
3) Action: Close minimum outdoor-air dampers **OR** Set outdoor-air dampers to minimum position, **as directed**.

d. Supply **OR** Mixed, **as directed**,-Air Temperature:

1) Input Device: Duct-mounted thermostat **OR** Electronic temperature sensor, **as directed**.
2) Output Device: Receiver controller **OR** DDC system analog output **OR** DDC system analog output to digital-to-pneumatic transducer, **as directed**, to modulating damper actuator(s).
3) Action: Modulate outdoor-, return-, and relief-air dampers to maintain air temperature set point of 55 deg F (13 deg C).

e. Cooling Reset:
1) Input Device: Outdoor- and return-air, duct-mounted thermostats **OR** electronic temperature sensors, **as directed**.
2) Output Device: Receiver controller **OR** DDC system analog output **OR** DDC system analog output to digital-to-pneumatic transducer, **as directed**, to damper actuator(s).
3) Action: Set outdoor-air dampers to minimum position when outdoor-air temperature exceeds return-air temperature **OR** enthalpy exceeds return-air enthalpy, **as directed**.

f. Unoccupied Time Schedule:
1) Input Device: Time clock **OR** DDC system time schedule, **as directed**.
2) Output Device: Receiver controller **OR** DDC system analog output **OR** DDC system analog output to digital-to-pneumatic transducer, **as directed**, to modulating damper actuator(s).
3) Action: Position outdoor- and relief-air dampers closed and return-air dampers open.

g. Display:
1) Mixed-air-temperature indication.
2) Mixed-air-temperature set point.
3) Mixed-air damper position.

8. Humidifier:
a. Occupied Time Schedule:
1) Input Device: Time clock **OR** DDC system time schedule, **as directed**, and airflow switch
2) Output Device: Pneumatic relay **OR** DDC system output, **as directed**.
3) Action: Enable control.

b. Humidity:
1) Input Device: Room humidistat **OR** Return-air, duct-mounted humidistat **OR** DDC system, **as directed**.
2) Output Device: Receiver controller **OR** DDC system analog output **OR** DDC system analog output to digital-to-pneumatic transducer, **as directed**, enables humidifier **OR** modulates control valve to maintain humidity **OR** cycles pump to maintain humidity **OR** cycles pump and modulates control valve to maintain humidity, **as directed**, in straight-line relationship for the following conditions:
a) 20 percent when outdoor-air temperature is minus 30 deg F (minus 35 deg C).
b) 40 percent when outdoor-air temperature is 75 deg F (24 deg C).
3) Action: Modulate outdoor-, return-, and relief-air dampers to maintain air temperature set point of 55 deg F (13 deg C).

c. Display:
1) Relative humidity indication.
2) Relative humidity set point.
3) Relative humidity control-valve position.

9. Filters: During occupied periods, when fan is running, differential air-pressure transmitters exist.
a. Occupied Time Schedule:
1) Input Device: Time clock **OR** DDC system time schedule, **as directed**.
2) Output Device: Electric relay **OR** DDC system output, **as directed**.
3) Action: Enable control.

b. Differential Pressure:

1) Input Device: Differential-pressure switches **OR** Pressure transmitter, **as directed**.
2) Output Device: Analog alarm panel **OR** DDC system alarm, **as directed**.
3) Action: Signal alarm on low- and high-pressure conditions.

c. Display:
1) Filter air-pressure-drop indication.
2) Filter low-air-pressure set point.
3) Filter high-air-pressure set point.

10. Hydronic **OR** Steam, **as directed**, Heating Coil:
a. Occupied Time Schedule:
1) Input Device: Time clock **OR** DDC system time schedule, **as directed**.
2) Output Device: Time clock **OR** Binary output, **as directed**.
3) Action: Enable control.

b. Supply **OR** Discharge, **as directed**,-Air Temperature:
1) Input Device: Duct-mounted thermostat **OR** Electronic temperature sensor, **as directed**.
2) Output Device: Normally open **OR** closed, **as directed**, modulating control valve.
3) Action: Maintain supply-air temperature set point of 55 deg F (13 deg C).

c. Temperature Reset (for constant-temperature supply-air systems):
1) Input Device: Duct-mounted thermostat **OR** Electronic temperature sensor, **as directed**, in return air.
2) Output Device: Direct to receiver controller **OR** DDC system, **as directed**, in straight-line relationship for the following conditions:
a) 65 deg F (18 deg C) when return-air temperature is 70 deg F (21 deg C).
b) 55 deg F (13 deg C) when return-air temperature is 75 deg F (24 deg C).
3) Action: Reset supply-air temperature set point of 55 deg F (13 deg C).

d. Temperature Reset (for multizone or dual-duct supply-air systems):
1) Input Device: Load analyzer **OR** DDC system, **as directed**, with input from room thermostats **OR** temperature sensors, **as directed**.
2) Output Device: Direct to receiver controller **OR** DDC system, **as directed**.
3) Action: Reset supply-air temperature in response to greatest heating demand.

e. Unoccupied Time Schedule:
1) Input Device: Time clock and room thermostat **OR** DDC system time schedule and output, **as directed**.
2) Output Device: Room thermostat (cycling fan) **OR** DDC system binary output, **as directed**.
3) Action: Enable normal control **OR** Return valve to normal position, **as directed**, when fan is cycled on.

f. Display:
1) Fan-discharge air-temperature indication.
2) Fan-discharge air-temperature set point.
3) Heating-coil air-temperature indication.
4) Heating-coil air-temperature set point.
5) Heating-coil pump operation indication.
6) Heating-coil control-valve position.
7) Hot-deck air-temperature indication.
8) Hot-deck air-temperature set point.

11. Hydronic Cooling Coil:
a. Occupied Time Schedule:
1) Input Device: Time clock **OR** DDC system time schedule, **as directed**.
2) Output Device: Time clock **OR** Binary output, **as directed**.
3) Action: Enable control.

b. Supply **OR** Discharge, **as directed**,-Air Temperature:
1) Input Device: Duct-mounted thermostat **OR** Electronic temperature sensor, **as directed**.
2) Output Device: Normally open **OR** closed, **as directed**, modulating control valve.
3) Action: Maintain supply-air temperature set point of 55 deg F (13 deg C).

c. Temperature Reset (for constant-temperature systems):
   1) Input Device: Duct-mounted thermostat **OR** Electronic temperature sensor, **as directed**, in return air.
   2) Output Device: Direct to receiver controller **OR** DDC system, **as directed**, in straight-line relationship for the following conditions:
      a) 65 deg F (18 deg C) when return-air temperature is 70 deg F (21 deg C).
      b) 55 deg F (13 deg C) when return-air temperature is 75 deg F (24 deg C).
   3) Action: Reset supply-air temperature set point of 55 deg F (13 deg C).

d. Temperature Reset (for multizone or dual-duct supply-air systems):
   1) Input Device: Load analyzer **OR** DDC system, **as directed**, with input from room thermostats **OR** temperature sensors, **as directed**.
   2) Output Device: Direct to receiver controller **OR** DDC system, **as directed**.
   3) Action: Reset supply-air temperature in response to greatest heating demand.

e. Unoccupied Time Schedule:
   1) Input Device: Time clock **OR** DDC system time schedule, **as directed**.
   2) Output Device: Time clock **OR** Binary output, **as directed**.
   3) Action: Disable control.

f. Display:
   1) Fan-discharge air-temperature indication.
   2) Fan-discharge air-temperature set point.
   3) Cooling-coil air-temperature indication.
   4) Cooling-coil air-temperature set point.
   5) Cooling-coil control-valve position.
   6) Cold-deck air-temperature indication.
   7) Cold-deck air-temperature set point.

12. Multizone Damper Control:
   a. Occupied Time Schedule:
      1) Input Device: Time clock **OR** DDC system time schedule, **as directed**.
      2) Output Device: Time clock **OR** Binary output, **as directed**.
      3) Action: Enable control.
   b. Room Temperature:
      1) Input Device: Room thermostat **OR** Electronic temperature sensor, **as directed**.
      2) Output Device: Damper actuator.
      3) Action: Maintain room temperature.
   c. Display:
      1) Room temperature indication.
      2) Room temperature set point.
      3) Multizone damper position.

13. Coordination of Air-Handling Unit Sequences: Ensure that preheat, mixed-air, heating-coil, and cooling-coil controls have common inputs and do not overlap in function.

14. Operator Station Display: Indicate the following on operator workstation display terminal:
   a. DDC system graphic.
   b. DDC system on-off indication.
   c. DDC system occupied/unoccupied mode.
   d. Outdoor-air-temperature indication.
   e. Supply-fan on-off indication.
   f. Supply-fan-discharge static-pressure indication.
   g. Supply-fan-discharge static-pressure set point.
   h. Supply-fan airflow rate.
   i. Supply-fan inlet vane position **OR** speed, **as directed**.
   j. Return-fan on-off indication.
   k. Return-air static-pressure indication.
   l. Return-air static-pressure set point.
   m. Return-fan airflow rate.
   n. Return-fan inlet vane position **OR** speed, **as directed**.

o. Building static-pressure indication.
p. Building static-pressure set point.
q. Preheat-coil air-temperature indication.
r. Preheat-coil air-temperature set point.
s. Preheat-coil pump operation indication.
t. Preheat-coil control-valve position.
u. Mixed-air-temperature indication.
v. Mixed-air-temperature set point.
w. Mixed-air damper position.
x. Relative humidity indication.
y. Relative humidity set point.
z. Relative humidity control-valve position.
aa. Filter air-pressure-drop indication.
bb. Filter low-air-pressure set point.
cc. Filter high-air-pressure set point.
dd. Fan-discharge air-temperature indication.
ee. Fan-discharge air-temperature set point.
ff. Heating-coil air-temperature indication.
gg. Heating-coil air-temperature set point.
hh. Heating-coil pump operation indication.
ii. Heating-coil control-valve position.
jj. Hot-deck air-temperature indication.
kk. Hot-deck air-temperature set point.
ll. Cooling-coil air-temperature indication.
mm. Cooling-coil air-temperature set point.
nn. Cooling-coil control-valve position.
oo. Cold-deck air-temperature indication.
pp. Cold-deck air-temperature set point.
qq. Room temperature indication.
rr. Room temperature set point.
ss. Multizone damper position.

G. Terminal Unit Operating Sequence
1. Cabinet Unit Heater, Hydronic **OR** Steam, **as directed**:
   a. Room Temperature:
      1) Input Device: Room thermostat **OR** Electronic temperature sensor, **as directed**.
      2) Output Device: Room thermostat **OR** DDC system binary output, **as directed**.
      3) Action: Cycle fan to maintain temperature.
   b. Low-Temperature Safety:
      1) Input Device: Line-voltage, on-off thermostat, pipe mounted.
      2) Output Device: Hard wired.
      3) Action: Stop fan when return heating-water **OR** condensate, **as directed**, temperature falls below 35 deg F (2 deg C).
   c. Display:
      1) Room temperature indication.
      2) Room temperature set point.
2. Cabinet Unit Heater, Electric: Room thermostat cycles fan and sequences stages of heating.
3. Unit Heater, Hydronic **OR** Steam, **as directed**:
   a. Room Temperature:
      1) Input Device: Room thermostat **OR** Electronic temperature sensor, **as directed**.
      2) Output Device: Room thermostat **OR** DDC system binary output, **as directed**.
      3) Action: Cycle fan to maintain temperature.
   b. Low-Temperature Safety:
      1) Input Device: Line-voltage, on-off thermostat, pipe mounted.
      2) Output Device: Hard wired.

3) Action: Stop fan when return heating-water **OR** condensate, **as directed**, temperature falls below 35 deg F (2 deg C).

c. Display:
1) Room temperature indication.
2) Room temperature set point.

4. Unit Heater, Electric: Room thermostat cycles fan and sequences stages of heating.
5. Combustion-Air Unit Heaters:
a. Room Temperature:
1) Input Device: Room thermostat **OR** Electronic temperature sensor, **as directed**.
2) Output Device: Pneumatic **OR** Electronic, **as directed**, control-valve operator.
3) Action: Modulate valve to maintain temperature.
b. Display:
1) Room temperature indication.
2) Room temperature set point.
3) Control-valve position.
6. Radiant Heating Cable, Electric: Room thermostat cycles power.
7. Radiant Heating Panel, Electric: Room thermostat cycles power.
8. Radiant Heating Panel, Hydronic:
a. Room Temperature:
1) Input Device: Room thermostat **OR** Electronic temperature sensor, **as directed**.
2) Output Device: Pneumatic **OR** Electronic, **as directed**, control-valve operator.
3) Action: Modulate valve to maintain temperature.
b. Display:
1) Room temperature indication.
2) Room temperature set point.
3) Control-valve position.
9. Two-Pipe, Single-Coil, Fan-Coil Unit:
a. Occupied Time Schedule:
1) Input Device: Fan switch **OR** Time clock **OR** DDC system time schedule, **as directed**.
2) Output Device: Time clock **OR** Binary output, **as directed**.
3) Action: Start and stop fan and enable control.
b. Room Temperature:
1) Input Device: Room thermostat **OR** Electronic temperature sensor, **as directed**, in room **OR** return air, **as directed**.
2) Output Device: Pneumatic **OR** Electronic, **as directed**, control-valve operator.
3) Action: Modulate valve to maintain temperature.
c. DDC System Changeover:
1) Input Device: Thermostat **OR** Electronic temperature sensor, **as directed**, in supply-water **OR** on supply-water piping **OR** DDC system, **as directed**.
2) Output Device: Hard-wired relay **OR** DDC system software, **as directed**.
3) Action: Reverse control-valve action to switch from heating to cooling.
d. Display:
1) DDC system graphic.
2) DDC system on-off indication.
3) DDC system occupied/unoccupied mode.
4) Room temperature indication.
5) Room temperature set point.
6) Control-valve position.
7) Supply-water temperature indication.
10. Four-Pipe, Hydronic Fan-Coil Unit:
a. Occupied Time Schedule:
1) Input Device: Fan switch **OR** Time clock **OR** DDC system time schedule, **as directed**.
2) Output Device: Time clock **OR** Binary output, **as directed**.

3) Action: Start and stop fan, and enable control.

b. Room Temperature:
1) Input Device: Room thermostat **OR** Electronic temperature sensor, **as directed**.
2) Output Device: Pneumatic **OR** Electronic, **as directed**, control-valve operators.
3) Action: Modulate multiport control valves to maintain temperature.

c. Display:
1) DDC system graphic.
2) DDC system on-off indication.
3) DDC system occupied/unoccupied mode.
4) Room temperature indication.
5) Room temperature set point.
6) Control-valve position.

11. Unit Ventilator: Room thermostat modulates heating-and-cooling control valves; airstream thermostats modulate outdoor- and return-air dampers as follows:

a. Occupied Time Schedule:
1) Input Device: Fan switch **OR** Time clock **OR** DDC system time schedule, **as directed**.
2) Output Device: Time clock **OR** Binary output, **as directed**.
3) Action: Start and stop fan, move outdoor- and return-air dampers to minimum **OR** maximum, **as directed**, outdoor-air position, and enable control.

b. Room Temperature - Valves:
1) Input Device: Room thermostat **OR** Electronic temperature sensor, **as directed**.
2) Output Device: Pneumatic **OR** Electronic, **as directed**, control-valve operators.
3) Action: Modulate heating-water supply control valve and chilled-water supply control valve in sequence to maintain temperature.

c. Room Temperature - Dampers:
1) Input Device: Thermostat **OR** Electronic temperature sensor, **as directed**, in mixed air.
2) Output Device: Pneumatic **OR** Electronic, **as directed**, control damper actuators.
3) Action: Modulate outdoor- and return-air dampers to maintain temperature.

d. Supply-Air Temperature Limit:
1) Input Device: Thermostat **OR** Electronic temperature sensor, **as directed**, in discharge air.
2) Output Device: Pneumatic **OR** Electronic, **as directed**, control-valve operators and control damper actuators.
3) Action: Override room thermostat to control valves and dampers to prevent discharge air from dropping below a minimum set point.

e. Warm-up Cycle:
1) Input Device: Time clock **OR** DDC system time schedule, **as directed**.
2) Output Device: Hard-wired relay **OR** DDC system binary output, **as directed**.
3) Action: Open heating-water supply control valve, close outdoor-air damper, and open return-air damper.

f. Display:
1) DDC system graphic.
2) DDC system on-off indication.
3) DDC system occupied/unoccupied mode.
4) Room temperature indication.
5) Room temperature set point.
6) Control-valve position.
7) Damper position.

12. Heating Coils, Hydronic **OR** Steam, **as directed**:

a. Room Temperature:
1) Input Device: Room thermostat **OR** Electronic temperature sensor, **as directed**.
2) Output Device: Pneumatic **OR** Electronic **OR** Electric, **as directed**, control-valve operators.
3) Action: Modulate **OR** Cycle, **as directed**, valve to maintain temperature.

b. Display:
   1) Room temperature indication.
   2) Room temperature set point.
   3) Control-valve position.

13. Heating Coils, Electric: Room thermostat cycles coils **OR** sequences stages of heating, **as directed**.
14. Radiators and Convectors, Hydronic **OR** Steam, **as directed**:
    a. Occupancy:
       1) Input Device: Occupancy sensor.
       2) Output Device: DDC system binary output.
       3) Action: Report occupancy and enable occupied temperature set point.
    b. Room Temperature:
       1) Input Device: Room thermostat **OR** Electronic temperature sensor, **as directed**.
       2) Output Device: Pneumatic **OR** Electronic **OR** Electric, **as directed**, control-valve operators.
       3) Action: Modulate **OR** Cycle, **as directed**, valve to maintain temperature.
          a) Occupied Temperature: 75 deg F (24 deg C).
          b) Unoccupied Temperature: 65 deg F (18 deg C).
    c. Display:
       1) Room/area served.
       2) Room temperature indication.
       3) Room temperature set point.
       4) Room temperature set point, occupied.
       5) Room temperature set point, occupied standby.
       6) Room temperature set point, unoccupied.
       7) Control-valve position as percent open.
15. Radiators and Convectors, Electric: Room thermostat cycles coils **OR** sequences stages of heating, **as directed**.
16. Constant-Volume, Terminal Air Units, Hydronic **OR** Steam, **as directed**:
    a. Occupancy:
       1) Input Device: Occupancy sensor.
       2) Output Device: DDC system binary output.
       3) Action: Report occupancy and enable occupied temperature set point.
          a) Occupied Temperature: 75 deg F (24 deg C).
          b) Unoccupied Temperature: 65 deg F (18 deg C).
    b. Room Temperature:
       1) Input Device: Room thermostat **OR** Electronic temperature sensor, **as directed**.
       2) Output Device: Pneumatic **OR** Electronic **OR** Electric, **as directed**, control-valve operators.
       3) Action: Modulate **OR** Cycle, **as directed**, valve to maintain temperature.
    c. Display:
       1) Room/area served.
       2) Room occupied/unoccupied.
       3) Room temperature indication.
       4) Room temperature set point.
       5) Room temperature set point, occupied.
       6) Room temperature set point, unoccupied.
       7) Control-valve position as percent open.
17. VAV, Terminal Air Units with Hydronic **OR** Steam, **as directed**, Coils:
    a. Occupancy:
       1) Input Device: Occupancy sensor.
       2) Output Device: DDC system binary output.
       3) Action: Report occupancy and enable occupied temperature set point.
          a) Occupied Temperature: 75 deg F (24 deg C).
          b) Unoccupied Temperature: 65 deg F (18 deg C).

b. Room Temperature:
   1) Input Device: Room thermostat **OR** Electronic temperature sensor, **as directed**.
   2) Output Device: Pneumatic **OR** Electronic, **as directed**, damper actuators and control-valve operators.
   3) Action: Modulate damper and valve to maintain temperature.
      a) Sequence damper from full open to minimum position, then valve from closed to fully open.

c. Display:
   1) Room/area served.
   2) Room occupied/unoccupied.
   3) Room temperature indication.
   4) Room temperature set point.
   5) Room temperature set point, occupied.
   6) Room temperature set point, unoccupied.
   7) Air-damper position as percent open.
   8) Control-valve position as percent open.

18. Dual-Duct, VAV, Terminal Air Units:

a. Occupancy:
   1) Input Device: Occupancy sensor.
   2) Output Device: DDC system binary output.
   3) Action: Report occupancy and enable occupied temperature set point.
      a) Occupied Temperature: 75 deg F (24 deg C).
      b) Unoccupied Temperature: 65 deg F (18 deg C).

b. Room Temperature:
   1) Input Device: Room thermostat **OR** Electronic temperature sensor, **as directed**.
   2) Output Device: Pneumatic **OR** Electronic, **as directed**, damper actuators.
   3) Action: Modulate dampers to maintain temperature.
      a) Sequence when space temperature is below set point: Close VAV damper to minimum position, open hot-deck dampers and close cold-deck dampers, then open VAV damper.
      b) Sequence when space temperature is above set point: Close VAV damper to minimum position, close hot-deck dampers and open cold-deck dampers, then open VAV damper.

c. Display:
   1) Room/area served.
   2) Room occupied/unoccupied.
   3) Room temperature indication.
   4) Room temperature set point.
   5) Room temperature set point, occupied.
   6) Room temperature set point, unoccupied.
   7) VAV damper position as percent open.
   8) Hot-deck damper position as percent open.
   9) Cold-deck damper position as percent open.

H. Ventilation Sequences

1. Combustion-Air, Makeup Unit Control, Electric: Start fan when served appliance burner starts; room thermostat sequences stages of heating.
2. Combustion-Air, Makeup Unit Control, Hydronic **OR** Steam, **as directed**: Start fan when served appliance burner starts; room thermostat cycles **OR** modulates, **as directed**, control valve.
3. Gravity Roof Ventilator: Occupancy sensor **OR** Room thermostat, **as directed**, opens dampers.
4. Exhaust Fan: Occupancy sensor **OR** Interlock with light switch **OR** Room thermostat, **as directed**, cycles fan.
5. Kitchen Exhaust Fan: Occupancy sensor starts fan and energizes makeup air unit.

1.2 PRODUCTS (Not Applicable)

1.3 EXECUTION (Not Applicable)

END OF SECTION 15041

SECTION 15042 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for identification for plumbing piping and equipment. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section Includes:
a. Equipment labels.
b. Warning signs and labels.
c. Pipe labels.
d. Stencils.
e. Valve tags.
f. Warning tags.

C. Submittals
1. Product Data: For each type of product indicated.

1.2 PRODUCTS

A. Equipment Labels
1. Metal Labels for Equipment:
a. Material and Thickness: Brass, 0.032-inch (0.8-mm) **OR** Stainless steel, 0.025-inch (0.64-mm) **OR** Aluminum, 0.032-inch (0.8-mm) **OR** anodized aluminum, 0.032-inch (0.8-mm), **as directed**, minimum thickness, and having predrilled or stamped holes for attachment hardware.
b. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
c. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
d. Fasteners: Stainless-steel rivets **OR** self-tapping screws, **as directed**.
e. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
2. Plastic Labels for Equipment:
a. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) **OR** 1/8 inch (3.2 mm), **as directed**, thick, and having predrilled holes for attachment hardware.
b. Letter Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.
c. Background Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.
d. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
e. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
f. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), 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, **as directed**.
h. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

3. 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.
4. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) 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.

B. Warning Signs And Labels
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) **OR** 1/8 inch (3.2 mm), **as directed**, thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.
3. Background Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), 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, **as directed**.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
9. Label Content: Include caution and warning information, plus emergency notification instructions.

C. Pipe Labels
1. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
2. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover **OR** cover full, **as directed,** circumference of pipe and to attach to pipe without fasteners or adhesive.
3. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
4. 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.
   a. 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.
   b. Lettering Size: At least 1-1/2 inches (38 mm) high.

D. Stencils
1. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch (19 mm) for access panel and door labels, equipment labels, and similar operational instructions.
   a. Stencil Material: Aluminum **OR** Brass **OR** Fiberboard, **as directed**.
   b. Stencil Paint: Exterior, gloss, alkyd enamel **OR** acrylic enamel, **as directed**, black unless otherwise indicated. Paint may be in pressurized spray-can form.
   c. Identification Paint: Exterior, alkyd enamel **OR** acrylic enamel, **as directed**, in colors according to ASME A13.1 unless otherwise indicated.

E. Valve Tags
1. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.
   a. Tag Material: Brass, 0.032-inch (0.8-mm) **OR** Stainless steel, 0.025-inch (0.64-mm) **OR** Aluminum, 0.032-inch (0.8-mm) **OR** anodized aluminum, 0.032-inch (0.8-mm), **as directed**, minimum thickness, and having predrilled or stamped holes for attachment hardware.

b. Fasteners: Brass wire-link chain **OR** beaded chain **OR** S-hook, **as directed**.

2. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) 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.
   a. Valve-tag schedule shall be included in operation and maintenance data.

F. Warning Tags
1. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
   a. Size: 3 by 5-1/4 inches (75 by 133 mm) minimum **OR** Approximately 4 by 7 inches (100 by 178 mm), **as directed**.
   b. Fasteners: Brass grommet and wire **OR** Reinforced grommet and wire or string, **as directed**.
   c. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
   d. Color: Yellow background with black lettering.

1.3 EXECUTION

A. Preparation
1. 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.

B. Equipment Label Installation
1. Install or permanently fasten labels on each major item of mechanical equipment.
2. Locate equipment labels where accessible and visible.

C. Pipe Label Installation
1. Piping Color-Coding: Painting of piping is specified in Division 09 Section(s) "Interior Painting" OR "High-performance Coatings", **as directed**.
2. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles **OR** complying with ASME A13.1, **as directed**, on each piping system.
   a. Identification Paint: Use for contrasting background.
   b. Stencil Paint: Use for pipe marking.
3. 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:
   a. Near each valve and control device.
   b. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
   c. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
   d. At access doors, manholes, and similar access points that permit view of concealed piping.
   e. Near major equipment items and other points of origination and termination.
   f. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
   g. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
4. Pipe Label Color Schedule:
   a. Low-Pressure, Compressed-Air Piping:
      1) Background Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.
      2) Letter Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.
   b. Medium-Pressure, Compressed-Air Piping:
      1) Background Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.

2) Letter Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.

c. Domestic Water Piping:

1) Background Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.

2) Letter Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.

d. Sanitary Waste and Storm Drainage Piping:

1) Background Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.

2) Letter Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.

D. Valve-Tag Installation

1. 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.

2. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

a. Valve-Tag Size and Shape:

1) Cold Water: 1-1/2 inches (38 mm) **OR** 2 inches (50 mm), **as directed**, round **OR** square, **as directed**.

2) Hot Water: 1-1/2 inches (38 mm) **OR** 2 inches (50 mm), **as directed**, round **OR** square, **as directed**.

3) Low-Pressure Compressed Air: 1-1/2 inches (38 mm) **OR** 2 inches (50 mm), **as directed**, round **OR** square, **as directed**.

4) High-Pressure Compressed Air: 1-1/2 inches (38 mm) **OR** 2 inches (50 mm), **as directed**, round **OR** square, **as directed**.

b. Valve-Tag Color:

1) Cold Water: Natural **OR** Green, **as directed**.

2) Hot Water: Natural **OR** Green, **as directed**.

3) Low-Pressure Compressed Air: Natural **OR** Green, **as directed**.

4) High-Pressure Compressed Air: Natural **OR** Green, **as directed**.

c. Letter Color:

1) Cold Water: Black **OR** White, **as directed**.

2) Hot Water: Black **OR** White, **as directed**.

3) Low-Pressure Compressed Air: Black **OR** White, **as directed**.

4) High-Pressure Compressed Air: Black **OR** White, **as directed**.

E. Warning-Tag Installation

1. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 15042

SECTION 15042a - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for identification for HVAC piping and equipment. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section Includes:
a. Equipment labels.
b. Warning signs and labels.
c. Pipe labels.
d. Duct labels.
e. Stencils.
f. Valve tags.
g. Warning tags.

C. Submittals
1. Product Data: For each type of product indicated.

1.2 PRODUCTS

A. Equipment Labels
1. Metal Labels for Equipment:
a. Material and Thickness: Brass, 0.032-inch (0.8-mm) **OR** Stainless steel, 0.025-inch (0.64-mm) **OR** Aluminum, 0.032-inch (0.8-mm) **OR** anodized aluminum, 0.032-inch (0.8-mm), **as directed**, minimum thickness, and having predrilled or stamped holes for attachment hardware.
b. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
c. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
d. Fasteners: Stainless-steel rivets **OR** self-tapping screws, **as directed**.
e. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
2. Plastic Labels for Equipment:
a. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) **OR** 1/8 inch (3.2 mm), **as directed**, thick, and having predrilled holes for attachment hardware.
b. Letter Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.
c. Background Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.
d. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
e. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
f. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), 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, **as directed**.

h. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

3. 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.
4. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) 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.

B. Warning Signs And Labels

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) **OR** 1/8 inch (3.2 mm), **as directed**, thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.
3. Background Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), 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, **as directed**.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
9. Label Content: Include caution and warning information, plus emergency notification instructions.

C. Pipe Labels

1. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
2. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover **OR** cover full, **as directed**, circumference of pipe and to attach to pipe without fasteners or adhesive.
3. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
4. 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.
   a. 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.
   b. Lettering Size: At least 1-1/2 inches (38 mm) high.

D. Duct Labels

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) **OR** 1/8 inch (3.2 mm), **as directed**, thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.
3. Background Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), 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, **as directed**.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

9. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
   a. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
   b. Lettering Size: At least 1-1/2 inches (38 mm) high.

E. Stencils
1. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches (32 mm) for ducts; and minimum letter height of 3/4 inch (19 mm) for access panel and door labels, equipment labels, and similar operational instructions.
   a. Stencil Material: Aluminum **OR** Brass **OR** Fiberboard, **as directed**.
   b. Stencil Paint: Exterior, gloss, alkyd enamel **OR** acrylic enamel, **as directed**, black unless otherwise indicated. Paint may be in pressurized spray-can form.
   c. Identification Paint: Exterior, alkyd enamel **OR** acrylic enamel, **as directed**, in colors according to ASME A13.1 unless otherwise indicated.

F. Valve Tags
1. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.
   a. Tag Material: Brass, 0.032-inch (0.8-mm) **OR** Stainless steel, 0.025-inch (0.64-mm) **OR** Aluminum, 0.032-inch (0.8-mm) **OR** anodized aluminum, 0.032-inch (0.8-mm), **as directed**, minimum thickness, and having predrilled or stamped holes for attachment hardware.
   b. Fasteners: Brass wire-link chain **OR** beaded chain **OR** S-hook, **as directed**.
2. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) 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.
   a. Valve-tag schedule shall be included in operation and maintenance data.

G. Warning Tags
1. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
   a. Size: 3 by 5-1/4 inches (75 by 133 mm) minimum **OR** Approximately 4 by 7 inches (100 by 178 mm), **as directed**.
   b. Fasteners: Brass grommet and wire **OR** Reinforced grommet and wire or string, **as directed**.
   c. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
   d. Color: Yellow background with black lettering.

1.3 EXECUTION

A. Preparation
1. 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.

B. Equipment Label Installation
1. Install or permanently fasten labels on each major item of mechanical equipment.
2. Locate equipment labels where accessible and visible.

C. Pipe Label Installation
1. Piping Color-Coding: Painting of piping is specified in Division 09 Section(s) "Interior Painting" OR "High-performance Coatings", **as directed**.

2. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles **OR** complying with ASME A13.1**, as directed**, on each piping system.
   a. Identification Paint: Use for contrasting background.
   b. Stencil Paint: Use for pipe marking.
3. 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:
   a. Near each valve and control device.
   b. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
   c. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
   d. At access doors, manholes, and similar access points that permit view of concealed piping.
   e. Near major equipment items and other points of origination and termination.
   f. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
   g. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
4. Pipe Label Color Schedule:
   a. Chilled-Water Piping:
      1) Background Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.
      2) Letter Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.
   b. Condenser-Water Piping:
      1) Background Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.
      2) Letter Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **asa directed**.
   c. Heating Water Piping:
      1) Background Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.
      2) Letter Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.
   d. Refrigerant Piping:
      1) Background Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.
      2) Letter Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.
   e. Low-Pressure Steam Piping:
      1) Background Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.
      2) Letter Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.
   f. High-Pressure Steam Piping:
      1) Background Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.
      2) Letter Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.
   g. Steam Condensate Piping:
      1) Background Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.
      2) Letter Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.

D. Duct Label Installation
1. Install plastic-laminated **OR** self-adhesive, **as directed**, duct labels with permanent adhesive on air ducts in the following color codes:
   a. Blue: For cold-air supply ducts.
   b. Yellow: For hot-air supply ducts.
   c. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
   d. ASME A13.1 Colors and Designs: For hazardous material exhaust.
2. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be provided instead of plastic-laminated duct labels, at Installer's option, if lettering larger than 1 inch (25 mm) high is needed for proper identification because of distance from normal location of required identification.
3. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet (15 m) in each space where ducts are exposed or concealed by removable ceiling system.

E. Valve-Tag Installation
1. 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 HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
2. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
   a. Valve-Tag Size and Shape:
      1) Chilled Water: 1-1/2 inches (38 mm) **OR** 2 inches (50 mm), **as directed**, round **OR** square, **as directed**.
      2) Condenser Water: 1-1/2 inches (38 mm) **OR** 2 inches (50 mm), **as directed**, round **OR** square, **as directed**.
      3) Refrigerant: 1-1/2 inches (38 mm) **OR** 2 inches (50 mm), **as directed**, round **OR** square, **as directed**.
      4) Hot Water: 1-1/2 inches (38 mm) **OR** 2 inches (50 mm), **as directed**, round **OR** square, **as directed**.
      5) Gas: 1-1/2 inches (38 mm) **OR** 2 inches (50 mm), **as directed**, round **OR** square, **as directed**.
      6) Low-Pressure Steam: 1-1/2 inches (38 mm)2 inches (50 mm), **as directed**, round **OR** square, **as directed**.
      7) High-Pressure Steam: 1-1/2 inches (38 mm) **OR** 2 inches (50 mm), **as directed**, round **OR** square, **as directed**.
      8) Steam Condensate: 1-1/2 inches (38 mm) **OR** 2 inches (50 mm), **as directed**, round **OR** square, **as directed**.
   b. Valve-Tag Color:
      1) Chilled Water: Natural **OR** Green, **as directed.**
      2) Condenser Water: Natural **OR** Green, **as directed.**
      3) Refrigerant: Natural **OR** Green, **as directed**.
      4) Hot Water: Natural **OR** Green, **as directed**.
      5) Gas: Natural **OR** Yellow, **as directed**.
      6) Low-Pressure Steam: Natural **OR** Yellow, **as directed**.
      7) High-Pressure Steam: Natural **OR** Green, **as directed**.
      8) Steam Condensate: Natural **OR** Green, **as directed**.
   c. Letter Color:
      1) Chilled Water: Black **OR** White, **as directed**.
      2) Condenser Water: Black **OR** White, **as directed**.
      3) Refrigerant: Black **OR** White, **as directed**.
      4) Hot Water: Black **OR** White, **as directed**.
      5) Gas: Black **OR** White, **as directed**.
      6) Low-Pressure Steam: Black **OR** White, **as directed**.
      7) High-Pressure Steam: Black **OR** White, **as directed**.
      8) Steam Condensate: Black **OR** White, **as directed**.

F. Warning-Tag Installation
1. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 15042a

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Task	Specification	Specification Description
15042	15041	Sequence Of Operation

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SECTION 15043 - TESTING, ADJUSTING, AND BALANCING

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for testing, adjusting and balancing. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section Includes:
a. Balancing Air Systems:
1) Constant-volume air systems.
2) Dual-duct systems.
3) Variable-air-volume systems.
4) Multizone systems.
5) Induction-unit systems.
b. Balancing Hydronic Piping Systems:
1) Constant-flow hydronic systems.
2) Variable-flow hydronic systems.
3) Primary-secondary hydronic systems.

C. Definitions
1. AABC: Associated Air Balance Council.
2. NEBB: National Environmental Balancing Bureau.
3. TAB: Testing, adjusting, and balancing.
4. TABB: Testing, Adjusting, and Balancing Bureau.
5. TAB Specialist: An entity engaged to perform TAB Work.

D. Submittals
1. LEED Submittal:
a. Air-Balance Report for LEED Prerequisite EQ 1: Documentation of work performed for ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."
2. Strategies and Procedures Plan: Within 30 **OR** 60 **OR** 90, **as directed**, days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
3. Certified TAB reports.

E. Quality Assurance
1. TAB Contractor Qualifications: Engage a TAB entity certified by AABC **OR** NEBB **OR** TABB, **as directed**.
a. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC **OR** NEBB **OR** TABB, **as directed**.
b. TAB Technician: Employee of the TAB contractor and who is certified by AABC **OR** NEBB **OR** TABB, **as directed**, as a TAB technician.
2. Certify TAB field data reports and perform the following:
a. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
b. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
3. TAB Report Forms: Use standard TAB contractor's forms approved by the Owner **OR** Owner **OR** Commissioning Authority, **as directed**.
4. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

F. Project Conditions

1. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

   OR

   Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.2 PRODUCTS (Not Applicable)

1.3 EXECUTION

A. Examination

1. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
2. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
3. Examine the approved submittals for HVAC systems and equipment.
4. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
5. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 15 Section(s) "Metal Ducts" OR "Nonmetal Ducts", **as directed**, and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
6. Examine equipment performance data including fan and pump curves.
   a. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
   b. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
7. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
8. Examine test reports specified in individual system and equipment Sections.
9. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
10. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
11. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
12. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
13. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
14. Examine system pumps to ensure absence of entrained air in the suction piping.
15. Examine operating safety interlocks and controls on HVAC equipment.
16. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

B. Preparation
1. Prepare a TAB plan that includes strategies and step-by-step procedures.
2. Complete system-readiness checks and prepare reports. Verify the following:
   a. Permanent electrical-power wiring is complete.
   b. Hydronic systems are filled, clean, and free of air.
   c. Automatic temperature-control systems are operational.
   d. Equipment and duct access doors are securely closed.
   e. Balance, smoke, and fire dampers are open.
   f. Isolating and balancing valves are open and control valves are operational.
   g. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
   h. Windows and doors can be closed so indicated conditions for system operations can be met.

C. General Procedures For Testing And Balancing
1. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" **OR** ASHRAE 111 **OR** NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" **OR** SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing", **as directed**, and in this Section.
   a. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."
2. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
   a. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
      OR
      After testing and balancing, install test ports and duct access doors that comply with requirements in Division 15 Section "Duct Accessories".
   b. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 15 Section "Hvac Insulation".
3. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
4. Take and report testing and balancing measurements in inch-pound (IP) **OR** metric (SI) **OR** inch-pound (IP) and metric (SI), **as directed,** units.

D. General Procedures For Balancing Air Systems
1. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
2. Prepare schematic diagrams of systems' "as-built" duct layouts.
3. For variable-air-volume systems, develop a plan to simulate diversity.
4. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
5. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
6. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
7. Verify that motor starters are equipped with properly sized thermal protection.
8. Check dampers for proper position to achieve desired airflow path.
9. Check for airflow blockages.
10. Check condensate drains for proper connections and functioning.
11. Check for proper sealing of air-handling-unit components.
12. Verify that air duct system is sealed as specified in Division 15 Section "Metal Ducts".

E. Procedures For Constant-Volume Air Systems
1. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

a. Measure total airflow.
   1) Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
b. Measure fan static pressures as follows to determine actual static pressure:
   1) Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
   2) Measure static pressure directly at the fan outlet or through the flexible connection.
   3) Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
   4) Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
c. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
   1) Report the cleanliness status of filters and the time static pressures are measured.
d. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
e. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
f. Obtain approval from the Owner **OR** Owner **OR** Commissioning Authority, **as directed**, for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 15 for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
g. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

2. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
   a. Measure airflow of submain and branch ducts.
      1) Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
   b. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
   c. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
3. Measure air outlets and inlets without making adjustments.
   a. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
4. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
   a. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
   b. Adjust patterns of adjustable outlets for proper distribution without drafts.

F. Procedures For Dual-Duct Systems
   1. Verify that the cooling coil is capable of full-system airflow, and set mixing boxes at full-cold airflow position for fan volume.

2. Measure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate controls of mixing boxes and to overcome resistance in the ducts and outlets downstream from mixing boxes.
   a. If insufficient static pressure exists, increase airflow at the fan.
3. Test and adjust the constant-volume mixing boxes as follows:
   a. Verify both hot and cold operations by adjusting the thermostat and observing changes in air temperature and volume.
   b. Verify sufficient inlet static pressure before making volume adjustments.
   c. Adjust mixing boxes to indicated airflows within specified tolerances. Measure airflow by Pitot-tube traverse readings or by measuring static pressure at mixing-box taps if provided by mixing-box manufacturer.
4. Do not overpressurize ducts.
5. Remeasure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate controls of mixing boxes and to overcome resistance in the ducts and outlets downstream from mixing boxes.
6. Adjust variable-air-volume, dual-duct systems in the same way as constant-volume, dual-duct systems; adjust maximum- and minimum-airflow setting of each mixing box.

G. Procedures For Variable-Air-Volume Systems
1. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
2. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
   a. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
   b. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
   c. Measure total system airflow. Adjust to within indicated airflow.
   d. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
   e. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
      1) If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
   f. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
      1) Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
   g. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
   h. Record final fan-performance data.
3. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
   a. Balance variable-air-volume systems the same as described for constant-volume air systems.
   b. Set terminal units and supply fan at full-airflow condition.

c. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
d. Readjust fan airflow for final maximum readings.
e. Measure operating static pressure at the sensor that controls the supply fan if one is installed, and verify operation of the static-pressure controller.
f. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
g. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
    1) If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
h. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
    1) Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

4. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
    a. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
    b. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
    c. Set terminal units at full-airflow condition.
    d. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
    e. Adjust terminal units for minimum airflow.
    f. Measure static pressure at the sensor.
    g. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

H. Procedures For Multizone Systems
1. Set unit at maximum airflow through the cooling coil.
2. Adjust each zone's balancing damper to achieve indicated airflow within the zone.

I. Procedures For Induction-Unit Systems
1. Balance primary-air risers by measuring static pressure at the nozzles of the top and bottom units of each riser to determine which risers must be throttled. Adjust risers to indicated airflow within specified tolerances.
2. Adjust each induction unit.

J. General Procedures For Hydronic Systems
1. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
2. Prepare schematic diagrams of systems' "as-built" piping layouts.
3. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
    a. Open all manual valves for maximum flow.
    b. Check liquid level in expansion tank.
    c. Check makeup water-station pressure gage for adequate pressure for highest vent.

d. Check flow-control valves for specified sequence of operation, and set at indicated flow.
e. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
f. Set system controls so automatic valves are wide open to heat exchangers.
g. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
h. Check air vents for a forceful liquid flow exiting from vents when manually operated.

K. Procedures For Constant-Flow Hydronic Systems
1. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
a. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
1) If impeller sizes must be adjusted to achieve pump performance, obtain approval from the Owner **OR** Owner **OR** Commissioning Authority, **as directed**, and comply with requirements in Division 15 Section "Hydronic Pumps".
b. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
1) Monitor motor performance during procedures and do not operate motors in overload conditions.
c. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
d. Report flow rates that are not within plus or minus 10 percent of design.
2. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
3. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
4. Set calibrated balancing valves, if installed, at calculated presettings.
5. Measure flow at all stations and adjust, where necessary, to obtain first balance.
a. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
6. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
7. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
a. Determine the balancing station with the highest percentage over indicated flow.
b. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
c. Record settings and mark balancing devices.
8. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
9. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
10. Check settings and operation of each safety valve. Record settings.

L. Procedures For Variable-Flow Hydronic Systems
1. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

M. Procedures For Primary-Secondary Hydronic Systems
1. Balance the primary circuit flow first and then balance the secondary circuits.

N. Procedures For Steam Systems
   1. Measure and record upstream and downstream pressure of each piece of equipment.
   2. Measure and record upstream and downstream steam pressure of pressure-reducing valves.
   3. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.
   4. Check settings and operation of each safety valve. Record settings.
   5. Verify the operation of each steam trap.

O. Procedures For Heat Exchangers
   1. Measure water flow through all circuits.
   2. Adjust water flow to within specified tolerances.
   3. Measure inlet and outlet water temperatures.
   4. Measure inlet steam pressure.
   5. Check settings and operation of safety and relief valves. Record settings.

P. Procedures For Motors
   1. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
      a. Manufacturer's name, model number, and serial number.
      b. Motor horsepower rating.
      c. Motor rpm.
      d. Efficiency rating.
      e. Nameplate and measured voltage, each phase.
      f. Nameplate and measured amperage, each phase.
      g. Starter thermal-protection-element rating.
   2. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

Q. Procedures For Chillers
   1. Balance water flow through each evaporator and condenser, **as directed**, to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
      a. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
      b. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
      c. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
      d. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
      e. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
      f. Capacity: Calculate in tons of cooling.
      g. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

R. Procedures For Cooling Towers
   1. Shut off makeup water for the duration of the test, and verify that makeup and blowdown systems are fully operational after tests and before leaving the equipment. Perform the following tests and record the results:
      a. Measure condenser-water flow to each cell of the cooling tower.
      b. Measure entering- and leaving-water temperatures.
      c. Measure wet- and dry-bulb temperatures of entering air.
      d. Measure wet- and dry-bulb temperatures of leaving air.
      e. Measure condenser-water flow rate recirculating through the cooling tower.

f. Measure cooling-tower spray pump discharge pressure.
g. Adjust water level and feed rate of makeup water system.
h. Measure flow through bypass.

S. Procedures For Condensing Units
1. Verify proper rotation of fans.
2. Measure entering- and leaving-air temperatures.
3. Record compressor data.

T. Procedures For Boilers
1. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.
2. Steam Boilers: Measure and record entering-water temperature and flow and leaving-steam pressure, temperature, and flow.

U. Procedures For Heat-Transfer Coils
1. Measure, adjust, and record the following data for each water coil:
   a. Entering- and leaving-water temperature.
   b. Water flow rate.
   c. Water pressure drop.
   d. Dry-bulb temperature of entering and leaving air.
   e. Wet-bulb temperature of entering and leaving air for cooling coils.
   f. Airflow.
   g. Air pressure drop.
2. Measure, adjust, and record the following data for each electric heating coil:
   a. Nameplate data.
   b. Airflow.
   c. Entering- and leaving-air temperature at full load.
   d. Voltage and amperage input of each phase at full load and at each incremental stage.
   e. Calculated kilowatt at full load.
   f. Fuse or circuit-breaker rating for overload protection.
3. Measure, adjust, and record the following data for each steam coil:
   a. Dry-bulb temperature of entering and leaving air.
   b. Airflow.
   c. Air pressure drop.
   d. Inlet steam pressure.
4. Measure, adjust, and record the following data for each refrigerant coil:
   a. Dry-bulb temperature of entering and leaving air.
   b. Wet-bulb temperature of entering and leaving air.
   c. Airflow.
   d. Air pressure drop.
   e. Refrigerant suction pressure and temperature.

V. Procedures For Testing, Adjusting, And Balancing Existing Systems
1. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
   a. Measure and record the operating speed, airflow, and static pressure of each fan.
   b. Measure motor voltage and amperage. Compare the values to motor nameplate information.
   c. Check the refrigerant charge.
   d. Check the condition of filters.
   e. Check the condition of coils.
   f. Check the operation of the drain pan and condensate-drain trap.
   g. Check bearings and other lubricated parts for proper lubrication.
   h. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

2. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
   a. New filters are installed.
   b. Coils are clean and fins combed.
   c. Drain pans are clean.
   d. Fans are clean.
   e. Bearings and other parts are properly lubricated.
   f. Deficiencies noted in the preconstruction report are corrected.
3. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
   a. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
   b. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
   c. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
   d. Balance each air outlet.

W. Tolerances

X. Set HVAC system's air flow rates and water flow rates within the following tolerances:
   a. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
   b. Air Outlets and Inlets: Plus or minus 10 percent.
   c. Heating-Water Flow Rate: Plus or minus 10 percent.
   d. Cooling-Water Flow Rate: Plus or minus 10 percent.

Y. Reporting
1. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
2. Status Reports: Prepare weekly **OR** biweekly **OR** monthly, **as directed**, progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

Z. Final Report
1. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
   a. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
   b. Include a list of instruments used for procedures, along with proof of calibration.
2. Final Report Contents: In addition to certified field-report data, include the following:
   a. Pump curves.
   b. Fan curves.
   c. Manufacturers' test data.
   d. Field test reports prepared by system and equipment installers.
   e. Other information relative to equipment performance; do not include Shop Drawings and product data.
3. General Report Data: In addition to form titles and entries, include the following data:
   a. Title page.
   b. Name and address of the TAB contractor.

c. Project name.
d. Project location.
e. Architect's name and address.
f. Engineer's name and address.
g. Contractor's name and address.
h. Report date.
i. Signature of TAB supervisor who certifies the report.
j. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
k. Summary of contents including the following:
    1) Indicated versus final performance.
    2) Notable characteristics of systems.
    3) Description of system operation sequence if it varies from the Contract Documents.
l. Nomenclature sheets for each item of equipment.
m. Data for terminal units, including manufacturer's name, type, size, and fittings.
n. Notes to explain why certain final data in the body of reports vary from indicated values.
o. Test conditions for fans and pump performance forms including the following:
    1) Settings for outdoor-, return-, and exhaust-air dampers.
    2) Conditions of filters.
    3) Cooling coil, wet- and dry-bulb conditions.
    4) Face and bypass damper settings at coils.
    5) Fan drive settings including settings and percentage of maximum pitch diameter.
    6) Inlet vane settings for variable-air-volume systems.
    7) Settings for supply-air, static-pressure controller.
    8) Other system operating conditions that affect performance.

4. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
    a. Quantities of outdoor, supply, return, and exhaust airflows.
    b. Water and steam flow rates.
    c. Duct, outlet, and inlet sizes.
    d. Pipe and valve sizes and locations.
    e. Terminal units.
    f. Balancing stations.
    g. Position of balancing devices.
5. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
    a. Unit Data:
        1) Unit identification.
        2) Location.
        3) Make and type.
        4) Model number and unit size.
        5) Manufacturer's serial number.
        6) Unit arrangement and class.
        7) Discharge arrangement.
        8) Sheave make, size in inches (mm), and bore.
        9) Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
        10) Number, make, and size of belts.
        11) Number, type, and size of filters.
    b. Motor Data:
        1) Motor make, and frame type and size.
        2) Horsepower and rpm.
        3) Volts, phase, and hertz.
        4) Full-load amperage and service factor.
        5) Sheave make, size in inches (mm), and bore.
        6) Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
    c. Test Data (Indicated and Actual Values):
        1) Total air flow rate in cfm (L/s).

2) Total system static pressure in inches wg (Pa).
3) Fan rpm.
4) Discharge static pressure in inches wg (Pa).
5) Filter static-pressure differential in inches wg (Pa).
6) Preheat-coil static-pressure differential in inches wg (Pa).
7) Cooling-coil static-pressure differential in inches wg (Pa).
8) Heating-coil static-pressure differential in inches wg (Pa).
9) Outdoor airflow in cfm (L/s).
10) Return airflow in cfm (L/s).
11) Outdoor-air damper position.
12) Return-air damper position.
13) Vortex damper position.

6. Apparatus-Coil Test Reports:
   a. Coil Data:
      1) System identification.
      2) Location.
      3) Coil type.
      4) Number of rows.
      5) Fin spacing in fins per inch (mm) o.c.
      6) Make and model number.
      7) Face area in sq. ft. (sq. m).
      8) Tube size in NPS (DN).
      9) Tube and fin materials.
      10) Circuiting arrangement.
   b. Test Data (Indicated and Actual Values):
      1) Air flow rate in cfm (L/s).
      2) Average face velocity in fpm (m/s).
      3) Air pressure drop in inches wg (Pa).
      4) Outdoor-air, wet- and dry-bulb temperatures in deg F (deg C).
      5) Return-air, wet- and dry-bulb temperatures in deg F (deg C).
      6) Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
      7) Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).
      8) Water flow rate in gpm (L/s).
      9) Water pressure differential in feet of head or psig (kPa).
      10) Entering-water temperature in deg F (deg C).
      11) Leaving-water temperature in deg F (deg C).
      12) Refrigerant expansion valve and refrigerant types.
      13) Refrigerant suction pressure in psig (kPa).
      14) Refrigerant suction temperature in deg F (deg C).
      15) Inlet steam pressure in psig (kPa).
7. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
   a. Unit Data:
      1) System identification.
      2) Location.
      3) Make and type.
      4) Model number and unit size.
      5) Manufacturer's serial number.
      6) Fuel type in input data.
      7) Output capacity in Btu/h (kW).
      8) Ignition type.
      9) Burner-control types.
      10) Motor horsepower and rpm.
      11) Motor volts, phase, and hertz.
      12) Motor full-load amperage and service factor.

13) Sheave make, size in inches (mm), and bore.
14) Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

b. Test Data (Indicated and Actual Values):
1) Total air flow rate in cfm (L/s).
2) Entering-air temperature in deg F (deg C).
3) Leaving-air temperature in deg F (deg C).
4) Air temperature differential in deg F (deg C).
5) Entering-air static pressure in inches wg (Pa).
6) Leaving-air static pressure in inches wg (Pa).
7) Air static-pressure differential in inches wg (Pa).
8) Low-fire fuel input in Btu/h (kW).
9) High-fire fuel input in Btu/h (kW).
10) Manifold pressure in psig (kPa).
11) High-temperature-limit setting in deg F (deg C).
12) Operating set point in Btu/h (kW).
13) Motor voltage at each connection.
14) Motor amperage for each phase.
15) Heating value of fuel in Btu/h (kW).

8. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
a. Unit Data:
1) System identification.
2) Location.
3) Coil identification.
4) Capacity in Btu/h (kW).
5) Number of stages.
6) Connected volts, phase, and hertz.
7) Rated amperage.
8) Air flow rate in cfm (L/s).
9) Face area in sq. ft. (sq. m).
10) Minimum face velocity in fpm (m/s).

b. Test Data (Indicated and Actual Values):
1) Heat output in Btu/h (kW).
2) Air flow rate in cfm (L/s).
3) Air velocity in fpm (m/s).
4) Entering-air temperature in deg F (deg C).
5) Leaving-air temperature in deg F (deg C).
6) Voltage at each connection.
7) Amperage for each phase.

9. Fan Test Reports: For supply, return, and exhaust fans, include the following:
a. Fan Data:
1) System identification.
2) Location.
3) Make and type.
4) Model number and size.
5) Manufacturer's serial number.
6) Arrangement and class.
7) Sheave make, size in inches (mm), and bore.
8) Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

b. Motor Data:
1) Motor make, and frame type and size.
2) Horsepower and rpm.
3) Volts, phase, and hertz.
4) Full-load amperage and service factor.
5) Sheave make, size in inches (mm), and bore.
6) Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

7) Number, make, and size of belts.

c. Test Data (Indicated and Actual Values):
1) Total airflow rate in cfm (L/s).
2) Total system static pressure in inches wg (Pa).
3) Fan rpm.
4) Discharge static pressure in inches wg (Pa).
5) Suction static pressure in inches wg (Pa).

10. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
a. Report Data:
1) System and air-handling-unit number.
2) Location and zone.
3) Traverse air temperature in deg F (deg C).
4) Duct static pressure in inches wg (Pa).
5) Duct size in inches (mm).
6) Duct area in sq. ft. (sq. m).
7) Indicated air flow rate in cfm (L/s).
8) Indicated velocity in fpm (m/s).
9) Actual air flow rate in cfm (L/s).
10) Actual average velocity in fpm (m/s).
11) Barometric pressure in psig (Pa).

11. Air-Terminal-Device Reports:
a. Unit Data:
1) System and air-handling unit identification.
2) Location and zone.
3) Apparatus used for test.
4) Area served.
5) Make.
6) Number from system diagram.
7) Type and model number.
8) Size.
9) Effective area in sq. ft. (sq. m).
b. Test Data (Indicated and Actual Values):
1) Air flow rate in cfm (L/s).
2) Air velocity in fpm (m/s).
3) Preliminary air flow rate as needed in cfm (L/s).
4) Preliminary velocity as needed in fpm (m/s).
5) Final air flow rate in cfm (L/s).
6) Final velocity in fpm (m/s).
7) Space temperature in deg F (deg C).

12. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
a. Unit Data:
1) System and air-handling-unit identification.
2) Location and zone.
3) Room or riser served.
4) Coil make and size.
5) Flowmeter type.
b. Test Data (Indicated and Actual Values):
1) Air flow rate in cfm (L/s).
2) Entering-water temperature in deg F (deg C).
3) Leaving-water temperature in deg F (deg C).
4) Water pressure drop in feet of head or psig (kPa).
5) Entering-air temperature in deg F (deg C).
6) Leaving-air temperature in deg F (deg C).

13. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
    a. Unit Data:
        1) Unit identification.
        2) Location.
        3) Service.
        4) Make and size.
        5) Model number and serial number.
        6) Water flow rate in gpm (L/s).
        7) Water pressure differential in feet of head or psig (kPa).
        8) Required net positive suction head in feet of head or psig (kPa).
        9) Pump rpm.
        10) Impeller diameter in inches (mm).
        11) Motor make and frame size.
        12) Motor horsepower and rpm.
        13) Voltage at each connection.
        14) Amperage for each phase.
        15) Full-load amperage and service factor.
        16) Seal type.
    b. Test Data (Indicated and Actual Values):
        1) Static head in feet of head or psig (kPa).
        2) Pump shutoff pressure in feet of head or psig (kPa).
        3) Actual impeller size in inches (mm).
        4) Full-open flow rate in gpm (L/s).
        5) Full-open pressure in feet of head or psig (kPa).
        6) Final discharge pressure in feet of head or psig (kPa).
        7) Final suction pressure in feet of head or psig (kPa).
        8) Final total pressure in feet of head or psig (kPa).
        9) Final water flow rate in gpm (L/s).
        10) Voltage at each connection.
        11) Amperage for each phase.
14. Instrument Calibration Reports:
    a. Report Data:
        1) Instrument type and make.
        2) Serial number.
        3) Application.
        4) Dates of use.
        5) Dates of calibration.

AA. Inspections
1. Initial Inspection:
    a. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
    b. Check the following for each system:
        1) Measure airflow of at least 10 percent of air outlets.
        2) Measure water flow of at least 5 percent of terminals.
        3) Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
        4) Verify that balancing devices are marked with final balance position.
        5) Note deviations from the Contract Documents in the final report.
2. Final Inspection:
    a. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by the Owner **OR** Owner **OR** Commissioning Authority, **as directed**.

b. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of the Owner **OR** Owner **OR** Commissioning Authority, **as directed**.

c. the Owner **OR** Owner **OR** Commissioning Authority, **as directed**, shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

d. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

e. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

3. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

a. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.

b. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

4. Prepare test and inspection reports.

BB. Additional Tests

1. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

2. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 15043

Task	Specification	Specification Description
15043	15041	Sequence Of Operation
15044	15041	Sequence Of Operation

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SECTION 15048 - AIR DUCT CLEANING

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for HVAC air-distribution system cleaning. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section includes cleaning HVAC air-distribution equipment, ducts, plenums, and system components.

C. Definitions
1. ASCS: Air systems cleaning specialist.
2. NADCA: National Air Duct Cleaners Association.

D. Submittals
1. Qualification Data: For an ASCS.
2. Strategies and procedures plan.
3. Cleanliness verification report.

E. Quality Assurance
1. ASCS Qualifications: A certified member of NADCA.
   a. Certification: Employ an ASCS certified by NADCA on a full-time basis.
   b. Supervisor Qualifications: Certified as an ASCS by NADCA.
2. UL Compliance: Comply with UL 181 and UL 181A for fibrous-glass ducts.
3. Cleaning Conference: Conduct conference at Project site.

1.2 PRODUCTS (Not Used)

1.3 EXECUTION

A. Examination
1. Examine HVAC air-distribution equipment, ducts, plenums, and system components to determine appropriate methods, tools, and equipment required for performance of the Work.
2. Perform "Project Evaluation and Recommendation" according to NADCA ACR 2006.
3. Prepare written report listing conditions detrimental to performance of the Work.
4. Proceed with work only after unsatisfactory conditions have been corrected.

B. Preparation
1. Prepare a written plan that includes strategies and step-by-step procedures. At a minimum, include the following:
   a. Supervisor contact information.
   b. Work schedule including location, times, and impact on occupied areas.
   c. Methods and materials planned for each HVAC component type.
   d. Required support from other trades.
   e. Equipment and material storage requirements.
   f. Exhaust equipment setup locations.
2. Use the existing service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry and for inspection.

3. Comply with NADCA ACR 2006, "Guidelines for Constructing Service Openings in HVAC Systems" Section.

C. Cleaning
1. Comply with NADCA ACR 2006.
2. Remove visible surface contaminants and deposits from within the HVAC system.
3. Systems and Components to Be Cleaned:
   a. Air devices for supply and return air.
   b. Air-terminal units.
   c. Ductwork:
      1) Supply-air ducts, including turning vanes and reheat coils, to the air-handling unit.
      2) Return-air ducts to the air-handling unit.
      3) Exhaust-air ducts.
   d. Air-Handling Units:
      1) Interior surfaces of the unit casing.
      2) Coil surfaces compartment.
      3) Condensate drain pans.
      4) Fans, fan blades, and fan housings.
   e. Filters and filter housings.
4. Collect debris removed during cleaning. Ensure that debris is not dispersed outside the HVAC system during the cleaning process.
5. Particulate Collection:
   a. For particulate collection equipment, include adequate filtration to contain debris removed. Locate equipment downwind and away from all air intakes and other points of entry into the building.
   b. HEPA filtration with 99.97 percent collection efficiency for particles sized 0.3 micrometer or larger shall be used where the particulate collection equipment is exhausting inside the building,
6. Control odors and mist vapors during the cleaning and restoration process.
7. Mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning. Restore them to their marked position on completion of cleaning.
8. System components shall be cleaned so that all HVAC system components are visibly clean. On completion, all components must be returned to those settings recorded just prior to cleaning operations.
9. Clean all air-distribution devices, registers, grilles, and diffusers.
10. Clean visible surface contamination deposits according to NADCA ACR 2006 and the following:
    a. Clean air-handling units, airstream surfaces, components, condensate collectors, and drains.
    b. Ensure that a suitable operative drainage system is in place prior to beginning wash-down procedures.
    c. Clean evaporator coils, reheat coils, and other airstream components.
11. Duct Systems:
    a. Create service openings in the HVAC system as necessary to accommodate cleaning.
    b. Mechanically clean duct systems specified to remove all visible contaminants so that the systems are capable of passing the HVAC System Cleanliness Tests (see NADCA ACR 2006).
12. Debris removed from the HVAC system shall be disposed of according to applicable Federal, state, and local requirements.
13. Mechanical Cleaning Methodology:
    a. Source-Removal Cleaning Methods: The HVAC system shall be cleaned using source-removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and to safely remove these contaminants from the facility. No cleaning method, or combination of methods, shall be used that could potentially damage components of the HVAC system or negatively alter the integrity of the system.

1) Use continuously operating vacuum-collection devices to keep each section being cleaned under negative pressure.
2) Cleaning methods that require mechanical agitation devices to dislodge debris that is adhered to interior surfaces of HVAC system components shall be equipped to safely remove these devices. Cleaning methods shall not damage the integrity of HVAC system components or damage porous surface materials such as duct and plenum liners.

b. Cleaning Mineral-Fiber Insulation Components:
1) Fibrous-glass thermal or acoustical insulation elements present in equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment while the HVAC system is under constant negative pressure and shall not be permitted to get wet according to NADCA ACR 2006.
2) Cleaning methods used shall not cause damage to fibrous-glass components and will render the system capable of passing the HVAC System Cleanliness Tests (see NADCA ACR 2006).
3) Fibrous materials that become wet shall be discarded and replaced.

14. Coil Cleaning:
a. Measure static-pressure differential across each coil.
b. See NADCA ACR 2006, "Coil Surface Cleaning" Section. Type 1, or Type 1 and Type 2, cleaning methods shall be used to render the coil visibly clean and capable of passing Coil Cleaning Verification (see applicable NADCA ACR 2006).
c. Coil drain pans shall be subject to NADCA ACR 2006, "Non-Porous Surfaces Cleaning Verification." Ensure that condensate drain pans are operational.
d. Electric-resistance coils shall be de-energized, locked out, and tagged before cleaning.
e. Cleaning methods shall not cause any appreciable damage to, cause displacement of, inhibit heat transfer, or cause erosion of the coil surface or fins, and shall comply with coil manufacturer's written recommendations when available.
f. Rinse thoroughly with clean water to remove any latent residues.

15. Antimicrobial Agents, Coatings, and Sanitizers:
a. Apply antimicrobial agents, coatings, and sanitizers if active fungal growth is reasonably suspected or where unacceptable levels of fungal contamination have been verified. Apply antimicrobial agents and coatings according to manufacturer's written recommendations and EPA registration listing after the removal of surface deposits and debris.
b. When used, antimicrobial treatments, coatings, and sanitizers shall be applied after the system is rendered clean.
c. Apply antimicrobial agents, coatings, and sanitizers directly onto surfaces of interior ductwork. Fogging is prohibited.
d. Sanitizing agent products shall be registered by the EPA as specifically intended for use in HVAC systems and ductwork.

D. Cleanliness Verification
1. Verify cleanliness according to NADCA ACR 2006, "Verification of HVAC System Cleanliness" Section.
2. Verify HVAC system cleanliness after mechanical cleaning and before applying any treatment or introducing any treatment-related substance to the HVAC system, including biocidal agents, coatings, and sanitizers.
3. Perform visual inspection for cleanliness. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.
4. Additional Verification:
a. Perform surface comparison testing or NADCA vacuum test.
b. Conduct NADCA vacuum gravimetric test analysis for nonporous surfaces.
5. Verification of Coil Cleaning:
a. Measure static-pressure differential across each coil.

b. Coil will be considered clean if cleaning restored the coil static-pressure differential within 10 percent of <**Insert inches wg (Pa)**>, the differential measured when the coil was first installed.
OR
Coil will be considered clean if the coil is free of foreign matter and chemical residue, based on a thorough visual inspection.

6. Prepare a written cleanliness verification report. At a minimum, include the following:
   a. Written documentation of the success of the cleaning.
   b. Site inspection reports, initialed by supervisor, including notation on areas of inspection, as verified through visual inspection.
   c. Surface comparison test results if required.
   d. Gravimetric analysis (nonporous surfaces only).
   e. System areas found to be damaged.
7. Photographic Documentation: Comply with requirements listed in Scope of Work.

E. Restoration
1. Restore and repair HVAC air-distribution equipment, ducts, plenums, and components according to NADCA ACR 2006, "Restoration and Repair of Mechanical Systems" Section.
2. Restore service openings capable of future reopening. Comply with requirements in Division 15 Section "Metal Ducts". Include location of service openings in Project closeout report.
3. Replace fibrous-glass materials that cannot be restored by cleaning or resurfacing. Comply with requirements in Division 15 Section(s) "Metal Ducts" AND "Nonmetal Ducts"
4. Replace damaged insulation according to Division 15 Section "Hvac Insulation",
5. Ensure that closures do not hinder or alter airflow.
6. New closure materials, including insulation, shall match opened materials and shall have removable closure panels fitted with gaskets and fasteners.
7. Reseal fibrous-glass ducts. Comply with requirements in Division 15 Section "Nonmetal Ducts".

END OF SECTION 15048

Task	Specification	Specification Description
15048	01720	Cutting and Patching
15048	02112	Selective Demolition
15048	15041	Sequence Of Operation
15048	15043	Testing, Adjusting, And Balancing

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SECTION 15061 - DOMESTIC WATER PIPING

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for domestic water piping. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section Includes:
a. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
b. Encasement for piping.
c. Specialty valves.
d. Flexible connectors.
e. Water meters furnished by utility company for installation by Contractor.
OR
Water meters.
f. Escutcheons.
g. Sleeves and sleeve seals.
h. Wall penetration systems.

C. Performance Requirements
1. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to ASCE/SEI 7.

D. Submittals
1. Product Data: For each type of product indicated.
2. LEED Submittal:
a. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.
3. Field quality-control reports.

E. Quality Assurance
1. Piping materials shall bear label, stamp, or other markings of specified testing agency.
2. Comply with NSF 14 for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping, **as directed**.
3. Comply with NSF 61 for potable domestic water piping and components.

F. Project Conditions
1. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
a. Notify the Owner no fewer than two days in advance of proposed interruption of water service.
b. Do not proceed with interruption of water service without the Owner's written permission.

1.2 PRODUCTS

A. Piping Materials

1. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Copper Tube And Fittings
1. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) water tube, drawn temper.
   a. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
   b. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
   c. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
   d. 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.
   e. Copper Pressure-Seal-Joint Fittings:
      1) NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
      2) NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.
   f. Copper Push-on-Joint Fittings:
      1) Description: Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22; with stainless-steel teeth and EPDM-rubber O-ring seal in each end instead of solder-joint ends.
   g. Copper-Tube Extruded-Tee Connections:
      1) Description: Tee formed in copper tube according to ASTM F 2014.
   h. Grooved-Joint Copper-Tube Appurtenances:
      1) Copper Grooved-End Fittings: ASTM B 75 (ASTM B 75M) copper tube or ASTM B 584 bronze castings.
      2) Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.
2. Soft Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A) and ASTM B 88, Type L (ASTM B 88M, Type B) water tube, annealed temper.
   a. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
   b. Copper Pressure-Seal-Joint Fittings:
      1) NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
      2) NPS 3 and NPS 4 (DN 80 and DN 100): Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

C. Ductile-Iron Pipe And Fittings
1. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
   a. Standard-Pattern, Mechanical-Joint Fittings: AWWA C110, ductile or gray iron.
   b. Compact-Pattern, Mechanical-Joint Fittings: AWWA C153, ductile iron.
      1) Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
2. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
   a. Standard-Pattern, Push-on-Joint Fittings: AWWA C110, ductile or gray iron.
      1) Gaskets: AWWA C111, rubber.
   b. Compact-Pattern, Push-on-Joint Fittings: AWWA C153, ductile iron.
      1) Gaskets: AWWA C111, rubber.
3. Plain-End, Ductile-Iron Pipe: AWWA C151.
   a. Grooved-Joint, Ductile-Iron-Pipe Appurtenances:
      1) Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.

2) Grooved-End, Ductile-Iron-Pipe Couplings: AWWA C606 for ductile-iron-pipe dimensions. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.

D. Galvanized-Steel Pipe And Fittings
1. Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B, Standard Weight. Include ends matching joining method.
a. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Standard Weight, seamless steel pipe with threaded ends.
b. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
c. 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.
d. Flanges: ASME B16.1, Class 125, cast iron.
e. Grooved-Joint, Galvanized-Steel-Pipe Appurtenances:
1) Galvanized, Grooved-End Fittings for Galvanized-Steel Piping: ASTM A 47/A 47M, malleable-iron casting; ASTM A 106/A 106M, steel pipe; or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
2) Grooved-End-Pipe Couplings for Galvanized-Steel Piping: AWWA C606 for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.

E. CPVC Piping
1. CPVC Pipe: ASTM F 441/F 441M, Schedule 40 and Schedule 80.
a. CPVC Socket Fittings: ASTM F 438 for Schedule 40 and ASTM F 439 for Schedule 80.
b. CPVC Threaded Fittings: ASTM F 437, Schedule 80.
2. CPVC Piping System: ASTM D 2846/D 2846M, SDR 11, pipe and socket fittings.
3. CPVC Tubing System: ASTM D 2846/D 2846M, SDR 11, tube and socket fittings.

F. PEX Tube And Fittings
1. PEX Distribution System: ASTM F 877, SDR 9 tubing.
a. Fittings for PEX Tube: ASTM F 1807, metal-insert type with copper or stainless-steel crimp rings and matching PEX tube dimensions.
b. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F 877; with plastic or corrosion-resistant-metal valve for each outlet.

G. PVC Pipe And Fittings
1. PVC Pipe: ASTM D 1785, Schedule 40 and Schedule 80.
a. PVC Socket Fittings: ASTM D 2466 for Schedule 40 and ASTM D 2467 for Schedule 80.
b. PVC Schedule 80 Threaded Fittings: ASTM D 2464.

H. Piping Joining Materials
1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
2. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
3. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
4. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
5. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.
a. Use CPVC solvent cement that has a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
b. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

a. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
b. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

7. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

I. Encasement For Piping
1. Standard: ASTM A 674 or AWWA C105.
2. Form: Sheet **OR** Tube, **as directed**.
3. Material: LLDPE film of 0.008-inch (0.20-mm) **OR** LLDPE film of 0.008-inch (0.20-mm) minimum thickness or high-density, cross-laminated PE film of 0.004-inch (0.10-mm) **OR** High-density, cross-laminated PE film of 0.004-inch (0.10-mm), **as directed**, minimum thickness.
4. Color: Black **OR** Natural, **as directed**.

J. Specialty Valves
1. Comply with requirements in Division 15 Section "General-duty Valves For Plumbing Piping" for general-duty metal valves.
2. Comply with requirements in Division 15 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.
3. CPVC Union Ball Valves:
   a. Description:
      1) Standard: MSS SP-122.
      2) Pressure Rating: 125 psig (860 kPa) **OR** 150 psig (1035 kPa), **as directed**, at 73 deg F (23 deg C).
      3) Body Material: CPVC.
      4) Body Design: Union type.
      5) End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, socket **OR** threaded, **as directed**.
      6) End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Detachable, socket **OR** threaded **OR** flanged, **as directed**.
      7) Ball: CPVC; full port.
      8) Seals: PTFE or EPDM-rubber O-rings.
      9) Handle: Tee shaped.
4. PVC Union Ball Valves:
   a. Description:
      1) Standard: MSS SP-122.
      2) Pressure Rating: 125 psig (860 kPa) **OR** 150 psig (1035 kPa), **as directed**, at 73 deg F (23 deg C).
      3) Body Material: PVC.
      4) Body Design: Union type.
      5) End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, socket **OR** threaded, **as directed**.
      6) End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Detachable, socket **OR** threaded **OR** flanged, **as directed**.
      7) Ball: PVC; full port.
      8) Seals: PTFE or EPDM-rubber O-rings.
      9) Handle: Tee shaped.
5. CPVC Non-Union Ball Valves:
   a. Description:
      1) Standard: MSS SP-122.
      2) Pressure Rating: 125 psig (860 kPa) **OR** 150 psig (1035 kPa), **as directed**, at 73 deg F (23 deg C).
      3) Body Material: CPVC.
      4) Body Design: Non-union type.

5) End Connections: Socket or threaded.
6) Ball: CPVC; full or reduced port.
7) Seals: PTFE or EPDM-rubber O-rings.
8) Handle: Tee shaped.

6. PVC Non-Union Ball Valves:
   a. Description:
      1) Standard: MSS SP-122.
      2) Pressure Rating: 125 psig (860 kPa) **OR** 150 psig (1035 kPa), **as directed**, at 73 deg F (23 deg C).
      3) Body Material: PVC.
      4) Body Design: Non-union type.
      5) End Connections: Socket or threaded.
      6) Ball: PVC; full or reduced port.
      7) Seals: PTFE or EPDM-rubber O-rings.
      8) Handle: Tee shaped.
7. CPVC Butterfly Valves:
   a. Description:
      1) Pressure Rating: 125 psig (860 kPa) **OR** 150 psig (1035 kPa), **as directed**, at 73 deg F (23 deg C).
      2) Body Material: CPVC.
      3) Body Design: Lug or wafer type.
      4) Seat: EPDM rubber.
      5) Seals: PTFE or EPDM-rubber O-rings.
      6) Disc: CPVC.
      7) Stem: Stainless steel.
      8) Handle: Lever.
8. PVC Butterfly Valves:
   a. Description:
      1) Pressure Rating: 125 psig (860 kPa) **OR** 150 psig (1035 kPa), **as directed**, at 73 deg F (23 deg C).
      2) Body Material: PVC.
      3) Body Design: Lug or wafer type.
      4) Seat: EPDM rubber.
      5) Seals: PTFE or EPDM-rubber O-rings.
      6) Disc: PVC.
      7) Stem: Stainless steel.
      8) Handle: Lever.
9. CPVC Ball Check Valves:
   a. Description:
      1) Pressure Rating: 125 psig (860 kPa) **OR** 150 psig (1035 kPa), **as directed**, at 73 deg F (23 deg C).
      2) Body Material: CPVC.
      3) Body Design: Union-type ball check.
      4) End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, socket **OR** threaded, **as directed**.
      5) End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Detachable, socket **OR** threaded **OR** flanged, **as directed**.
      6) Ball: CPVC.
      7) Seals: EPDM- or FKM-rubber O-rings.
10. PVC Ball Check Valves:
   a. Description:
      1) Pressure Rating: 125 psig (860 kPa) **OR** 150 psig (1035 kPa), **as directed**, at 73 deg F (23 deg C).
      2) Body Material: PVC.
      3) Body Design: Union-type ball check.

4) End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, socket **OR** threaded, **as directed**.
5) End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Detachable, socket **OR** threaded **OR** flanged, **as directed**.
6) Ball: PVC.
7) Seals: EPDM- or FKM-rubber O-rings.

11. CPVC Gate Valves:
    a. Description:
        1) Pressure Rating: 125 psig (860 kPa) **OR** 150 psig (1035 kPa), **as directed**, at 73 deg F (23 deg C).
        2) Body Material: CPVC.
        3) Body Design: Nonrising stem.
        4) End Connections for Valves NPS 2 (DN 50) and Smaller: Socket **OR** Threaded, **as directed**.
        5) End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Socket **OR** Threaded **OR** Flanged, **as directed**.
        6) Gate and Stem: Plastic.
        7) Seals: EPDM rubber.
        8) Handle: Wheel.
12. PVC Gate Valves:
    a. Description:
        1) Pressure Rating: 125 psig (860 kPa) **OR** 150 psig (1035 kPa), **as directed**, at 73 deg F (23 deg C).
        2) Body Material: PVC.
        3) Body Design: Nonrising stem.
        4) End Connections for Valves NPS 2 (DN 50) and Smaller: Socket **OR** Threaded, **as directed**.
        5) End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Socket **OR** Threaded **OR** Flanged, **as directed**.
        6) Gate and Stem: Plastic.
        7) Seals: EPDM rubber.
        8) Handle: Wheel.

K. Transition Fittings
1. General Requirements:
    a. Same size as pipes to be joined.
    b. Pressure rating at least equal to pipes to be joined.
    c. End connections compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Sleeve-Type Transition Coupling: AWWA C219.
4. Plastic-to-Metal Transition Fittings:
    a. Description: CPVC **OR** PVC, **as directed**, one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert and one solvent-cement-socket threaded, **as directed**, end.
5. Plastic-to-Metal Transition Unions:
    a. Description: CPVC **OR** PVC, **as directed**, four-part union. Include brass or stainless-steel, **as directed**, threaded end, solvent-cement-joint or threaded, **as directed**, plastic end, rubber O-ring, and union nut.

L. Dielectric Fittings
1. 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.
2. Dielectric Unions:

a. Description:
1) Pressure Rating: 150 psig (1035 kPa) **OR** 250 psig (1725 kPa), **as directed**, at 180 deg F (82 deg C).
2) End Connections: Solder-joint copper alloy and threaded ferrous.

3. Dielectric Flanges:
a. Description:
1) Factory-fabricated, bolted, companion-flange assembly.
2) Pressure Rating: 150 psig (1035 kPa) **OR** 175 psig (1200 kPa) minimum **OR** 300 psig (2070 kPa), **as directed**.
3) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

4. Dielectric-Flange Kits:
a. Description:
1) Nonconducting materials for field assembly of companion flanges.
2) Pressure Rating: 150 psig (1035 kPa).
3) Gasket: Neoprene or phenolic.
4) Bolt Sleeves: Phenolic or polyethylene.
5) Washers: Phenolic with steel backing washers.

5. Dielectric Couplings:
a. Description:
1) Galvanized-steel coupling.
2) Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).
3) End Connections: Female threaded.
4) Lining: Inert and noncorrosive, thermoplastic.

6. Dielectric Nipples:
a. Description:
1) Electroplated steel nipple complying with ASTM F 1545.
2) Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).
3) End Connections: Male threaded or grooved.
4) Lining: Inert and noncorrosive, propylene.

M. Flexible Connectors
1. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
a. Working-Pressure Rating: Minimum 200 psig (1380 kPa) **OR** 250 psig (1725 kPa), **as directed**.
b. End Connections NPS 2 (DN 50) and Smaller: Threaded copper pipe or plain-end copper tube.
c. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged copper alloy.

2. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
a. Working-Pressure Rating: Minimum 200 psig (1380 kPa) **OR** 250 psig (1725 kPa), **as directed**.
b. End Connections NPS 2 (DN 50) and Smaller: Threaded steel-pipe nipple.
c. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged steel nipple.

N. Water Meters
1. Displacement-Type Water Meters:
a. Description:
1) Standard: AWWA C700.
2) Pressure Rating: 150-psig (1035-kPa) working pressure.
3) Body Design: Nutating disc; totalization meter.
4) Registration: In gallons (liters) or cubic feet (cubic meters) as required by utility.
5) Case: Bronze.
6) End Connections: Threaded.

2. Turbine-Type Water Meters:

a. Description:
1) Standard: AWWA C701.
2) Pressure Rating: 150-psig (1035-kPa) working pressure.
3) Body Design: Turbine; totalization meter.
4) Registration: In gallons (liters) or cubic feet (cubic meters) as required by utility company.
5) Case: Bronze.
6) End Connections for Meters NPS 2 (DN 50) and Smaller: Threaded.
7) End Connections for Meters NPS 2-1/2 (DN 65) and Larger: Flanged.

3. Compound-Type Water Meters:
a. Description:
1) Standard: AWWA C702.
2) Pressure Rating: 150-psig (1035-kPa) working pressure.
3) Body Design: With integral mainline and bypass meters; totalization meter.
4) Registration: In gallons (liters) or cubic feet (cubic meters) as required by utility company.
5) Case: Bronze.
6) Pipe Connections: Flanged.

4. Fire-Service-Type Water Meters:
a. Description:
1) Standard: AWWA C703 and UL listing.
2) Pressure Rating: 175-psig (1200-kPa) working pressure.
3) Body Design:
a) Proportional, Detector-Type Water Meters: With meter on bypass.
i. Bypass Meter: AWWA C701, turbine **OR** AWWA C702, compound, **as directed**, type with bronze case; size not less than one-half nominal size of main-line meter.
b) Turbine-Type Water Meters: With strainer, and with meter on bypass.
i. Strainer: Full size, matching water meter.
ii. Bypass Meter: AWWA C701, turbine type with bronze case; not less than NPS 2 (DN 50).
4) Registration: In gallons (liters) or cubic feet (cubic meters) as required by utility company.
5) Case: Bronze.
6) Pipe Connections for Meters NPS 2 (DN 50) and Smaller: Threaded.
7) Pipe Connections for Meters NPS 2-1/2 (DN 65) and Larger: Flanged.

5. Remote Registration System: Direct-reading type complying with AWWA C706; modified with signal transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.
OR
Remote Registration System: Encoder type complying with AWWA C707; modified with signal transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

O. Escutcheons
1. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
2. One Piece, Cast Brass: Polished, chrome-plated **OR** rough-brass, **as directed**, finish with setscrews.
3. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.
4. One Piece, Stamped Steel: Chrome-plated finish with setscrew **OR** spring clips, **as directed**.
5. Split Casting, Cast Brass: Polished, chrome-plated **OR** rough-brass, **as directed**, finish with concealed hinge and setscrew.
6. Split Plate, Stamped Steel: Chrome-plated finish with concealed **OR** exposed-rivet, **as directed**, hinge, setscrew **OR** spring clips, **as directed**.
7. One-Piece Floor Plates: Cast-iron flange with holes for fasteners, **as directed**.

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

P. Sleeves
1. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
2. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
3. Molded-PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
4. Molded-PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.
5. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
6. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.
7. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
   a. Underdeck Clamp: Clamping ring with setscrews.

Q. Sleeve Seals
1. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.
   a. Sealing Elements: EPDM-rubber **OR** NBR, **as directed**, interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   b. Pressure Plates: Carbon steel **OR** Plastic **OR** Stainless steel, **as directed**.
   c. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, **OR** Stainless steel, **as directed**, of length required to secure pressure plates to sealing elements.

R. Wall Penetration Systems
1. Description: Wall-sleeve assembly, consisting of housing and gland, gaskets, and pipe sleeve.
   a. Carrier-Pipe Deflection: Up to 5 percent without leakage.
   b. Housing: Ductile-iron casting with hub, waterstop, anchor ring, and locking devices. Include gland, bolts, and nuts.
   c. Housing-to-Sleeve Gasket: EPDM rubber **OR** NBR, **as directed**.
   d. Housing-to-Carrier-Pipe Gasket: AWWA C111, EPDM rubber **OR** NBR, **as directed**.
   e. Pipe Sleeve: AWWA C151, ductile-iron pipe **OR** ASTM A 53/A 53M, Schedule 40, zinc-coated steel pipe, **as directed**.

S. Grout
1. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
2. Characteristics: Nonshrink; recommended for interior and exterior applications.
3. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
4. Packaging: Premixed and factory packaged.

1.3 EXECUTION

A. Earthwork
1. Comply with requirements in Division 02 Section "Earthwork" for excavating, trenching, and backfilling.

B. Piping Installation
1. 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.
2. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

3. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
4. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105.
5. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 15 Section "Meters And Gages For Plumbing Piping" for pressure gages and Division 15 Section "Domestic Water Piping Specialties" for drain valves and strainers.
6. Install shutoff valve immediately upstream of each dielectric fitting.
7. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 15 Section "Domestic Water Piping Specialties" for pressure-reducing valves.
8. Install domestic water piping level with 0.25 percent slope downward toward drain **OR** without pitch, **as directed**, and plumb.
9. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
10. Install seismic restraints on piping. Comply with requirements in Division 15 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment" for seismic-restraint devices.
11. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
12. 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.
13. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
14. Install piping adjacent to equipment and specialties to allow service and maintenance.
15. Install piping to permit valve servicing.
16. 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.
17. Install piping free of sags and bends.
18. Install fittings for changes in direction and branch connections.
19. Install PEX piping with loop at each change of direction of more than 90 degrees.
20. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
21. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 15 Section "Meters And Gages For Plumbing Piping" for pressure gages.
22. Install thermostats in hot-water circulation piping. Comply with requirements in Division 15 Section "Domestic Water Pumps" for thermostats.
23. Install thermometers on inlet **OR** inlet and outlet, **as directed**, piping from each water heater. Comply with requirements in Division 15 Section "Meters And Gages For Plumbing Piping" for thermometers.

C. Joint Construction
1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
2. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
3. 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:
   a. Apply appropriate tape or thread compound to external pipe threads.
   b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
4. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

5. 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."
6. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
7. Copper-Tubing, Push-on Joints: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.
8. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
9. Copper-Tubing Grooved Joints: Roll groove end of tube. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for roll-grooved joints.
10. Ductile-Iron-Piping Grooved Joints: Cut groove end of pipe. Assemble coupling with housing, gasket, lubricant, and bolts. Join ductile-iron pipe and grooved-end fittings according to AWWA C606 for ductile-iron-pipe, cut-grooved joints.
11. Steel-Piping Grooved Joints: Cut **OR** Roll, **as directed**, groove end of pipe. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
12. 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.
13. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
    a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
    b. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
    c. PVC Piping: Join according to ASTM D 2855.
14. PEX Piping Joints: Join according to ASTM F 1807.
15. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

D. Valve Installation
1. General-Duty Valves: Comply with requirements in Division 15 Section "General-duty Valves For Plumbing Piping" for valve installations.
2. 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 or gate valves for piping NPS 2 (DN 50) and smaller. Use butterfly or gate valves for piping NPS 2-1/2 (DN 65) and larger.
3. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 15 Section "Domestic Water Piping Specialties".
    a. Hose-End Drain Valves: At low points in water mains, risers, and branches.
    b. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.
4. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 (DN 50) and smaller and butterfly valves for piping NPS 2-1/2 (DN 65) and larger. Comply with requirements in Division 15 Section "Domestic Water Piping Specialties" for balancing valves.
5. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 15 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

E. Transition Fitting Installation
1. Install transition couplings at joints of dissimilar piping.
2. Transition Fittings in Underground Domestic Water Piping:

a. NPS 1-1/2 (DN 40) and Smaller: Fitting-type coupling.
b. NPS 2 (DN 50) and Larger: Sleeve-type coupling.

3. Transition Fittings in Aboveground Domestic Water Piping NPS 2 (DN 50) and Smaller: Plastic-to-metal transition fittings **OR** unions, **as directed**.

F. Dielectric Fitting Installation
1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric couplings **OR** nipples **OR** unions, **as directed**.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges **OR** flange kits **OR** nipples, **as directed**.
4. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

G. Flexible Connector Installation
1. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump, **as directed**.
2. Install bronze-hose flexible connectors in copper domestic water tubing.
3. Install stainless-steel-hose flexible connectors in steel domestic water piping.

H. Water Meter Installation
1. Rough-in domestic water piping for water meter installation, and install water meters, **as directed**, according to utility company's requirements.
2. Water meters will be furnished and installed by utility company.
OR
Install water meters according to AWWA M6 and utility company's requirements.
3. Install displacement-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities having jurisdiction.
OR
Install turbine-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities having jurisdiction.
OR
Install compound-type water meters with shutoff valves on water-meter inlet and outlet and on valved bypass around meter. Support meters, valves, and piping on brick or concrete piers.
OR
Install fire-service water meters with shutoff valves on water-meter inlet and outlet and on full-size valved bypass around meter. Support meter, valves, and piping on brick or concrete piers.
4. Install remote registration system according to standards of utility company and of authorities having jurisdiction.

I. Hanger And Support Installation
1. Comply with requirements in Division 15 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment" for seismic-restraint devices.
2. Comply with requirements in Division 15 Section "Hangers And Supports For Plumbing Piping And Equipment" for pipe hanger and support products and installation.
a. Vertical Piping: MSS Type 8 or 42, clamps.
b. Individual, Straight, Horizontal Piping Runs:
1) 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
2) Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
3) Longer Than 100 Feet (30 m) If Indicated: MSS Type 49, spring cushion rolls.
c. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
d. Base of Vertical Piping: MSS Type 52, spring hangers.
3. Support vertical piping and tubing at base and at each floor.

4. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch (10 mm).
5. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   a. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
   b. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
   c. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
   d. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
   e. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
   f. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
   g. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.
6. Install supports for vertical copper tubing every 10 feet (3 m).
7. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
   a. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
   b. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
   c. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
   d. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
   e. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
   f. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
   g. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
   h. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
8. Install supports for vertical steel piping every 15 feet (4.5 m).
9. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:
   a. NPS 1 (DN 25) and Smaller: 36 inches (900 mm) with 3/8-inch (10-mm) rod.
   b. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
   c. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
   d. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
   e. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
   f. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
10. Install supports for vertical CPVC piping every 60 inches (1500 mm) for NPS 1 (DN 25) and smaller, and every 72 inches (1800 mm) for NPS 1-1/4 (DN 32) and larger.
11. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:
    a. NPS 1 (DN 25) and Smaller: 32 inches (815 mm) with 3/8-inch (10-mm) rod.
12. Install hangers for vertical PEX piping every 48 inches (1200 mm).
13. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
    a. NPS 2 (DN 50) and Smaller: 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
    b. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
    c. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
    d. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
    e. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
14. Install supports for vertical PVC piping every 48 inches (1200 mm).
15. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

J. Connections
   1. Drawings indicate general arrangement of piping, fittings, and specialties.
   2. Install piping adjacent to equipment and machines to allow service and maintenance.

3. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
4. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
   a. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
   b. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
   c. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 15 Section(s) "Plumbing Fixtures" OR "Medical Plumbing Fixtures" OR "Emergency Plumbing Fixtures" OR "Security Plumbing Fixtures", **as directed**, for connection sizes.
   d. 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 (DN 65) and larger.

K. Escutcheon Installation
1. Install escutcheons for penetrations of walls, ceilings, and floors.
2. Escutcheons for New Piping:
   a. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
   b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish **OR** stamped steel with set screw **OR** stamped steel with set screw or spring clips **OR** stamped steel with spring clips, **as directed**.
   c. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish **OR** One piece or split casting, cast brass with polished chrome-plated finish **OR** Split casting, cast brass with polished chrome-plated finish **OR** One piece, stamped steel with set screw **OR** One piece or split plate, stamped steel with set screw **OR** Split plate, stamped steel with set screw, **as directed**.
   d. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish **OR** cast brass with rough-brass finish **OR** stamped steel with set screw **OR** stamped steel with spring clips **OR** stamped steel with set screw or spring clips, **as directed**.
   e. Bare Piping in Equipment Rooms: One piece, cast brass **OR** stamped steel with set screw **OR** stamped steel with spring clips **OR** stamped steel with set screw or spring clips, **as directed**.
   f. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.
3. Escutcheons for Existing Piping:
   a. Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.
   b. Insulated Piping: Split plate, stamped steel with concealed **OR** exposed-rivet, **as directed**, hinge and spring clips.
   c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish **OR** plate, stamped steel with concealed hinge and spring clips, **as directed**.
   d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish **OR** plate, stamped steel with concealed hinge and set screw, **as directed**.
   e. Bare Piping in Unfinished Service Spaces: Split casting, cast brass with polished chrome-plated finish **OR** casting, cast brass with rough-brass finish **OR** plate, stamped steel with concealed hinge and set screw or spring clips **OR** plate, stamped steel with concealed or exposed-rivet hinge and set screw or spring clips **OR** plate, stamped steel with exposed-rivet hinge and set screw or spring clips, **as directed**.
   f. Bare Piping in Equipment Rooms: Split casting, cast brass **OR** plate, stamped steel with set screw or spring clips, **as directed**.
   g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.

L. Sleeve Installation

1. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
2. Sleeves are not required for core-drilled holes.
3. Permanent sleeves are not required for holes formed by removable PE sleeves.
4. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
5. Install sleeves in new partitions, slabs, and walls as they are built.
6. 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.
7. 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.
8. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals **OR** wall penetration systems, **as directed**, specified in this Section.
9. Seal space outside of sleeves in concrete slabs and walls with grout.
10. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
11. Install sleeve materials according to the following applications:
    a. Sleeves for Piping Passing through Concrete Floor Slabs: Molded PE **OR** Molded PVC **OR** Steel pipe, **as directed**.
    b. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe **OR** Stack sleeve fittings, **as directed**.
        1) Extend sleeves 2 inches (50 mm) above finished floor level.
        2) For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing And Trim" for flashing.
    c. Sleeves for Piping Passing through Gypsum-Board Partitions:
        1) PVC pipe **OR** Steel pipe, **as directed**, sleeves for pipes smaller than NPS 6 (DN 150).
        2) Galvanized-steel sheet sleeves for pipes NPS 6 (DN 150) and larger.
        3) Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
    d. Sleeves for Piping Passing through Concrete Roof Slabs: Molded PE **OR** Molded PVC **OR** Steel pipe, **as directed**.
    e. Sleeves for Piping Passing through Exterior Concrete Walls:
        1) Steel pipe sleeves for pipes smaller than NPS 6 (DN 150).
        2) Cast-iron wall pipe sleeves for pipes NPS 6 (DN 150) and larger.
        3) Install sleeves that are large enough to provide 1-inch (25-mm) annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
        4) Do not use sleeves when wall penetration systems are used.
    f. Sleeves for Piping Passing through Interior Concrete Walls:
        1) PVC pipe **OR** Steel pipe, **as directed**, sleeves for pipes smaller than NPS 6 (DN 150).
        2) Galvanized-steel sheet sleeves for pipes NPS 6 (DN 150) and larger.
12. 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 "Through-penetration Firestop Systems" for firestop materials and installations.

M. Sleeve Seal Installation
1. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
2. 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.

N. Wall Penetration System Installation
1. Install wall penetration systems in new, exterior concrete walls.
2. 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.

O. Identification
1. Identify system components. Comply with requirements in Division 15 Section "Identification For Plumbing Piping And Equipment" for identification materials and installation.
2. Label pressure piping with system operating pressure.

P. Field Quality Control
1. Perform tests and inspections.
2. Piping Inspections:
   a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
   b. 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:
      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 final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
   c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
   d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
3. Piping Tests:
   a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
   b. 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 a separate report for each test, complete with diagram of portion of piping tested.
   c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   d. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
   e. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
   f. Prepare reports for tests and for corrective action required.
4. Domestic water piping will be considered defective if it does not pass tests and inspections.
5. Prepare test and inspection reports.

Q. Adjusting
1. Perform the following adjustments before operation:
   a. Close drain valves, hydrants, and hose bibbs.
   b. Open shutoff valves to fully open position.
   c. Open throttling valves to proper setting.
   d. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

1) Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
2) Adjust calibrated balancing valves to flows indicated.

e. Remove plugs used during testing of piping and for temporary sealing of piping during installation.

f. Remove and clean strainer screens. Close drain valves and replace drain plugs.

g. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.

h. Check plumbing specialties and verify proper settings, adjustments, and operation.

R. Cleaning

1. Clean and disinfect potable and non-potable, **as directed**, domestic water piping as follows:
   a. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
   b. 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:
      1) Flush piping system with clean, potable water until dirty water does not appear at outlets.
      2) Fill and isolate system according to either of the following:
         a) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.
         b) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
      3) Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
      4) Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
2. Clean non-potable domestic water piping as follows:
   a. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
   b. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
      1) Flush piping system with clean, potable water until dirty water does not appear at outlets.
      2) Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
3. Prepare and submit reports of purging and disinfecting activities.
4. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

S. Piping Schedule

1. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
2. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
3. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
4. Under-building-slab, domestic water, building service piping, NPS 3 (DN 80) and smaller, shall be one of the following:
   a. Soft copper tube, ASTM B 88, Type K (ASTM B 88M, Type A) **OR** ASTM B 88, Type L (ASTM B 88M, Type B), **as directed**; wrought-copper solder-joint fittings; and brazed **OR** copper pressure-seal fittings; and pressure-sealed, **as directed**, joints.
   b. PVC, Schedule 40 pipe; PVC, Schedule 40 **OR** Schedule 80 pipe; PVC, Schedule 80, **as directed**, socket fittings; and solvent-cemented joints.
5. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 (DN 100 to DN 200) and larger, shall be one of the following:

a. Soft copper tube, ASTM B 88, Type K (ASTM B 88M, Type A) **OR** ASTM B 88, Type L (ASTM B 88M, Type B), **as directed**; wrought-copper solder-joint fittings; and brazed joints.
b. Mechanical-joint, ductile-iron pipe; standard-pattern **OR** compact-pattern, **as directed**, mechanical-joint fittings; and mechanical joints.
c. Push-on-joint, ductile-iron pipe; standard-pattern **OR** compact-pattern, **as directed**, push-on-joint fittings; and gasketed joints.
d. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
e. PVC, Schedule 40 pipe; PVC, Schedule 40 **OR** Schedule 80 pipe; PVC, Schedule 80, **as directed**, socket fittings; and solvent-cemented joints.

6. Under-building slab, combined domestic water, building-service, and fire-service-main piping, NPS 6 to NPS 12 (DN 150 to DN 300), shall be one of the following:
   a. Mechanical-joint, ductile-iron pipe; standard-pattern **OR** compact-pattern, **as directed**, mechanical-joint fittings; and mechanical joints.
   b. Push-on-joint, ductile-iron pipe; standard-pattern **OR** compact-pattern, **as directed**, push-on-joint fittings; and gasketed joints.
   c. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
7. Under-building-slab, domestic water piping, NPS 2 (DN 50) and smaller, shall be one of the following:
   a. Hard **OR** Soft, **as directed**, copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); wrought-copper solder-joint fittings; and brazed **OR** copper pressure-seal-joint fittings; and pressure-sealed, **as directed**, joints.
   b. PVC, Schedule 40 pipe; PVC, Schedule 40 **OR** Schedule 80 pipe; PVC, Schedule 80, **as directed**, socket fittings; and solvent-cemented joints.
8. Aboveground domestic water piping, NPS 2 (DN 50) and smaller, shall be one of the following:
   a. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
   b. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B), **as directed**; cast-copper **OR** wrought-copper, **as directed**, solder-joint fittings; and brazed **OR** soldered, **as directed**, joints.
   c. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B, **as directed**; copper pressure-seal-joint fittings; and pressure-sealed joints.
   d. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B) **OR**, **as directed**; copper push-on-joint fittings; and push-on joints.
   e. CPVC, Schedule 40 pipe; CPVC, Schedule 40 **OR** Schedule 80 pipe; CPVC, Schedule 80, **as directed**, socket fittings; and solvent-cemented joints.
   f. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
   g. CPVC Tubing System: CPVC tube; CPVC socket fittings; and solvent-cemented joints. NPS 1-1/2 (DN 40) and NPS 2 (DN 50) CPVC pipe with CPVC socket fittings may be used instead of tubing.
   h. PEX Tube, NPS 1 (DN 25) and smaller; fittings for PEX tube; and crimped joints.
   i. PVC, Schedule 40 pipe; PVC, Schedule 40 **OR** Schedule 80 pipe; PVC, Schedule 80, **as directed**, socket fittings; and solvent-cemented joints.
9. Aboveground domestic water piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100), shall be one of the following:
   a. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B), **as directed**; cast-copper **OR** wrought-copper, **as directed**, solder-joint fittings; and brazed **OR** soldered, **as directed**, joints.
   b. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B), **as directed**; copper pressure-seal-joint fittings; and pressure-sealed joints.
   c. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B, **as directed**; grooved-joint copper-tube appurtenances; and grooved joints.

d. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
e. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
f. CPVC, Schedule 40 pipe; CPVC, Schedule 40 **OR** Schedule 80 pipe; CPVC, Schedule 80, **as directed**, socket fittings; and solvent-cemented joints.
g. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
h. PVC, Schedule 40 pipe; PVC, Schedule 40 **OR** Schedule 80 pipe; PVC, Schedule 80, **as directed**, socket fittings; and solvent-cemented joints.

10. Aboveground domestic water piping, NPS 5 to NPS 8 (DN 125 to DN 200), shall be one of the following:
    a. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B), **as directed**; cast-copper **OR** wrought-copper, **as directed**, solder-joint fittings; and brazed **OR** soldered, **as directed**, joints.
    b. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B), **as directed**; grooved-joint copper-tube appurtenances; and grooved joints.
    c. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
    d. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
    e. CPVC, Schedule 40 pipe; CPVC, Schedule 40 **OR** Schedule 80 pipe; CPVC, Schedule 80, **as directed**, socket fittings; and solvent-cemented joints.
    f. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
    g. PVC, Schedule 40 pipe; PVC, Schedule 40 **OR** Schedule 80 pipe; PVC, Schedule 80, **as directed**, socket fittings; and solvent-cemented joints.
11. Aboveground, combined domestic-water-service and fire-service-main piping, NPS 6 to NPS 12 (DN 150 to DN300), shall be one of the following:
    a. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
    b. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
    c. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.

T. Valve Schedule
1. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
    a. Shutoff Duty: Use ball or gate valves for piping NPS 2 (DN 50) and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
    b. Throttling Duty: Use ball or globe valves for piping NPS 2 (DN 50) and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
    c. Hot-Water Circulation Piping, Balancing Duty: Calibrated **OR** Memory-stop, **as directed**, balancing valves.
    d. Drain Duty: Hose-end drain valves.
2. Use check valves to maintain correct direction of domestic water flow to and from equipment.
3. Iron grooved-end valves may be used with grooved-end piping.
4. CPVC and PVC valves matching piping materials may be used.

END OF SECTION 15061

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SECTION 15061a - SANITARY WASTE AND VENT PIPING

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for sanitary waste and vent piping. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. This Section includes:
a. Pipe, tube, and fittings.
b. Special pipe fittings.
c. Encasement for underground metal piping.

C. Performance Requirements
1. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
a. Soil, Waste, and Vent Piping: 10-foot head of water (30 kPa).
b. Sanitary Sewer, Force-Main Piping: 50 psig (345 kPa) **OR** 100 psig (690 kPa) **OR** 150 psig (1035 kPa), **as directed**.
2. Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of earthquake motions determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

D. Submittals
1. Product Data: For each type of product indicated.
2. LEED Submittal:
a. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.
3. Shop Drawings: For solvent Drainage System: Include plans, elevations, sections, and details.
4. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
b. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.
5. Field quality-control inspection and test reports.

E. Quality Assurance
1. Piping materials shall bear label, stamp, or other markings of specified testing agency.
2. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

F. Project Conditions
1. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
a. Notify the Owner no fewer than two days in advance of proposed interruption of sanitary waste service.

b. Do not proceed with interruption of sanitary waste service without the Owner written permission.

1.2 PRODUCTS

A. Piping Materials
1. Comply with requirements in "Piping Applications" Article for applications of pipe, tube, fitting, and joining methods for specific services, service locations, and pipe sizes.

B. Hub-And-Spigot, Cast-Iron Soil Pipe And Fittings
1. Pipe and Fittings: ASTM A 74, Service and Extra-Heavy class(es).
2. Gaskets: ASTM C 564, rubber.
3. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

C. Hubless, Cast-Iron Soil Pipe And Fittings
1. Pipe and Fittings: ASTM A 888 or CISPI 301.
2. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.
3. CISPI, Hubless-Piping Couplings:
   a. Standards: ASTM C 1277 and CISPI 310
   b. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
4. Heavy-Duty, Hubless-Piping Couplings:
   a. Standards: ASTM C 1277 and ASTM C 1540.
   b. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
5. Cast-Iron, Hubless-Piping Couplings:
   a. Standard: ASTM C 1277.
   b. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

D. Galvanized-Steel Pipe And Fittings
1. Galvanized Steel Pipe: ASTM A 53/A 53M, Type E, Standard Weight. Include ends matching joining method.
2. Galvanized-Cast-Iron Drainage Fittings: ASME B16.12, galvanized.
3. Steel Pipe Pressure Fittings:
   a. Galvanized-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.
   b. 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.
   c. Galvanized-Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, **as directed**, standard pattern.
4. Cast-Iron Flanges: ASME B16.1, Class 125.
   a. Flange Gasket Materials: ASME ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
   b. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
5. Grooved-Joint Systems:
   a. Galvanized, Grooved-End Fittings for Galvanized-Steel Piping: ASTM A 536 ductile-iron castings, ASTM A 47/A 47M malleable-iron castings, ASTM A 234/A 234M forged steel fittings, or ASTM A 106/A 106M steel pipes with dimensions matching ASTM A 53/A 53M steel pipe, and complying with AWWA C606 for grooved ends.
   b. Grooved Mechanical Couplings for Galvanized-Steel Piping: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber gasket suitable for hot and cold water; and bolts and nuts.

E. Stainless-Steel Pipe And Fittings
1. Pipe and Fittings: ASME A112.3.1, drainage pattern with socket and spigot ends.
2. Internal Sealing Rings: Elastomeric gasket shaped to fit socket groove.
a. Material: EPDM, unless NBR is indicated.

F. Ductile-Iron Pipe And Fittings
1. Ductile-Iron, Mechanical-Joint Piping:
a. Ductile-Iron Pipe: AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
b. Ductile-Iron Fittings: AWWA C110/A21.10, mechanical-joint, ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
c. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
2. Ductile-Iron, Push-on-Joint Piping:
a. Ductile-Iron Pipe: AWWA C151/A21.51, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
b. Ductile-Iron Fittings: AWWA C110/A21.10, push-on-joint ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
c. Gaskets: AWWA C111/A21.11, rubber.
3. Ductile-Iron, Grooved-Joint Piping:
a. Ductile-Iron Pipe: AWWA C151/A21.51 with round-cut-grooved ends according to AWWA C606.
b. Ductile-Iron-Pipe Appurtenances:
1) Grooved-End, Ductile-Iron Fittings: ASTM A 536 ductile-iron castings with dimensions matching AWWA C110/A 21.10 ductile-iron pipe or AWWA C153/A 21.53 ductile-iron fittings and complying with AWWA C606 for grooved ends.
2) Grooved Mechanical Couplings for Ductile-Iron Pipe: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber center-leg gasket suitable for hot and cold water; and bolts and nuts.

G. Copper Tube And Fittings
1. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
2. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
3. Hard Copper Tube: ASTM B 88, Types L and M (ASTM B 88M, Types B and C), water tube, drawn temper.
4. Soft Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B), water tube, annealed temper.
5. Copper Pressure Fittings:
a. ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
b. Copper Unions: MSS SP-123, copper-alley, hexagonal-stock body with ball-and-socket, metal-to metal seating surfaces, and solder-joint or threaded ends
6. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
a. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
b. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
7. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux

H. ABS Pipe And Fittings
1. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40.
2. Cellular-Core ABS Pipe: ASTM F 628, Schedule 40.
3. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.
4. Solvent Cement ASTM D 2235:
a. Use ABS solvent cement that has a VOC content of 325 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

I. PVC Pipe And Fittings
   1. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
   2. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.
   3. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
   4. Adhesive Primer: ASTM F 656.
      a. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   5. Solvent Cement: ASTM D 2564.
      a. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

J. Specialty Pipe Fittings
   1. Transition Couplings:
      a. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
      b. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
      c. Unshielded, Nonpressure Transition Couplings:
         1) Standard: ASTM C 1173.
         2) Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
         3) Sleeve Materials:
            a) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
            b) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
            c) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
      d. Shielded Nonpressure Transition Couplings:
         1) ASTM C 1460.
         2) Description: Eelastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
      e. Pressure Transition Pipe Couplings:
         1) AWWA C219.
         2) Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
         3) Center-Sleeve Material: Manufacturer's standard **OR** Carbon steel **OR** Stainless steel **OR** Ductile iron **OR** Malleable iron, **as directed**.
         4) Gasket Material: Natural or synthetic rubber.
         5) Metal Component Finish: Corrosion-resistant coating or material.
   2. Dielectric Fittings:
      a. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
      b. Dielectric Unions:
         1) Description:
            a) Standard: ASSE 1079.
            b) Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C) **OR** 150 psig (1035 kPa) **OR** 250 psig (1725 kPa), **as directed**.
            c) End Connections: Solder-joint copper alloy and threaded ferrous.
      c. Dielectric Flanges:
         1) Description:
            a) Standard: ASSE 1079.

b) Factory-fabricated, bolted, companion-flange assembly.
c) Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C) **OR** 150 psig (1035 kPa) **OR** 175 psig (1200 kPa) **OR** 300 psig (2070 kPa), **as directed**.
d) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

d. Dielectric-Flange Insulating Kits:
1) Description:
a) Nonconducting materials for field assembly of companion flanges.
b) Pressure Rating: 150 psig (1035 kPa).
c) Gasket: Neoprene or phenolic.
d) Bolt Sleeves: Phenolic or polyethylene.
e) Washers: Phenolic with steel backing washers.

e. Dieletric Nipples
1) Description:
a) Electroplated steel nipple complying with ASTM F 1545.
b) Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).
c) End Connections: Male threaded or grooved.
d) Lining: Inert and noncorrosive, propylene.

K. Encasement For Underground Metal Piping
1. Standard: ASTM A 674 or AWWA C105/A 21.5
2. Material: Linear low-density polyethylene film of 0.008-inch (0.20-mm) **OR** high density, cross-laminated polyethylene film of 0.004-inch (0.10-mm), **as directed**, minimum thickness.
3. Form: Sheet **OR** Tube, **as directed**.
4. Color: Black **OR** Natural, **as directed**.

1.3 EXECUTION

A. Earth Moving
1. Refer to Division 02 Section "Earthwork" for excavating, trenching, and backfilling.

B. Piping Installation
1. 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.
2. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
3. 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.
4. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
5. Install piping to permit valve servicing.
6. Install piping at indicated slopes.
7. Install piping free of sags and bends.
8. Install fittings for changes in direction and branch connections.
9. Install piping to allow application of insulation.
10. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Division 15 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment".
11. 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 1/4 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 two 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.

12. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
13. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
    a. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent **OR** 2 percent, as directed downward in direction of flow for piping NPS 4 (DN 100) and larger.
    b. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
    c. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
14. 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."
    a. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.
15. Install steel piping according to applicable plumbing code.
16. Install stainless-steel piping according to ASME A112.3.1 and applicable plumbing code.
17. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
18. Install aboveground ABS piping according to ASTM D 2661.
19. Install aboveground PVC piping according to ASTM D 2665.
20. Install underground ABS and PVC piping according to ASTM D 2321.
21. Install engineered soil and waste drainage and vent piping systems as follows:
    a. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
    b. Sovent Drainage System: Comply with ASSE 1043 and sovent fitting manufacturer's written installation instructions.
    c. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
22. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to sanitary sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
    a. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.
23. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."
    a. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.
24. Install force mains at elevations indicated.
25. Plumbing Specialties:
    a. Install backwater valves in sanitary waste gravity-flow piping. Comply with requirements for backwater valves specified in Division 15 Section "Sanitary Waste Piping Specialties".
    b. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Division 15 Section "Sanitary Waste Piping Specialties".
    c. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Division 15 Section "Sanitary Waste Piping Specialties".
26. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
27. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 15 Section "Common Work Results For Plumbing".
28. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 15 Section "Common Work Results For Plumbing".

29. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 15 Section "Common Work Results For Plumbing".

C. Joint Construction
1. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
2. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.
3. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
4. 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:
   a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   b. 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.
5. Join stainless-steel pipe and fittings with gaskets according to ASME A112.3.1.
6. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
7. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
8. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
9. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   b. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
   c. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

D. Specialty Pipe Fitting Installation
1. Transition Couplings:
   a. Install transition couplings at joints of piping with small differences in OD's.
   b. In Drainage Piping: Unshielded **OR** Shielded, **as directed**, nonpressure transition couplings.
   c. In Aboveground Force Main Piping: Fitting-type transition couplings.
   d. In Underground Force Main Piping:
      1) NPS 1-1/2 (DN 40) and Smaller: Fitting-type transition couplings.
      2) NPS 2 (DN 50) and Larger: Pressure transition couplings.
2. Dielectric Fittings:
   a. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
   b. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric nipples **OR** unions, **as directed**.
   c. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100: Use dielectric flanges **OR** flange kits **OR** nipples, **as directed**.
   d. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

E. Valve Installation
1. General valve installation requirements are specified in Division 15 Section "General-duty Valves For Plumbing Piping".
2. Shutoff Valves:
   a. Install shutoff valve on each sewage pump discharge.

b. Install gate or full-port ball valve for piping NPS 2 (DN 50) and smaller.
c. Install gate valve for piping NPS 2-1/2 (DN 65) and larger.

3. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.
4. Backwater Valves: Install backwater valves in piping subject to sewage backflow.
   a. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
   b. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
   c. Install backwater valves in accessible locations.
   d. Backwater valve are specified in Division 15 Section "Sanitary Waste Piping Specialties".

F. Hanger And Support Installation
1. Comply with requirements for seismic-restraint devices specified in Division 15 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment".
2. Comply with requirements for pipe hanger and support devices and installation specified in Division 15 Section "Hangers And Supports For Plumbing Piping And Equipment".
   a. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
   b. Install stainless-steel **OR** fiberglass pipe hangers, **as directed** for horizontal piping in corrosive environments.
   c. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
   d. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
   e. Vertical Piping: MSS Type 8 or Type 42, clamps.
   f. Install individual, straight, horizontal piping runs according to the following:
      1) 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
      2) Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
      3) Longer Than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.
   g. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   h. Base of Vertical Piping: MSS Type 52, spring hangers.
3. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting[**, valve,**] and coupling.
4. Support vertical piping and tubing at base and at each floor.
5. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
6. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   a. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
   b. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
   c. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
   d. NPS 6 (DN 150): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
   e. NPS 8 to NPS 12 (DN 200 to DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
   f. Spacing for 10-foot (3-m) lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).
7. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).
8. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
   a. NPS 1-1/4 (DN 32): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
   b. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
   c. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
   d. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
   e. NPS 3 (DN 80): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
   f. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
   g. NPS 6 and NPS 8 (DN 150 and DN 200): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
   h. NPS 10 to NPS 12 (DN 250 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.

9. Install supports for vertical steel piping every 15 feet (4.5 m).
10. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
    a. NPS 2 (DN 50): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
    b. NPS 3 (DN 80): 96 inches (2400 mm) with 1/2-inch (13-mm) rod.
    c. NPS 4 (DN 100): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
    d. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
11. Install supports for vertical stainless-steel piping every 10 feet (3 m).
12. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
    a. NPS 1-1/4 (DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
    b. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
    c. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
    d. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
    e. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
    f. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.
13. Install supports for vertical copper tubing every 10 feet (3 m).
14. Install hangers for ABS and PVC piping with the following maximum horizontal spacing and minimum rod diameters:
    a. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
    b. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
    c. NPS 4 and 5 (DN 100 and 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
    d. NPS 6 and NPS8 (DN 150 and DN 200): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
    e. NPS 10 to NPS 12 (DN 250 to DN 300): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
15. Install supports for vertical ABS and PVC piping every 48 inches (1200 mm).
16. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

G. Connections
1. Drawings indicate general arrangement of piping, fittings, and specialties.
2. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
3. Connect drainage and vent piping to the following:
    a. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
    b. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
    c. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
    d. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
    e. Install horizontal backwater valves with cleanout cover flush with floor **OR** in pit with pit cover flush with floor**, as directed**.
    f. Comply with requirements for backwater valves, cleanouts and drains specified in Division 15 Section "Storm Drainage Piping".
    g. 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 (DN 65) and larger.
4. Connect force-main piping to the following:
    a. Sanitary Sewer: To exterior force main or sanitary manhole.
    b. Sewage Pumps: To sewage pump discharge.
5. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
6. Make connections according to the following unless otherwise indicated:

a. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
b. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

H. Identification
1. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 15 Section "Identification For Plumbing Piping And Equipment".

I. Field Quality Control
1. 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.
   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 for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
2. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
3. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
4. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   a. 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.
   b. 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.
   c. 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, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
   d. 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 (250 Pa). 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.
   e. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   f. Prepare reports for tests and required corrective action.
5. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   a. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   b. Cap and subject piping to static-water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
   c. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   d. Prepare reports for tests and required corrective action.

J. Cleaning and Protection
   1. Clean interior of piping. Remove dirt and debris as work progresses.
   2. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
   3. Place plugs in ends of uncompleted piping at end of day and when work stops.
   4. Exposed ABS and PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION 15061a

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SECTION 15061b - STORM DRAINAGE PIPING

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for storm drainage piping. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section includes:
a. Pipe, tube, and fittings.
b. Special pipe fittings.
c. Encasement for underground metal piping.

C. Performance Requirements
1. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:
a. Storm Drainage Piping: 10-foot head of water (30 kPa).
b. Storm Drainage, Force-Main Piping: 50 psig (345 kPa) **OR** 100 psig (690 kPa) **OR** 150 psig (1035 kPa), **as directed**.
2. Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of seismic events determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

D. Submittals
1. Product Data: For each type of product indicated.
2. LEED Submittal:
a. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.
3. Shop Drawings: For controlled-flow **OR** siphonic roof drainage system, as directed by the Owner. Include calculations, plans, and details. Controlled-Flow Storm Drainage System: Include calculations, plans, and details.
4. Seismic Qualification Certificates: For storm drainage piping, accessories, and components, from manufacturer.
a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
b. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
5. Field quality-control inspection and test reports.

E. Quality Assurance
1. Piping materials shall bear label, stamp, or other markings of specified testing agency.
2. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

F. Project Conditions
1. Interruption of Existing Storm-Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
a. Notify the Owner no fewer than two days in advance of proposed interruption of storm-drainage service.

b. Do not proceed with interruption of storm-drainage service without the Owner's written permission.

1.2 PRODUCTS

A. Piping Materials
1. Refer to Part 1.3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining methods for specific services, service locations, and pipe sizes.

B. Hub-And-Spigot, Cast-Iron Soil Pipe And Fittings
1. Pipe and Fittings: ASTM A 74, Service and Extra-Heavy class(es).
2. Gaskets: ASTM C 564, rubber.
3. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

C. Hubless Cast-Iron Soil Pipe And Fittings
1. Pipe and Fittings: ASTM A 888 or CISPI 301.
2. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
   a. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
   b. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
   c. 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.
3. Rigid, Unshielded Couplings: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Galvanized-Steel Pipe And Fittings
1. 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.
2. Drainage Fittings: ASME B16.12, galvanized, **as directed**, threaded, cast-iron drainage pattern.
3. Pressure Fittings:
   a. 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.
   b. 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.
   c. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, **as directed**, standard pattern.
   d. Cast-Iron Flanges: ASME B16.1, Class 125.
   e. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized, **as directed**.
4. Grooved-Joint Systems:
   a. Grooved-End, Steel-Piping Fittings: ASTM A 47/A 47M, galvanized, **as directed**, malleable-iron casting; ASTM A 106, galvanized-steel pipe; or ASTM A 536, galvanized, **as directed**, ductile-iron casting; with dimensions matching steel pipe.
   b. Grooved-End, Steel-Piping Couplings: AWWA C606, for steel-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

E. Ductile-Iron, Pipe and Fittings
1. Ductile-Iron, Mechanical-Joint Piping
   a. Ductile-Iron Pipe: AWWA C151/A21.51, with mechanical-joint bell and plain spigot end, unless grooved or flanged ends are indicated.
   b. Ductile-Iron Fittings: AWWA C110/A21.10, mechanical-joint ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.

c. Glands, Gaskets, and Bolts: AWWA C111/A121.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2. Ductile-Iron, Push-on-Joint,
   a. Ductile-Iron Pipe: AWWA C151/A21.51, with push-on-joint bell and plain spigot end, unless grooved or flanged ends are indicated.
   b. Ductile-Iron Fittings: AWWA C110/A21.10, ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
   c. Gaskets: AWWA C111/A21.11, rubber.
3. Ductile Iron, Grooved-Joint Piping:
   a. Ductile-Iron Pipe: AWWA C151/A21.51 with round-cut-grooved ends according to AWWA C606.
   b. Ductile-Iron-Pipe Appurtenances:
      1) Grooved-End, Ductile-Iron Fittings: ASTM A 536, ductile-iron castings with dimensions matching pipe. AWWA C110/A21.10 ductile-iron pipe or AWWA C153/A21.53 ductile-iron fittings and complying with AWWA C606 for grooved ends.
      2) Grooved Mechanical Couplings for Ductile-Iron Pipe: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys, EPMD-rubber center-leg gasket suitable for hot and cold water, and bolts and nuts.

F. Copper Tube And Fittings
1. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
2. Copper Drainage Fittings: ASME B16.23, cast-copper or ASME B16.29, wrought-copper, solder-joint fittings.
3. Hard Copper Tube: ASTM B 88, Types L and M (ASTM B 88M, Types B and C), water tube, drawn temper.
4. Soft Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B), water tube, annealed temper.
5. Copper Pressure Fittings:
   a. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
   b. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
6. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
   a. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
   b. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
7. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

G. ABS Pipe And Fittings
1. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40.
2. Cellular-Core ABS Pipe: ASTM F 628, Schedule 40.
3. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.
4. Solvent Cement: ASTM D 2235
   a. Use ABS solvent cement that has a VOC content of 325 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

H. PVC Pipe And Fittings
1. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
2. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.
3. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
4. Adhesive Primer: ASTM F 656.
   a. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
5. Solvent Cement: ASTM D 2564.

a. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

I. Specialty Pipe Fittings
1. Transition Couplings:
a. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
b. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.
c. Unshielded, Nonpressure Transition Couplings:
1) Standard: ASTM C 1173.
2) Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
3) Sleeve Materials:
a) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
b) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
c) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
d. Shielded, Nonpressure Transition Couplings:
1) Standard: ASTM C 1460.
2) Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
e. Pressure Transition Couplings:

f. Standard: AWWA C219.
g. Description: Metal, sleeve-type couplings same size as, with pressure rating at least equal to and ends compatible with, pipes to be joined.
h. Center-Sleeve Material: Manufacturer's standard **OR** Carbon steel **OR** Stainless steel **OR** Ductile iron **OR** Malleable iron, **as directed.**
i. Gasket Material: Natural or synthetic rubber.
j. Metal Component Finish: Corrosion-resistant coating or material.
2. Dielectric Fittings:
a. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
b. Dielectric Unions:
1) Description:
a) Standard: ASSE 1079.
b) Pressure Rating: **150 psig (1035 kPa) OR 250 psig (1725 kPa)** at 180 deg F (82 deg C), **as directed.**
c) End Connections: Solder-joint copper alloy and threaded ferrous.
c. Dielectric Flanges:
1) Description:
a) Standard: ASSE 1079.
b) Factory-fabricated, bolted, companion-flange assembly.
c) Pressure Rating: **150 psig (1035 kPa) OR 175 psig (1200 kPa)** minimum **OR 300 psig (2070 kPa), as directed.**
d) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
d. Dielectric-Flange Insulating Kits:
1) Description:
a) Nonconducting materials for field assembly of companion flanges.

b) Pressure Rating: **150 psig (1035 kPa)**
c) Gasket: Neoprene or phenolic.
d) Bolt Sleeves: Phenolic or polyethylene.
e) Washers: Phenolic with steel-backing washers.

e. Dielectric Nipples:
1) Description:
a) Electroplated steel nipple complying with ASTM F 1545.
b) Pressure Rating: **300 psig (2070 kPa)** at **225 deg F (107 deg C)**.
c) End Connections: Male threaded or grooved.
d) Lining: Inert and noncorrosive, propylene.

J. Encasement For Underground Metal Piping
1. Description: ASTM A 674 or AWWA C105
2. Material: High-density, crosslaminated PE film of 0.004-inch (0.10-mm) **OR** LLDPE film of 0.008-inch (0.20-mm), **as directed**, minimum thickness.
3. Form: Sheet **OR** Tube, **as directed**.
4. Color: Black **OR** Natural, **as directed**.

1.3 EXECUTION

A. Earth Moving
1. Refer to Division 02 Section "Earthwork" for excavating, trenching, and backfilling.

B. Piping Installation
1. 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 from layout are approved on coordination drawings.
2. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
3. 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.
4. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
5. Install piping to permit valve servicing.
6. Install piping at indicated slopes.
7. Install piping free of sags and bends.
8. Install fittings for changes in direction and branch connections.
9. Install piping to allow application of insulation.
10. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Division 15 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment".
11. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. 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.
12. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
13. Install storm drainage piping at the following minimum slopes unless otherwise indicated:
a. Building Storm Drain: 1 percent **OR** 2 percent, **as directed**, downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent **OR** 2 percent**, as directed,** downward in direction of flow for piping NPS 4 (DN 100) and larger.

b. Horizontal Storm-Drainage Piping: **2 percent** downward in direction of flow.

14. 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."
    a. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
15. Install steel piping according to applicable plumbing code.
16. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
17. Install aboveground ABS piping according to ASTM D 2661.
18. Install aboveground PVC piping according to ASTM D 2665.
19. Install underground ABS and PVC piping according to ASTM D 2321.
20. Install engineered controlled-flow **OR** siphonic**, as directed,** drain specialties and storm drainage piping in locations indicated.
21. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to storm sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
    a. Install encasement on piping according to ASTM A 674 or AWWA C105.
22. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."
    a. Install encasement on piping according to ASTM A 674 or AWWA C105.
23. Install force mains at elevations indicated.
24. Plumbing Specialties:
    a. Install backwater valves in storm drainage gravity-flow piping. Comply with requirements for backwater valves specified in Division 02 Section "Storm Drainage".
    b. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts specified in Division 02 Section "Storm Drainage".
    c. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains specified in Division 02 Section "Storm Drainage".
25. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
26. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 15 Section "Common Work Results For Plumbing".
27. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 15 Section "Common Work Results For Plumbing".
28. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 15 Section "Common Work Results For Plumbing".

C. Joint Construction
1. Basic piping joint construction requirements are specified in Division 15 Section "Common Work Results For Plumbing".
2. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
3. Hub-and-Spigot, Cast-Iron Soil Piping Calked Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
4. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
5. 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:
    a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
    b. 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.

6. Join copper tube and fittings with soldered joints according to ASTM B 828 procedure. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
7. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fittings. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
8. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
9. Plastic, Nonpressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   b. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
   c. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

D. Specialty Pipe Fitting Installation
1. Transition Couplings:
   a. Install transition couplings at joints of piping with small differences in OD's.
   b. In Drainage Piping: Unshielded **OR** Shielded, **as directed** nonpressure transition couplings.
   c. In Aboveground Force-Main Piping: Fitting-type transition couplings.
   d. In Underground Force-Main Piping:
      1) NPS 1-1/2 (DN 40) and Smaller: Fitting-type transition couplings.
      2) NPS 2 (DN 50) and Larger: Pressure transition couplings.
2. Dielectric Fittings:
   a. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
   b. Dielectric Fittings for **NPS 2 (DN 50)** and Smaller: Use dielectric nipples **OR** unions, **as directed**.
   c. Dielectric Fittings for **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Use dielectric flanges **OR** flange kits **OR** nipples, **as directed.**
   d. Dielectric Fittings for **NPS 5 (DN 125)** and Larger: Use dielectric flange kits.

E. Valve Installation
1. General valve installation requirements are specified in Division 15 Section "General-duty Valves For Plumbing Piping".
2. Shutoff Valves: Install shutoff valve on each sump pump discharge.
   a. Install gate or full-port ball valve for piping NPS 2 (DN 50) and smaller.
   b. Install gate valve for piping NPS 2-1/2 (DN 65) and larger.
3. Check Valves: Install swing check valve, between pump and shutoff valve, on each sump pump discharge.
4. Backwater Valves: Install backwater valves in piping subject to backflow.
   a. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
   b. Install backwater valves in accessible locations.
   c. Comply with requirements for backwater valve specified in Division 15 Section "Storm Drainage Piping Specialties".

F. Hanger And Support Installation
1. Comply with requirements for seismic-restraint devices specified in Division 15 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment".
2. Comply with requirements for pipe hangers and supports and installation specified in Division 15 Section "Hangers And Supports For Plumbing Piping And Equipment".
   a. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
   b. Install stainless-steel **OR** fiberglass pipe hangers, **as directed,** for horizontal piping in corrosive environments.
   c. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.

d. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
e. Vertical Piping: MSS Type 8 or Type 42, clamps.
f. Individual, Straight, Horizontal Piping Runs:
   1) 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
   2) Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
   3) Longer Than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.
g. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
h. Base of Vertical Piping: MSS Type 52, spring hangers.

3. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting, valve, and coupling.
4. Support vertical piping and tubing at base and at each floor.
5. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
6. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   a. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
   b. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
   c. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
   d. NPS 6 (DN 150): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
   e. NPS 8 to NPS 12 (DN 200 to DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
   f. Spacing for 10-foot (3-m) lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).
7. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).
8. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
   a. NPS 1-1/4 (DN 32): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
   b. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
   c. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
   d. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
   e. NPS 3 (DN 80): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
   f. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
   g. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
   h. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
9. Install supports for vertical steel piping every 15 feet (4.5 m).
10. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
    a. NPS 1-1/4 (DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
    b. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
    c. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
    d. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
    e. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
    f. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.
11. Install supports for vertical copper tubing every 10 feet (3 m).
12. Install hangers for ABS and PVC piping with the following maximum horizontal spacing and minimum rod diameters:
    a. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
    b. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
    c. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
    d. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
    e. NPS 8 to NPS 12 (DN 200 to DN 300): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
13. Install supports for vertical ABS and PVC piping every 48 inches (1200 mm).

14. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

G. Connections
1. Drawings indicate general arrangement of piping, fittings, and specialties.
2. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
3. Connect storm drainage piping to roof drains and storm drainage specialties.
   a. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
   b. Install horizontal backwater valves with cleanout cover flush with floor **OR** in pit with pit cover flush with floor, **as directed.**
   c. Comply with requirements for backwater valves, cleanouts and drains specified in Division 15 Section "Storm Drainage Piping Specialties".
4. Connect force-main piping to the following:
   a. Storm Sewer: To exterior force main or storm manhole.
   b. Sump Pumps: To sump pump discharge.
5. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
6. Make connections according to the following unless otherwise indicated:
   a. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
   b. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

H. Identification
1. Identify exposed storm drainage piping. Comply with requirements for identification specified in Division 15 Section "Identification For Plumbing Piping And Equipment".

I. Field Quality Control
1. 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.
   a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
   b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
2. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
3. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
4. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   a. 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.
   b. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   c. Test Procedure: Test storm drainage piping, except outside leaders, **as directed**, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
   d. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   e. Prepare reports for tests and required corrective action.

5. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   a. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   b. Cap and subject piping to static-water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
   c. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   d. Prepare reports for tests and required corrective action.

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

K. Piping Schedule
1. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
2. Aboveground storm drainage piping NPS 6 (DN 150) and smaller shall be any of the following:
   a. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
   b. Hubless, cast-iron soil pipe and fittings; **CISPI, heavy-duty,** hubless-piping couplings; and coupled joints.
   c. Galvanized-steel pipe, drainage fittings, and threaded joints.
   d. Copper tube and fittings in first subparagraph below are only available in NPS 1-1/4 to NPS 8 (DN 32 to DN 200).
   e. Copper DWV tube, copper drainage fittings, and soldered joints.
   f. Solid-wall **OR** Cellular-core ABS pipe, **as directed**, ABS socket fittings, and solvent-cemented joints.
   g. Solid-wall **OR** Cellular-core PVC pipe, **as directed,** PVC socket fittings, and solvent-cemented joints.
   h. Dissimilar Pipe-Material Couplings: Unshielded **OR** Shielded, **as directed,** nonpressure transition couplings.
3. Aboveground, storm drainage piping NPS 8 (DN 200) and larger shall be any of the following:
   a. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
   b. Hubless, cast-iron soil pipe and fittings; **CISPI, heavy-duty,** hubless-piping couplings; and coupled joints.
   c. Galvanized-steel pipe, drainage fittings, and threaded joints.
   d. Copper DWV tube, copper drainage fittings, and soldered joints.
   e. Solid-wall **OR** Cellular-core PVC pipe, **as directed**, PVC socket fittings, and solvent-cemented joints.
   f. Dissimilar Pipe-Material Couplings: Unshielded **OR** Shielded, **as directed**, nonpressure transition couplings.
4. Underground storm drainage piping **NPS 6 (DN 150) and smaller** shall be **any of** the following:
   a. Extra Heavy **OR** Service class, **as directed,** cast-iron soil pipe and fittings; gaskets; and gasketed **OR** calking materials; and calked joints, **as directed.**
   b. Hubless, cast-iron soil pipe and fittings; **CISPI, heavy-duty, cast-iron,** hubless-piping couplings; and coupled joints.
   c. Solid-wall **OR** Cellular-core ABS pipe, **as directed**, ABS socket fittings, and solvent-cemented joints.
   d. **Solid-wall OR Cellular-core** PVC pipe, **as directed**, PVC socket fittings, and solvent-cemented joints.

e. Dissimilar Pipe-Material Couplings: Unshielded **OR** Shielded, **as directed**, nonpressure transition couplings.

5. Underground, storm drainage piping **NPS 8 (DN 200) and larger** shall be **any of** the following:
   a. Extra Heavy **OR** Service class, **as directed**, cast-iron soil pipe and fittings; gaskets; and gasketed **OR** calking materials; and calked joints **as directed**,.
   b. Hubless, cast-iron soil pipe and fittings; **CISPI, heavy-duty, cast-iron,** hubless-piping couplings; and coupled joints.
   c. **Solid-wall OR Cellular-core** PVC pipe, **as directed**, PVC socket fittings, and solvent-cemented joints.
   d. Cellular-core, sewer and drain series, PVC pipe; PVC socket fittings; and solvent-cemented joints.
   e. Dissimilar Pipe-Material Couplings: **Unshielded OR Shielded**, **as directed**, nonpressure transition couplings.
6. Aboveground storm drainage force mains **NPS 1-1/2 and NPS 2 (DN 40 and DN 50)** shall be **any of** the following:
   a. Hard copper tube, copper pressure fittings, and soldered joints.
   b. Galvanized-steel pipe, pressure fittings, and threaded joints.
7. Aboveground storm drainage force mains **NPS 2-1/2 to NPS 6 (DN 65 to DN 150)** shall be any of the following:
   a. Hard copper tube, copper pressure fittings, and soldered joints.
   b. Galvanized-steel pipe, pressure fittings, and threaded joints.
   c. Grooved-end, galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
   d. Fitting-type transition couplings if dissimilar pipe materials.
8. Underground storm drainage force mains NPS 4 (DN 100) and smaller shall be any of the following:
   a. Hard **OR** Soft**, as directed** copper tube; **wrought-**copper pressure fittings; and soldered joints.
   b. Ductile-iron, mechanical-joint piping and mechanical joints.
   c. Ductile-iron, push-on-joint piping and push-on joints.
   d. Ductile-iron, grooved-joint piping and grooved joints.
   e. Fitting-type transition coupling for piping smaller than NPS 1-1/2 (DN 40) and pressure transition coupling for NPS 1-1/2 (DN 40) and larger if dissimilar pipe materials.
9. Underground storm drainage force mains NPS 5 (DN 125) and larger shall be any of the following:
   a. Hard copper tube; **wrought-**copper pressure fittings; and soldered joints.
   b. Ductile-iron, mechanical-joint piping and mechanical joints.
   c. Ductile-iron, push-on-joint piping and push-on joints.
   d. Ductile-iron, grooved-joint piping and grooved joints.
   e. Pressure transition couplings if dissimilar pipe materials.

END OF SECTION 15061b

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SECTION 15061c - HYDRONIC PIPING

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for hydronic piping. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
a. Hot-water heating piping.
b. Chilled-water piping.
c. Dual-temperature heating and cooling water piping.
d. Condenser-water piping.
e. Glycol cooling-water piping.
f. Makeup-water piping.
g. Condensate-drain piping.
h. Blowdown-drain piping.
i. Air-vent piping.
j. Safety-valve-inlet and -outlet piping.

C. Definitions
1. PTFE: Polytetrafluoroethylene.
2. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
3. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

D. Performance Requirements
1. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
a. Hot-Water Heating Piping: **psig (kPa),** as directed by the Owner at 200 deg F (93 deg C).
b. Chilled-Water Piping: **psig (kPa),** as directed by the Owner at 200 deg F (93 deg C).
c. Dual-Temperature Heating and Cooling Water Piping: **psig (kPa),** ethylene at 200 deg F (93 deg C).
d. Condenser-Water Piping: **psig (kPa),** as directed by the Owner at 150 deg F (66 deg C).
e. Glycol Cooling-Water Piping: **psig (kPa),** as directed by the Owner at 150 deg F (66 deg C).
f. Makeup-Water Piping: 80 psig (552 kPa) at 150 deg F (66 deg C).
g. Condensate-Drain Piping: 150 deg F (66 deg C).
h. Blowdown-Drain Piping: 200 deg F (93 deg C).
i. Air-Vent Piping: 200 deg F (93 deg C).
j. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

E. Submittals
1. Product Data: For each type of the following:
a. Plastic pipe and fittings with solvent cement.
b. RTRP and RTRF with adhesive.
c. Pressure-seal fittings.
d. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
e. Air control devices.

f. Chemical treatment.
g. Hydronic specialties.

2. LEED Submittal:
   a. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.
3. Shop Drawings: Detail, at 1/4 (1:50) scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
4. Welding certificates.
5. Qualification Data: For Installer.
6. Field quality-control test reports.
7. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.
8. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

F. Quality Assurance
1. Installer Qualifications:
   a. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
   b. Fiberglass Pipe and Fitting Installers: Installers of RTRF and RTRP shall be certified by the manufacturer of pipes and fittings as having been trained and qualified to join fiberglass piping with manufacturer-recommended adhesive.
2. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
3. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
   a. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   b. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
4. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

1.2 PRODUCTS

A. Copper Tube And Fittings
1. Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B) **OR** ASTM B 88, Type M (ASTM B 88M, Type C), **as directed**.
2. Annealed-Temper Copper Tubing: ASTM B 88, Type K (ASTM B 88M, Type A).
3. DWV Copper Tubing: ASTM B 306, Type DWV.
4. Wrought-Copper Fittings: ASME B16.22.
   a. Grooved-End Copper Fittings: ASTM B 75 (ASTM B 75M), copper tube or ASTM B 584, bronze casting.
   b. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, prelubricated, **as directed**, EPDM gasket rated for minimum 230 deg F (110 deg C) for use with housing, and steel bolts and nuts.
5. Copper or Bronze Pressure-Seal Fittings:
   a. Housing: Copper.
   b. O-Rings and Pipe Stops: EPDM.

c. Tools: Manufacturer's special tools.
d. Minimum 200-psig (1379-kPa) working-pressure rating at 250 deg F (121 deg C).

6. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube.
7. Wrought-Copper Unions: ASME B16.22.

B. Steel Pipe And Fittings

1. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 1.3 "Piping Applications" Article.
2. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 1.3 "Piping Applications" Article.
3. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 1.3 "Piping Applications" Article.
4. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 1.3 "Piping Applications" Article.
5. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 1.3 "Piping Applications" Article.
6. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
7. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
   a. Material Group: 1.1.
   b. End Connections: Butt welding.
   c. Facings: Raised face.
8. Grooved Mechanical-Joint Fittings and Couplings:
   a. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
   b. Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
9. Steel Pressure-Seal Fittings:
   a. Housing: Steel.
   b. O-Rings and Pipe Stop: EPDM.
   c. Tools: Manufacturer's special tool.
   d. Minimum 300-psig (2070-kPa) working-pressure rating at 230 deg F (110 deg C).
10. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

C. Plastic Pipe And Fittings

1. CPVC Plastic Pipe: ASTM F 441/F 441M, Schedules 40 and 80, plain ends as indicated in Part 1.3 "Piping Applications" Article.
2. CPVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM F 438 for Schedule 40 pipe; ASTM F 439 for Schedule 80 pipe.
3. PVC Plastic Pipe: ASTM D 1785, Schedules 40 and 80, plain ends as indicated in Part 1.3 "Piping Applications" Article.
4. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.

D. Fiberglass Pipe And Fittings

1. RTRP: ASTM D 2996, filament-wound pipe with tapered bell and spigot ends for adhesive joints.
2. RTRF: Compression or spray-up/contact molded of same material, pressure class, and joining method as pipe.
3. Flanges: ASTM D 4024. Full-face gaskets suitable for the service, minimum 1/8-inch (3.2-mm) thick, 60-70 durometer. ASTM A 307, Grade B, hex head bolts with washers.

E. Joining Materials
1. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   a. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
      1) Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      2) Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
3. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
4. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
5. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
6. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
7. Solvent Cements for Joining Plastic Piping:
   a. CPVC Piping: ASTM F 493.
      1) Use CPVC solvent cement that has a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
      2) Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   b. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
      1) Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
      2) Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
8. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.
   a. Use fiberglass adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

F. Transition Fittings
1. Plastic-to-Metal Transition Fittings:
   a. CPVC **OR** PVC, **as directed**, one-piece fitting with one threaded brass or copper insert and one Schedule 80 solvent-cement-joint end.
2. Plastic-to-Metal Transition Unions:
   a. MSS SP-107, CPVC **OR** PVC, **as directed**, union. Include brass or copper end, Schedule 80 solvent-cement-joint end, rubber gasket, and threaded union.

G. Dielectric Fittings
1. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
2. Insulating Material: Suitable for system fluid, pressure, and temperature.
3. Dielectric Unions:
   a. Factory-fabricated union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
4. Dielectric Flanges:
   a. Factory-fabricated companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
5. Dielectric-Flange Kits:
   a. 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.

b. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure where required to suit system pressures.

6. Dielectric Couplings:
   a. Galvanized-steel coupling with inert and noncorrosive thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
7. Dielectric Nipples:
   a. Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

H. Valves
1. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 15 Section(s) "General-duty Valves For Plumbing Piping" OR "General-duty Valves For Hvac Piping".
2. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 15 Section "Hvac Instrumentation And Controls".
3. Plastic Ball Valves:
   a. Body: One-, two-, or three-piece CPVC or PVC to match piping.
   b. Ball: Full-port CPVC or PVC to match piping.
   c. Seats: PTFE.
   d. Seals: EPDM.
   e. End Connections: Socket, union, or flanged.
   f. Handle Style: Tee shape.
   g. CWP Rating: Equal to piping service.
   h. Maximum Operating Temperature: Equal to piping service.
   i. Comply with MSS SP-122.
4. Plastic Butterfly Valves:
   a. Body: PVC or CPVC to match piping wafer type for installation between flanges.
   b. Disc: EPDM-coated steel.
   c. Seats: PTFE.
   d. Handle Style: Locking lever.
   e. CWP Rating: Equal to piping service.
   f. Maximum Operating Temperature: Equal to piping service.
5. Plastic Check Valves:
   a. Body: One-, two-, or three-piece PVC or CPVC to match piping.
   b. Ends: Socket or flanged.
   c. Seats: PTFE.
   d. Check Style: Swing or ball type.
   e. CWP Rating: Equal to piping service.
   f. Maximum Operating Temperature: Equal to piping service.
6. Bronze, Calibrated-Orifice, Balancing Valves:
   a. Body: Bronze, ball or plug type with calibrated orifice or venturi.
   b. Ball: Brass or stainless steel.
   c. Plug: Resin.
   d. Seat: PTFE.
   e. End Connections: Threaded or socket.
   f. Pressure Gage Connections: Integral seals for portable differential pressure meter.
   g. Handle Style: Lever, with memory stop to retain set position.
   h. CWP Rating: Minimum 125 psig (860 kPa).
   i. Maximum Operating Temperature: 250 deg F (121 deg C).
7. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:
   a. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
   b. Ball: Brass or stainless steel.
   c. Stem Seals: EPDM O-rings.
   d. Disc: Glass and carbon-filled PTFE.
   e. Seat: PTFE.

f. End Connections: Flanged or grooved.
g. Pressure Gage Connections: Integral seals for portable differential pressure meter.
h. Handle Style: Lever, with memory stop to retain set position.
i. CWP Rating: Minimum 125 psig (860 kPa).
j. Maximum Operating Temperature: 250 deg F (121 deg C).

8. Diaphragm-Operated, Pressure-Reducing Valves:
   a. Body: Bronze or brass.
   b. Disc: Glass and carbon-filled PTFE.
   c. Seat: Brass.
   d. Stem Seals: EPDM O-rings.
   e. Diaphragm: EPT.
   f. Low inlet-pressure check valve.
   g. Inlet Strainer: removable without system shutdown.
   h. Valve Seat and Stem: Noncorrosive.
   i. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.
9. Diaphragm-Operated Safety Valves:
   a. Body: Bronze or brass.
   b. Disc: Glass and carbon-filled PTFE.
   c. Seat: Brass.
   d. Stem Seals: EPDM O-rings.
   e. Diaphragm: EPT.
   f. Wetted, Internal Work Parts: Brass and rubber.
   g. Inlet Strainer: removable without system shutdown.
   h. Valve Seat and Stem: Noncorrosive.
   i. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.
10. Automatic Flow-Control Valves:
   a. Body: Brass or ferrous metal.
   b. Piston and Spring Assembly: Stainless steel **OR** Corrosion resistant, **as directed**, tamper proof, self cleaning, and removable.
   c. Combination Assemblies: Include bonze or brass-alloy ball valve.
   d. Identification Tag: Marked with zone identification, valve number, and flow rate.
   e. Size: Same as pipe in which installed.
   f. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
   g. Minimum CWP Rating: 175 psig (1207 kPa) **OR** 300 psig (2070 kPa), **as directed**.
   h. Maximum Operating Temperature: 200 deg F (93 deg C) **OR** 250 deg F (121 deg C), **as directed**.

I. Air Control Devices
1. Manual Air Vents:
   a. Body: Bronze.
   b. Internal Parts: Nonferrous.
   c. Operator: Screwdriver or thumbscrew.
   d. Inlet Connection: NPS 1/2 (DN 15).
   e. Discharge Connection: NPS 1/8 (DN 6).
   f. CWP Rating: 150 psig (1035 kPa).
   g. Maximum Operating Temperature: 225 deg F (107 deg C).
2. Automatic Air Vents:
   a. Body: Bronze or cast iron.
   b. Internal Parts: Nonferrous.
   c. Operator: Noncorrosive metal float.
   d. Inlet Connection: NPS 1/2 (DN 15).

e. Discharge Connection: NPS 1/4 (DN 8).
f. CWP Rating: 150 psig (1035 kPa).
g. Maximum Operating Temperature: 240 deg F (116 deg C).

3. Expansion Tanks:
   a. Tank: Welded steel, rated for 125-psig (860-kPa) working pressure and 375 deg F (191 deg C) maximum operating temperature, with taps in bottom of tank for tank fitting and taps in end of tank for gage glass. Tanks shall be factory tested with taps fabricated and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
   b. Air-Control Tank Fitting: Cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, 100-gal. (379-L) unit only; sized for compression-tank diameter. Provide tank fittings for 125-psig (860-kPa) working pressure and 250 deg F (121 deg C) maximum operating temperature.
   c. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig (860-kPa) working pressure and 240 deg F (116 deg C) maximum operating temperature; constructed to admit air to compression tank, drain water, and close off system.
   d. Gage Glass: Full height with dual manual shutoff valves, 3/4-inch- (20-mm-) diameter gage glass, and slotted-metal glass guard.
4. Diaphragm-Type **OR** Bladder-Type, **as directed**, Expansion Tanks:
   a. Tank: Welded steel, rated for 125-psig (860-kPa) working pressure and 375 deg F (191 deg C) maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
   b. Diaphragm **OR** Bladder, **as directed**: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
   c. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.
5. Tangential-Type Air Separators:
   a. Tank: Welded steel; ASME constructed and labeled for 125-psig (860-kPa) minimum working pressure and 375 deg F (191 deg C) maximum operating temperature.
   b. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
   c. Tangential Inlet and Outlet Connections: Threaded for NPS 2 (DN 50) and smaller; flanged connections for NPS 2-1/2 (DN 65) and larger.
   d. Blowdown Connection: Threaded.
   e. Size: Match system flow capacity.
6. In-Line Air Separators:
   a. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
   b. Maximum Working Pressure: Up to 175 psig (1207 kPa).
   c. Maximum Operating Temperature: Up to 300 deg F (149 deg C).
7. Air Purgers:
   a. Body: Cast iron with internal baffles that slow the water velocity to separate the air from solution and divert it to the vent for quick removal.
   b. Maximum Working Pressure: 150 psig (1035 kPa).
   c. Maximum Operating Temperature: 250 deg F (121 deg C).

J. Chemical Treatment
1. Bypass Chemical Feeder: Welded steel construction; 125-psig (860-kPa) working pressure; 5-gal. (19-L) capacity; with fill funnel and inlet, outlet, and drain valves.
   a. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.
2. Ethylene and Propylene Glycol: Industrial grade with corrosion inhibitors and environmental-stabilizer additives for mixing with water in systems indicated to contain antifreeze or glycol solutions.

K. Hydronic Piping Specialties
1. Y-Pattern Strainers:

a. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
b. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
c. Strainer Screen: 40 **OR** 60, **as directed**,-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
d. CWP Rating: 125 psig (860 kPa).

2. Basket Strainers:
   a. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
   b. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
   c. Strainer Screen: 40 **OR** 60, **as directed**,-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
   d. CWP Rating: 125 psig (860 kPa).
3. T-Pattern Strainers:
   a. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
   b. End Connections: Grooved ends.
   c. Strainer Screen: 40 **OR** 60, **as directed**,-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
   d. CWP Rating: 750 psig (5170 kPa).
4. Stainless-Steel Bellow, Flexible Connectors:
   a. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
   b. End Connections: Threaded or flanged to match equipment connected.
   c. Performance: Capable of 3/4-inch (20-mm) misalignment.
   d. CWP Rating: 150 psig (1035 kPa).
   e. Maximum Operating Temperature: 250 deg F (121 deg C).
5. Spherical, Rubber, Flexible Connectors:
   a. Body: Fiber-reinforced rubber body.
   b. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
   c. Performance: Capable of misalignment.
   d. CWP Rating: 150 psig (1035 kPa).
   e. Maximum Operating Temperature: 250 deg F (121 deg C).
6. Expansion fittings are specified in Division 15 Section(s) "Expansion Fittings And Loops For Plumbing Piping" OR "Expansion Fittings And Loops For Hvac Piping".

1.3 EXECUTION

1. Hot-water heating piping, aboveground, NPS 2 (DN 50) and smaller, shall be any of the following:
   a. Type L (B) **OR** M (C), **as directed**, drawn-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed **OR** pressure-seal, **as directed**, joints.
   b. Schedule 40 **OR** 30 **OR** 20, **as directed**, steel pipe; Class 125, cast-iron **OR** 150, malleable-iron **OR** 250, cast-iron **OR** 300, malleable-iron, **as directed**, fittings; cast-iron flanges and flange fittings; and threaded joints.
   c. Schedule 5 steel pipe; steel, pressure-seal couplings and fittings; and pressure-seal joints.
   d. Schedule 40 **OR** 80, **as directed**, CPVC plastic pipe and fittings and solvent-welded joints.
2. Hot-water heating piping, aboveground, NPS 2-1/2 (DN 65) and larger, shall be any of the following:
   a. Type L (B) **OR** M (C), **as directed**, drawn-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed, **as directed**, joints.
   b. Schedule 40 **OR** 30 **OR** 20, **as directed**, steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
   c. Schedule 40 **OR** 30 **OR** 20, **as directed**, steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

d. Schedule 40 **OR** 80, **as directed**, CPVC plastic pipe and fittings and solvent-welded joints.
e. RTRP and RTRF with adhesive or flanged joints.

3. Hot-water heating piping installed belowground and within slabs shall be either of the following:
   a. Type K (A), annealed-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed, **as directed**, joints. Use the fewest possible joints.
   b. RTRP and RTRF with adhesive or flanged joints.
4. Chilled-water piping, aboveground, NPS 2 (DN 50) and smaller, shall be any of the following:
   a. Type L (B) **OR** M (C), **as directed**, drawn-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed **OR** pressure-seal, **as directed**, joints.
   b. Schedule 40 **OR** 30 **OR** 20, **as directed**, steel pipe; Class 125, cast-iron **OR** 150, malleable-iron **OR** 250, cast-iron **OR** 300, malleable-iron, **as directed**, fittings; cast-iron flanges and flange fittings; and threaded joints.
   c. Schedule 5 steel pipe; steel, pressure-seal couplings and fittings; and pressure-seal joints.
   d. Schedule 40 **OR** 80, **as directed**, CPVC plastic pipe and fittings and solvent-welded joints.
5. Chilled-water piping, aboveground, NPS 2-1/2 (DN 65) and larger, shall be any of the following:
   a. Type L (B) **OR** M (C), **as directed**, drawn-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed, **as directed**, joints.
   b. Schedule 40 **OR** 30 **OR** 20, **as directed**, steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
   c. Schedule 40 **OR** 30 **OR** 20, **as directed**, steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
   d. Schedule 40 **OR** 80, **as directed**, CPVC plastic pipe and fittings and solvent-welded joints.
   e. RTRP and RTRF with adhesive or flanged joints.
6. Chilled-water piping installed belowground and within slabs shall be either of the following:
   a. Type K (A), annealed-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed, **as directed**, joints. Use the fewest possible joints.
   b. RTRP and RTRF with adhesive or flanged joints.
7. Dual-temperature heating and cooling water piping, aboveground, NPS 2 (DN 50) and smaller, shall be any of the following:
   a. Type L (B) **OR** M (C), **as directed**, drawn-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed **OR** pressure-seal, **as directed**, joints.
   b. Schedule 40 **OR** 30 **OR** 20, **as directed**, steel pipe; Class 125, cast-iron **OR** 150, malleable-iron **OR** 250, cast-iron **OR** 300, malleable-iron, **as directed**, fittings; cast-iron flanges and flange fittings; and threaded joints.
   c. Schedule 5 steel pipe; steel, pressure-seal couplings and fittings; and pressure-seal joints.
   d. Schedule 40 **OR** 80, **as directed**, CPVC plastic pipe and fittings and solvent-welded joints.
8. Dual-temperature heating and cooling water piping, aboveground, NPS 2-1/2 (DN 65) and larger, shall be any of the following:
   a. Type L (B) **OR** M (C), **as directed**, drawn-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed, **as directed**, joints.
   b. Schedule 40 **OR** 30 **OR** 20, **as directed**, steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
   c. Schedule 40 **OR** 30 **OR** 20, **as directed**, steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
   d. Schedule 40 **OR** 80, **as directed**, CPVC plastic pipe and fittings and solvent-welded joints.
   e. RTRP and RTRF with adhesive or flanged joints.
9. Dual-temperature heating and cooling water piping installed belowground and within slabs shall be either of the following:
   a. Type K (A), annealed-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed, **as directed**, joints. Use the fewest possible joints.
   b. RTRP and RTRF with adhesive or flanged joints.
10. Condenser-water piping, aboveground, NPS 2 (DN 50) and smaller, shall be any of the following:
    a. Type L (B) **OR** M (C), **as directed**, drawn-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed **OR** pressure-seal, **as directed**, joints.

b. Schedule 80 **OR** 40 **OR** 30 **OR** 20, **as directed**, steel pipe; Class 125, cast-iron **OR** 150, malleable-iron **OR** 250, cast-iron **OR** 300, malleable-iron, **as directed**, fittings; cast-iron flanges and flange fittings; and threaded joints.
c. Schedule 5 steel pipe; steel, pressure-seal couplings and fittings; and pressure-seal joints.
d. Schedule 40 **OR** 80, **as directed**, CPVC plastic pipe and fittings and solvent-welded joints.

11. Condenser-water piping, aboveground, NPS 2-1/2 (DN 65) and larger, shall be any of the following:
    a. Type L (B) **OR** M (C), **as directed**,, drawn-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed, **as directed**, joints.
    b. Schedule 80 **OR** 40 **OR** 30 **OR** 20, **as directed**, steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
    c. Schedule 80 **OR** 40 **OR** 30 **OR** 20, **as directed**, steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
    d. Schedule 40 **OR** 80, **as directed**, CPVC plastic pipe and fittings and solvent-welded joints.
    e. RTRP and RTRF with adhesive or flanged joints.
12. Condenser-water piping installed belowground and within slabs shall be either of the following:
    a. Type K (A), annealed-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed, **as directed**, joints. Use the fewest possible joints.
    b. RTRP and RTRF with adhesive or flanged joints.
13. Glycol cooling-water piping, aboveground, NPS 2 (DN 50) and smaller, shall be any of the following:
    a. Type L (B) **OR** M (C), **as directed**, drawn-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed **OR** pressure-seal, **as directed**, joints.
    b. Schedule 40 **OR** 30 **OR** 20, **as directed**, steel pipe; Class 125, cast-iron **OR** 150, malleable-iron **OR** 250, cast-iron **OR** 300, malleable-iron, **as directed**, fittings; cast-iron flanges and flange fittings; and threaded joints.
    c. Schedule 5 steel pipe; steel, pressure-seal couplings and fittings; and pressure-seal joints.
    d. Schedule 40 **OR** 80, **as directed**, CPVC plastic pipe and fittings and solvent-welded joints.
14. Glycol cooling-water piping, aboveground, NPS 2-1/2 (DN 65) and larger, shall be any of the following:
    a. Type L (B) **OR** M (C), **as directed**, drawn-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed, **as directed**, joints.
    b. Schedule 40 **OR** 30 **OR** 20, **as directed**, steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
    c. Schedule 40 **OR** 30 **OR** 20, **as directed**, steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
    d. Schedule 40 **OR** 80, **as directed**, CPVC plastic pipe and fittings and solvent-welded joints.
    e. RTRP and RTRF with adhesive or flanged joints.
15. Glycol cooling-water piping installed belowground and within slabs shall be either of the following:
    a. Type K (A), annealed-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed, **as directed**, joints. Use the fewest possible joints.
    b. RTRP and RTRF with adhesive or flanged joints.
16. Makeup-water piping installed aboveground shall be either of the following:
    a. Type L (B) **OR** M (C), **as directed**, drawn-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed, **as directed**, joints.
    b. Schedule 40 **OR** 80, **as directed**, CPVC plastic pipe and fittings, and solvent-welded joints.
17. Makeup-Water Piping Installed Belowground and within Slabs: Type K (A), annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.
18. Condensate-Drain Piping: Type M (C) **OR** DWV, **as directed**, drawn-temper copper tubing, wrought-copper fittings, and soldered joints or Schedule 40 PVC plastic pipe and fittings and solvent-welded joints, **as directed**.
    OR
    Condensate-Drain Piping: Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.

19. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
20. Air-Vent Piping:
    a. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
    b. Outlet: Type K (A), annealed-temper copper tubing with soldered or flared joints.
21. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

B. Valve Applications
1. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.
2. Install throttling-duty **OR** calibrated-orifice, balancing, **as directed**, valves at each branch connection to return main.
3. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
4. Install check valves at each pump discharge and elsewhere as required to control flow direction.
5. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
6. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

C. Piping Installations
1. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such 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.
2. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
3. 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.
4. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
5. Install piping to permit valve servicing.
6. Install piping at indicated slopes.
7. Install piping free of sags and bends.
8. Install fittings for changes in direction and branch connections.
9. Install piping to allow application of insulation.
10. Select system components with pressure rating equal to or greater than system operating pressure.
11. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
12. Install drains, consisting of a tee fitting, NPS 3/4 (DN 20) ball valve, and short NPS 3/4 (DN 20) threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
13. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
14. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
15. Install branch connections to mains using mechanically formed, **as directed**, tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
16. Install valves according to Division 15 Section(s) "General-duty Valves For Plumbing Piping" OR "General-duty Valves For Hvac Piping".
17. Install unions in piping, NPS 2 (DN 50) and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

18. Install flanges in piping, NPS 2-1/2 (DN 65) and larger, at final connections of equipment and elsewhere as indicated.
19. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 (DN 20) nipple and ball valve in blowdown connection of strainers NPS 2 (DN 50) and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2 (DN 50).
20. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 15 Section(s) "Expansion Fittings And Loops For Plumbing Piping" OR "Expansion Fittings And Loops For Hvac Piping".
21. Identify piping as specified in Division 15 Section(s) "Identification For Plumbing Piping And Equipment" OR "Identification For Hvac Piping And Equipment".

D. Hangers And Supports
1. Hanger, support, and anchor devices are specified in Division 15 Section(s) "Hangers And Supports For Plumbing Piping And Equipment" OR "Hangers And Supports For Hvac Piping And Equipment". Comply with the following requirements for maximum spacing of supports.
2. Seismic restraints are specified in Division 15 Section(s) "Vibration And Seismic Controls For Fire-suppression Piping And Equipment" OR "Vibration And Seismic Controls For Plumbing Piping And Equipment" OR "Vibration And Seismic Controls For Hvac Piping And Equipment".
3. Install the following pipe attachments:
   a. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (6 m) long.
   b. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet (6 m) or longer.
   c. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
   d. Spring hangers to support vertical runs.
   e. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
   f. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
4. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
   a. NPS 3/4 (DN 20): Maximum span, 7 feet (2.1 m); minimum rod size, 3/8 inch (10 mm).
   b. NPS 1 (DN 25): Maximum span, 7 feet (2.1 m); minimum rod size, 3/8 inch (10 mm).
   c. NPS 1-1/4 (DN 32): Maximum span, 7 feet (2.1 m); minimum rod size, 3/8 inch (10 mm).
   d. NPS 1-1/2 (DN 40): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
   e. NPS 2 (DN 50): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).
   f. NPS 2-1/2 (DN 65): Maximum span, 11 feet (3.4 m); minimum rod size, 1/2 inch (12 mm).
   g. NPS 3 (DN 80): Maximum span, 12 feet (3.7 m); minimum rod size, 1/2 inch (12 mm).
   h. NPS 3-1/2 (DN 90): Maximum span, 13 feet (4 m); minimum rod size, 1/2 inch (12 mm).
   i. NPS 4 (DN 100): Maximum span, 14 feet (4.3 m); minimum rod size, 5/8 inch (16 mm).
   j. NPS 5 (DN 125): Maximum span, 16 feet (4.9 m); minimum rod size, 5/8 inch (16 mm).
   k. NPS 6 (DN 150): Maximum span, 17 feet (5.2 m); minimum rod size, 3/4 inch (20 mm).
   l. NPS 8 (DN 200): Maximum span, 19 feet (5.8 m); minimum rod size, 3/4 inch (20 mm).
   m. NPS 10 (DN 250): Maximum span, 22 feet (6.7 m); minimum rod size, 7/8 inch (20 mm).
   n. NPS 12 (DN 300): Maximum span, 23 feet (7 m); minimum rod size, 7/8 inch (20 mm).
   o. NPS 14 (DN 350): Maximum span, 25 feet (7.6 m); minimum rod size, 1 inch (24 mm).
   p. NPS 16 (DN 400): Maximum span, 27 feet (8.2 m); minimum rod size, 1 inch (24 mm).
   q. NPS 18 (DN 450): Maximum span, 28 feet (8.5 m); minimum rod size, 1 inch (24 mm).
   r. NPS 20 (DN 500): Maximum span, 30 feet (9.1 m); minimum rod size, 1-1/4 inches (30 mm).
5. Install hangers for drawn-temper copper tubing with the following maximum spacing and minimum rod sizes:
   a. NPS 3/4 (DN 20): Maximum span, 5 feet (1.5 m); minimum rod size, 3/8 inch (10 mm).
   b. NPS 1 (DN 25): Maximum span, 6 feet (1.8 m); minimum rod size, 3/8 inch (10 mm).
   c. NPS 1-1/4 (DN 32): Maximum span, 7 feet (2.1 m); minimum rod size, 3/8 inch (10 mm).

d. NPS 1-1/2 (DN 40): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
e. NPS 2 (DN 50): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
f. NPS 2-1/2 (DN 65): Maximum span, 9 feet (2.7 m); minimum rod size, 1/2 inch (12 mm).
g. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod size, 1/2 inch (12 mm).

6. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
7. Fiberglass Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
8. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.

E. Pipe Joint Construction
1. Join pipe and fittings according to the following requirements and Division 15 specifying piping systems.
2. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
3. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
4. 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.
5. 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.
6. 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:
   a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   b. 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.
7. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1.1 "Quality Assurance" Article.
8. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
9. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   b. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
   c. PVC Pressure Piping: Join ASTM D 1785 schedule number, 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.
   d. PVC Nonpressure Piping: Join according to ASTM D 2855.
10. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.
11. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.
12. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.
13. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

F. Hydronic Specialties Installation
1. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
   OR

Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.

2. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
3. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 (DN 50) and larger.

   OR

   Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.
4. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches (1200 mm) above the floor. Install feeder in minimum NPS 3/4 (DN 20) bypass line, from main with full-size, full-port, ball valve in the main between bypass connections. Install NPS 3/4 (DN 20) pipe from chemical feeder drain, to nearest equipment drain and include a full-size, full-port, ball valve.
5. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.
   a. Install tank fittings that are shipped loose.
   b. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.

   OR

   Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

G. Terminal Equipment Connections
1. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
2. Install control valves in accessible locations close to connected equipment.
3. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
4. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 15 Section(s) "Meters And Gages For Plumbing Piping" OR "Meters And Gages For Hvac Piping".

H. Chemical Treatment
1. Perform an analysis of makeup water to determine type and quantities of chemical treatment needed to keep system free of scale, corrosion, and fouling, and to sustain the following water characteristics:
   a. pH: 9.0 to 10.5.
   b. "P" Alkalinity: 100 to 500 ppm.
   c. Boron: 100 to 200 ppm.
   d. Chemical Oxygen Demand: Maximum 100 ppm. Modify this value if closed system contains glycol.
   e. Corrosion Inhibitor:
      1) Sodium Nitrate: 1000 to 1500 ppm.
      2) Molybdate: 200 to 300 ppm.
      3) Chromate: 200 to 300 ppm.
      4) Sodium Nitrate Plus Molybdate: 100 to 200 ppm each.
      5) Chromate Plus Molybdate: 50 to 100 ppm each.
   f. Soluble Copper: Maximum 0.20 ppm.
   g. Tolyiriazole Copper and Yellow Metal Corrosion Inhibitor: Minimum 10 ppm.
   h. Total Suspended Solids: Maximum 10 ppm.
   i. Ammonia: Maximum 20 ppm.
   j. Free Caustic Alkalinity: Maximum 20 ppm.
   k. Microbiological Limits:

1) Total Aerobic Plate Count: Maximum 1000 organisms/ml.
2) Total Anaerobic Plate Count: Maximum 100 organisms/ml.
3) Nitrate Reducers: 100 organisms/ml.
4) Sulfate Reducers: Maximum 0 organisms/ml.
5) Iron Bacteria: Maximum 0 organisms/ml.

2. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.
3. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.
4. Fill systems indicated to have antifreeze or glycol solutions with the following concentrations:
   a. Hot-Water Heating Piping: Minimum percent ethylene, as directed by the Owner **OR** propylene, **as directed**, glycol.
   b. Chilled-Water Piping: Minimum percent ethylene, as directed by the Owner **OR** propylene, **as directed**, glycol.
   c. Dual-Temperature Heating and Cooling Water Piping: Minimum percent, as directed by the Owner ethylene **OR** propylene, **as directed**, glycol.
   d. Glycol Cooling-Water Piping: Minimum percent ethylene, as directed by the Owner. **OR** propylene, **as directed**, glycol.

I. Field Quality Control
1. Prepare hydronic piping according to ASME B31.9 and as follows:
   a. Leave joints, including welds, uninsulated and exposed for examination during test.
   b. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
   c. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
   d. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
   e. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
2. Perform the following tests on hydronic piping:
   a. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
   b. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
   c. Isolate expansion tanks and determine that hydronic system is full of water.
   d. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
   e. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
   f. Prepare written report of testing.
3. Perform the following before operating the system:
   a. Open manual valves fully.
   b. Inspect pumps for proper rotation.
   c. Set makeup pressure-reducing valves for required system pressure.
   d. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
   e. Set temperature controls so all coils are calling for full flow.
   f. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.

g. Verify lubrication of motors and bearings.

END OF SECTION 15061c

SECTION 15061d - STEAM AND CONDENSATE PIPING

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for steam and condensate piping. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. This Section includes the following for LP and HP steam and condensate piping:
   a. Pipe and fittings.
   b. Strainers.
   c. Flash tanks.
   d. Safety valves.
   e. Pressure-reducing valves.
   f. Steam traps.
   g. Thermostatic air vents and vacuum breakers.
   h. Steam and condensate meters.

C. Definitions
1. HP Systems: High-pressure piping operating at more than 15 psig (104 kPa) as required by ASME B31.1.
2. LP Systems: Low-pressure piping operating at 15 psig (104 kPa) or less as required by ASME B31.9.
3. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
4. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

D. Performance Requirements
1. Components and installation shall be capable of withstanding the following minimum working pressures and temperatures:
   a. HP Steam Piping: <**Insert psig (kPa)**.>
   b. LP Steam Piping: <**Insert psig (kPa).**>
   c. Condensate Piping: <**Insert psig (kPa)**> at 250 deg F (121 deg C).
   d. Makeup-Water Piping: 80 psig (552 kPa) at 150 deg F (66 deg C).
   e. Blowdown-Drain Piping: Equal to pressure of the piping system to which it is attached.
   f. Air-Vent and Vacuum-Breaker Piping: Equal to pressure of the piping system to which it is attached.
   g. Safety-Valve-Inlet and -Outlet Piping: Equal to pressure of the piping system to which it is attached.

E. Submittals
1. Product Data: For each type of the following:
   a. RTRP and RTRF with adhesive.
   b. Pressure-reducing and safety valve.
   c. Steam trap.
   d. Air vent and vacuum breaker.
   e. Flash tank.
   f. Meter.
2. Shop Drawings: Detail, 1/4 inch equals 1 foot (1:50) scale, flash tank assemblies and fabrication of pipe anchors, hangers, pipe, multiple pipes, alignment guides, and expansion joints and loops and their attachment to the building structure. Detail locations of anchors, alignment guides, and expansion joints and loops.

3. Welding certificates.
4. Field quality-control test reports.
5. Operation and Maintenance Data: For valves, safety valves, pressure-reducing valves, steam traps, air vents, vacuum breakers, and meters to include in emergency, operation, and maintenance manuals.

F. Quality Assurance
1. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code - Steel."
2. Pipe Welding: Qualify processes and operators according to the following:
   a. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   b. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
3. ASME Compliance: Comply with ASME B31.1, "Power Piping" **AND/OR** ASME B31.9, "Building Services Piping", **as directed**, for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp flash tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

1.2 PRODUCTS

A. Copper Tube And Fittings
1. Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B) **OR** ASTM B 88, Type M (ASTM B 88M, Type C), **as directed**.
2. Annealed-Temper Copper Tubing: ASTM B 88, Type K (ASTM B 88M, Type A).
3. Wrought-Copper Fittings and Unions: ASME B16.22.

B. Steel Pipe And Fittings
1. Steel Pipe: ASTM A 53/A 53M, black steel, plain ends, Type, Grade, and Schedule as indicated in Part 3 piping applications articles.
2. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125, 150, and 300 as indicated in Part 3 piping applications articles.
3. Malleable-Iron Threaded Fittings: ASME B16.3; Classes 150 and 300 as indicated in Part 3 piping applications articles.
4. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 piping applications articles.
5. Cast-Iron Threaded Flanges and Flanged Fittings: ASME B16.1, Classes 125 and 250 as indicated in Part 3 piping applications articles; raised ground face, and bolt holes spot faced.
6. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
7. Wrought-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
   a. Material Group: 1.1.
   b. End Connections: Butt welding.
   c. Facings: Raised face.
8. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, black steel of same Type, Grade, and Schedule as pipe in which installed.
9. Stainless-Steel Bellows, Flexible Connectors:
   a. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforced, protective jacket.
   b. End Connections: Threaded or flanged to match equipment connected.
   c. Performance: Capable of 3/4-inch (20-mm) misalignment.
   d. CWP Rating: 150-psig (1035-kPa).
   e. Maximum Operating Temperature: 250 deg F (121 deg C).

C. Fiberglass Pipe And Fittings

1. RTRP: ASTM D 2996 filament-wound pipe with tapered bell and spigot ends for adhesive joints.
2. RTRF: Compression or spray-up/contact molded fittings of same material, pressure class, and joining method as pipe.
3. Flanges: ASTM D 4024 full-face gaskets suitable for the service, minimum 1/8 inch (3.2 mm) thick, 60-70 durometer. ASTM A 307, Grade B, hex head bolts with washers.
4. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.

D. Joining Materials
1. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   a. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
      1) Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      2) Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
3. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
4. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
5. Welding Filler Metals: Comply with AWS D10.12 (AWS D10.12M) for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
6. Welding Materials: Comply with Section II, Part C, of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

E. Dielectric Fittings
1. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
2. Insulating Material: Suitable for system fluid, pressure, and temperature.
3. Dielectric Unions:
   a. Factory-fabricated union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
4. Dielectric Flanges:
   a. Factory-fabricated companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
5. Dielectric-Flange Kits:
   a. 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.
   b. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

F. Valves
1. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 15 Section "General-duty Valves For Hvac Piping".
2. Stop-Check Valves:
   a. Body and Bonnet: Malleable iron.
   b. End Connections: Flanged.
   c. Disc: Cylindrical with removable liner and machined seat.
   d. Stem: Brass alloy.
   e. Operator: Outside screw and yoke with cast-iron handwheel.
   f. Packing: Polytetrafluoroethylene-impregnated packing with two-piece packing gland assembly.
   g. Pressure Class: 250.

G. Strainers
1. Y-Pattern Strainers:

a. Body: ASTM A 126, Class B cast iron, with bolted cover and bottom drain connection.
b. End Connections: Threaded ends for strainers NPS 2 (DN 50) and smaller; flanged ends for strainers NPS 2-1/2 (DN 65) and larger.
c. Strainer Screen: Stainless-steel, 20 mesh strainer, and perforated stainless-steel basket with 50 percent free area.
d. Tapped blowoff plug.
e. CWP Rating: 250-psig (1725-kPa) working steam pressure.

2. Basket Strainers:
a. Body: ASTM A 126, Class B cast iron, with bolted cover and bottom drain connection.
b. End Connections: Threaded ends for strainers NPS 2 (DN 50) and smaller; flanged ends for strainers NPS 2-1/2 (DN 65) and larger.
c. Strainer Screen: Stainless-steel, 20 mesh strainer, and perforated stainless-steel basket with 50 percent free area.
d. CWP Rating: 250-psig (1725-kPa) working steam pressure.

H. Flash Tanks
1. Shop or factory fabricated of welded steel according to ASME Boiler and Pressure Vessel Code, for 150-psig (1035-kPa) rating; and bearing ASME label. Fabricate with tappings for low-pressure steam and condensate outlets, high-pressure condensate inlet, air vent, safety valve, and legs.

I. Safety Valves
1. Bronze **OR** Brass, **as directed**, Safety Valves:
a. Disc Material: Forged copper alloy.
b. End Connections: Threaded inlet and outlet.
c. Spring: Fully enclosed steel spring with adjustable pressure range and positive shutoff, factory set and sealed.
d. Pressure Class: 250.
e. Drip-Pan Elbow: Cast iron and having threaded inlet and outlet with threads complying with ASME B1.20.1.
f. Size and Capacity: As required for equipment according to ASME Boiler and Pressure Vessel Code.

2. Cast-Iron Safety Valves:
a. Disc Material: Forged copper alloy with bronze nozzle.
b. End Connections: Raised-face flanged inlet and threaded or flanged outlet connections.
c. Spring: Fully enclosed cadmium-plated steel spring with adjustable pressure range and positive shutoff, factory set and sealed.
d. Pressure Class: 250.
e. Drip-Pan Elbow: Cast iron and having threaded inlet, outlet, and drain, with threads complying with ASME B1.20.1.
f. Exhaust Head: Cast iron and having threaded inlet and drain, with threads complying with ASME B1.20.1.
g. Size and Capacity: As required for equipment according to ASME Boiler and Pressure Vessel Code.

J. Pressure-Reducing Valves
1. Size, Capacity, and Pressure Rating: Factory set for inlet and outlet pressures indicated.
2. Description: Pilot-actuated, diaphragm type, with adjustable pressure range and positive shutoff.
3. Body: Cast iron.
4. End Connections: Threaded connections for valves NPS 2 (DN 50) and smaller and flanged connections for valves NPS 2-1/2 (DN 65) and larger.
5. Trim: Hardened stainless steel.
6. Head and Seat: Replaceable, main head stem guide fitted with flushing and pressure-arresting device cover over pilot diaphragm.
7. Gaskets: Non-asbestos materials.

K. Steam Traps
1. Thermostatic Traps:
   a. Body: Bronze angle-pattern body with integral union tailpiece and screw-in cap.
   b. Trap Type: Balanced-pressure.
   c. Bellows: Stainless steel or monel.
   d. Head and Seat: Replaceable, hardened stainless steel.
   e. Pressure Class: 125.
2. Thermodynamic Traps:
   a. Body: Stainless steel with screw-in cap.
   b. End Connections: Threaded.
   c. Disc and Seat: Stainless steel.
   d. Maximum Operating Pressure: 600 psig (4140 kPa).
3. Float and Thermostatic Traps:
   a. Body and Bolted Cap: ASTM A 126, cast iron.
   b. End Connections: Threaded.
   c. Float Mechanism: Replaceable, stainless steel.
   d. Head and Seat: Hardened stainless steel.
   e. Trap Type: Balanced pressure.
   f. Thermostatic Bellows: Stainless steel or monel.
   g. Thermostatic air vent capable of withstanding 45 deg F (25 deg C) of superheat and resisting water hammer without sustaining damage.
   h. Vacuum Breaker: Thermostatic with phosphor bronze bellows, and stainless steel cage, valve, and seat.
   i. Maximum Operating Pressure: 125 psig (860 kPa).
4. Inverted Bucket Traps:
   a. Body and Cap: Cast iron.
   b. End Connections: Threaded.
   c. Head and Seat: Stainless steel.
   d. Valve Retainer, Lever, and Guide Pin Assembly: Stainless steel.
   e. Bucket: Brass or stainless steel.
   f. Strainer: Integral stainless-steel inlet strainer within the trap body.
   g. Air Vent: Stainless-steel thermostatic vent.
   h. Pressure Rating: 250 psig (1725 kPa).

L. Thermostatic Air Vents And Vacuum Breakers
1. Thermostatic Air Vents:
   a. Body: Cast iron, bronze or stainless steel.
   b. End Connections: Threaded.
   c. Float, Valve, and Seat: Stainless steel.
   d. Thermostatic Element: Phosphor bronze bellows in a stainless-steel cage.
   e. Pressure Rating: 125 psig (861 kPa) **OR** 300 psig (2068 kPa), **as directed**.
   f. Maximum Temperature Rating: 350 deg F (177 deg C).
2. Vacuum Breakers:
   a. Body: Cast iron, bronze, or stainless steel.
   b. End Connections: Threaded.
   c. Sealing Ball, Retainer, Spring, and Screen: Stainless steel.
   d. O-ring Seal: EPR.
   e. Pressure Rating: 125 psig (861 kPa) **OR** 300 psig (2068 kPa), **as directed**.
   f. Maximum Temperature Rating: 350 deg F (177 deg C).

M. Steam Meters
1. Meters shall have a microprocessor to display totalizer flow, flow rate, temperature, pressure, time, and date; alarms for high and low flow rate and temperature.
   a. Computer shall have 4 to 20-mA or 2 to 10 volt output for temperature, pressure, and contact closure for flow increments.
   b. Independent timers to store four peak flow rates and total flow.

c. Interface compatible with central workstation described in Division 15 Section "Hvac Instrumentation And Controls".
d. Microprocessor Enclosure: NEMA 250, Type 4.

2. Sensor:
   a. Venturi, of stainless-steel **OR** carbon-steel, **as directed**, construction, for insertion in pipeline between flanges. At least 10:1 turndown with plus or minus 1 percent accuracy over full-flow range.
   b. Vortex type with stainless-steel wetted parts and wafer **OR** flange, **as directed**, connections; and with a piezoelectric sensor removable and serviceable without shutting down the process. At least 10:1 turndown with plus or minus 1 percent accuracy over full-flow range.
   c. Spring-loaded, variable-area flowmeter type; density compensated with stainless-steel wetted parts and wafer **OR** flange, **as directed**, connections. At least 10:1 turndown with plus or minus 2 percent accuracy over full-flow range.

N. Condensate Meters
1. Body: Cast iron, bronze, or brass.
2. Turbine: Copper, brass, or stainless steel.
3. Connections: Threaded for NPS 2 (DN 50) and smaller and flanged for NPS 2-1/2 (DN 65).
4. Totalizer: Meters shall have a microprocessor to display flow, flow rate, time, and date; alarms for high and low flow rate, pressure, and temperature.
   a. Computer shall have 4- to 20-mA or 2- to 10-volt output for temperature, pressure, and contact closure for flow increments.
   b. Independent timers to store four peak flow rates and total flow.
   c. Interface compatible with central workstation specified in Division 15 Section "Hvac Instrumentation And Controls".
   d. Microprocessor Enclosure: NEMA 250, Type 4.
5. Pressure Rating: Atmospheric.
6. Maximum Temperature Rating: 250 deg F (121 deg C).

1.3 EXECUTION

A. LP Steam Piping Applications
1. LP Steam Piping, NPS 2 (DN 50) and Smaller: Schedule 40 **OR** 80, **as directed**, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
2. LP Steam Piping, NPS 2-1/2 through NPS 12 (DN 65 through DN 300): Schedule 40 **OR** 80, **as directed**, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
3. LP Steam Piping, NPS 14 through NPS 18 (DN 350 through DN 450): Schedule 30, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
4. LP Steam Piping, NPS 20 (DN 500) and Larger: Schedule 20, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
5. Condensate piping above grade, NPS 2 (DN 50) and smaller, shall be either of the following, **as directed**:
   a. Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
   b. RTRP and RTRF with adhesive or flanged joints.
6. Condensate piping above grade, NPS 2-1/2 (DN 65) and larger, shall be either of the following, **as directed**:
   a. Schedule 80, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
   b. RTRP and RTRF with adhesive or flanged joints.
7. Condensate piping below grade, NPS 2 (DN 50) and smaller, shall be either of the following, **as directed**:

a. Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
b. RTRP and RTRF with adhesive or flanged joints.

8. Condensate piping below grade, NPS 2-1/2 (DN 65) and larger, shall be either of the following, **as directed**:
   a. Schedule 80, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
   b. RTRP and RTRF with adhesive or flanged joints.

B. HP Steam Piping Applications

1. HP Steam Piping, NPS 2 (DN 50) and Smaller: Schedule 40 **OR** 80, **as directed**, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
2. HP Steam Piping, NPS 2-1/2 through NPS 12 (DN 65 through DN 300): Schedule 40 **OR** 80, **as directed**, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
3. HP Steam Piping, NPS 14 through NPS 18 (DN 350 through DN 450): Schedule 30, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
4. HP Steam Piping, NPS 20 (DN 500) and Larger: Schedule 20, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
5. Condensate piping above grade, NPS 2 (DN 50) and smaller, shall be either of the following, **as directed**:
   a. Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
   b. RTRP and RTRF with adhesive or flanged joints.
6. Condensate piping above grade, NPS 2-1/2 (DN 65) and larger, shall be either of the following, **as directed**:
   a. Schedule 80, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
   b. RTRP and RTRF with adhesive or flanged joints.
7. Condensate piping below grade, NPS 2 (DN 50) and smaller, shall be either of the following, **as directed**:
   a. Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
   b. RTRP and RTRF with adhesive or flanged joints.
8. Condensate piping below grade, NPS 2-1/2 (DN 65) and larger, shall be either of the following, **as directed**:
   a. Schedule 80, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
   b. RTRP and RTRF with adhesive or flanged joints.

C. Ancillary Piping Applications

1. Makeup-water piping installed above grade shall be either of the following, **as directed**:
   a. Drawn-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed, **as directed**, joints.
   b. Schedule 40 **OR** 80, **as directed**, CPVC plastic pipe and fittings, and solvent welded joints.
2. Makeup-Water Piping Installed below Grade and within Slabs: Annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.
3. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
4. Air-Vent Piping:
   a. Inlet: Same as service where installed.
   b. Outlet: Type K (A) annealed-temper copper tubing with soldered or flared joints.
5. Vacuum-Breaker Piping: Outlet, same as service where installed.
6. Safety-Valve-Inlet and -Outlet Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.

D. Valve Applications

1. Install shutoff duty valves at branch connections to steam supply mains, at steam supply connections to equipment, and at the outlet of steam traps.
2. Install safety valves on pressure-reducing stations and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

E. Piping Installation
1. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Use indicated piping locations and arrangements if such were 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.
2. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
3. 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.
4. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
5. Install piping to permit valve servicing.
6. Install piping free of sags and bends.
7. Install fittings for changes in direction and branch connections.
8. Install piping to allow application of insulation.
9. Select system components with pressure rating equal to or greater than system operating pressure.
10. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
11. Install drains, consisting of a tee fitting, NPS 3/4 (DN 20) full port-ball valve, and short NPS 3/4 (DN 20) threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
12. Install steam supply piping at a minimum uniform grade of 0.2 percent downward in direction of steam flow.
13. Install condensate return piping at a minimum uniform grade of 0.4 percent downward in direction of condensate flow.
14. Reduce pipe sizes using eccentric reducer fitting installed with level side down.
15. Install branch connections to mains using mechanically formed, **as directed**, tee fittings in main pipe, with the branch connected to top of main pipe.
16. Install valves according to Division 15 Section "General-duty Valves For Hvac Piping".
17. Install unions in piping, NPS 2 (DN 50) and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
18. Install flanges in piping, NPS 2-1/2 (DN 65) and larger, at final connections of equipment and elsewhere as indicated.
19. Install strainers on supply side of control valves, pressure-reducing valves, traps, and elsewhere as indicated. Install NPS 3/4 (DN 20) nipple and full port ball valve in blowdown connection of strainers NPS 2 (DN 50) and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2 (DN 50).
20. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 15 Section "Expansion Fittings And Loops For Hvac Piping".
21. Identify piping as specified in Division 15 Section "Identification For Hvac Piping And Equipment".
22. Install drip legs at low points and natural drainage points such as ends of mains, bottoms of risers, and ahead of pressure regulators, and control valves.
    a. On straight runs with no natural drainage points, install drip legs at intervals not exceeding 300 feet (90 m).
    b. Size drip legs same size as main. In steam mains NPS 6 (DN 150) and larger, drip leg size can be reduced, but to no less than NPS 4 (DN 100).
23. Flash Tank:

a. Pitch condensate piping down toward flash tank.
b. If more than one condensate pipe discharges into flash tank, install a check valve in each line.
c. Install thermostatic air vent at tank top.
d. Install safety valve at tank top.
e. Install full-port ball valve, and swing check valve on condensate outlet.
f. Install inverted bucket or float and thermostatic trap at low-pressure condensate outlet, sized for three times the calculated heat load.
g. Install pressure gage on low-pressure steam outlet according to Division 15 Section "Meters And Gages For Hvac Piping".

F. Steam-Trap Installation
1. Install steam traps in accessible locations as close as possible to connected equipment.
2. Install full-port ball valve, strainer, and union upstream from trap; install union, check valve, and full-port ball valve downstream from trap unless otherwise indicated.

G. Pressure-Reducing Valve Installation
1. Install pressure-reducing valves in accessible location for maintenance and inspection.
2. Install bypass piping around pressure-reducing valves, with globe valve equal in size to area of pressure-reducing valve seat ring, unless otherwise indicated.
3. Install gate valves on both sides of pressure-reducing valves.
4. Install unions or flanges on both sides of pressure-reducing valves having threaded- or flanged-end connections respectively.
5. Install pressure gages on low-pressure side of pressure-reducing valves after the bypass connection according to Division 15 Section "Meters And Gages For Hvac Piping".
6. Install strainers upstream for pressure-reducing valve.
7. Install safety valve downstream from pressure-reducing valve station.

H. Steam Or Condensate Meter Installation
1. Install meters with lengths of straight pipe upstream and downstream according to steam meter manufacturer's instructions.
2. Provide data acquisition wiring. Refer to Division 15 Section "Hvac Instrumentation And Controls".

I. Safety Valve Installation
1. Install safety valves according to ASME B31.1, "Power Piping" **OR** ASME B31.9, "Building Services Piping," **as directed**
2. Pipe safety-valve discharge without valves to atmosphere outside the building.
3. Install drip-pan elbow fitting adjacent to safety valve and pipe drain connection to nearest floor drain.
4. Install exhaust head with drain to waste, on vents equal to or larger than NPS 2-1/2 (DN 65).

J. Hangers And Supports
1. Install hangers and supports according to Division 15 Section "Hangers And Supports For Hvac Piping And Equipment". Comply with requirements below for maximum spacing.
2. Seismic restraints are specified in Division 15 Section "Vibration And Seismic Controls For Hvac Piping And Equipment".
3. Install the following pipe attachments:
   a. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (6 m) long.
   b. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet (6 m) or longer.
   c. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
   d. Spring hangers to support vertical runs.
4. Install hangers with the following maximum spacing and minimum rod sizes:
   a. NPS 3/4 (DN 20): Maximum span, 9 feet (2.7 m); minimum rod size, 1/4 inch (6.4 mm).

b. NPS 1 (DN 25): Maximum span, 9 feet (2.7 m); minimum rod size, 1/4 inch (6.4 mm).
c. NPS 1-1/2 (DN 40): Maximum span, 12 feet (3.7 m); minimum rod size, 3/8 inch (10 mm).
d. NPS 2 (DN 50): Maximum span, 13 feet (4 m); minimum rod size, 3/8 inch (10 mm).
e. NPS 2-1/2 (DN 65): Maximum span, 14 feet (4.3 m); minimum rod size, 3/8 inch (10 mm).
f. NPS 3 (DN 80): Maximum span, 15 feet (4.6 m); minimum rod size, 3/8 inch (10 mm).
g. NPS 4 (DN 100): Maximum span, 17 feet (5.2 m); minimum rod size, 1/2 inch (13 mm).
h. NPS 6 (DN 150): Maximum span, 21 feet (6.4 m); minimum rod size, 1/2 inch (13 mm).
i. NPS 8 (DN 200): Maximum span, 24 feet (7.3 m); minimum rod size, 5/8 inch (16 mm).
j. NPS 10 (DN 250): Maximum span, 26 feet (8 m); minimum rod size, 3/4 inch (19 mm).
k. NPS 12 (DN 300): Maximum span, 30 feet (9.1 m); minimum rod size, 7/8 inch (22 mm).
l. NPS 14 (DN 350): Maximum span, 32 feet (9.8 m); minimum rod size, 1 inch (25 mm).
m. NPS 16 (DN 400): Maximum span, 35 feet (10.7 m); minimum rod size, 1 inch (25 mm).
n. NPS 18 (DN 450): Maximum span, 37 feet (11.3 m); minimum rod size, 1-1/4 inches (32 mm).
o. NPS 20 (DN 500): Maximum span, 39 feet (11.9 m); minimum rod size, 1-1/4 inches (32 mm).

5. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
   a. NPS 1/2 (DN 15): Maximum span, 4 feet (1.2 m); minimum rod size, 1/4 inch (6.4 mm).
   b. NPS 3/4 (DN 20): Maximum span, 5 feet (1.5 m); minimum rod size, 1/4 inch (6.4 mm).
   c. NPS 1 (DN 25): Maximum span, 6 feet (1.8 m); minimum rod size, 1/4 inch (6.4 mm).
   d. NPS 1-1/2 (DN 40): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
   e. NPS 2 (DN 50): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
   f. NPS 2-1/2 (DN 65): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
   g. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).
6. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.
7. Fiberglass Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

K. Pipe Joint Construction
1. Join pipe and fittings according to the following requirements and Division 15 specifying piping systems.
2. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
3. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
4. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube ends. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
5. 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.
6. 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:
   a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   b. 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.
7. Welded Joints: Construct joints according to AWS D10.12 (AWS D10.12M), using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
8. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
9. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

L. Terminal Equipment Connections

1. Size for supply and return piping connections shall be the same as or larger than equipment connections.
2. Install traps and control valves in accessible locations close to connected equipment.
3. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
4. Install vacuum breakers downstream from control valve, close to coil inlet connection.
5. Install a drip leg at coil outlet.

M. Field Quality Control
1. Prepare steam and condensate piping according to ASME B31.1, "Power Piping" **AND/OR** ASME B31.9, "Building Services Piping," **as directed,** and as follows:
   a. Leave joints, including welds, uninsulated and exposed for examination during test.
   b. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
   c. Flush system with clean water. Clean strainers.
   d. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
2. Perform the following tests on steam and condensate piping:
   a. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
   b. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength.
   c. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
3. Prepare written report of testing.

END OF SECTION 15061d

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SECTION 15061e - REFRIGERANT PIPING

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for refrigerant piping. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. This Section includes refrigerant piping used for air-conditioning applications.

C. Performance Requirements
1. Line Test Pressure for Refrigerant R-22:
   a. Suction Lines for Air-Conditioning Applications: 185 psig (1276 kPa).
   b. Suction Lines for Heat-Pump Applications: 325 psig (2241 kPa).
   c. Hot-Gas and Liquid Lines: 325 psig (2241 kPa).
2. Line Test Pressure for Refrigerant R-134a:
   a. Suction Lines for Air-Conditioning Applications: 115 psig (793 kPa).
   b. Suction Lines for Heat-Pump Applications: 225 psig (1551 kPa).
   c. Hot-Gas and Liquid Lines: 225 psig (1551 kPa).
3. Line Test Pressure for Refrigerant R-407C:
   a. Suction Lines for Air-Conditioning Applications: 230 psig (1586 kPa).
   b. Suction Lines for Heat-Pump Applications: 380 psig (2620 kPa).
   c. Hot-Gas and Liquid Lines: 380 psig (2620 kPa).
4. Line Test Pressure for Refrigerant R-410A:
   a. Suction Lines for Air-Conditioning Applications: 300 psig (2068 kPa).
   b. Suction Lines for Heat-Pump Applications: 535 psig (3689 kPa).
   c. Hot-Gas and Liquid Lines: 535 psig (3689 kPa).

D. Submittals
1. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:
   a. Thermostatic expansion valves.
   b. Solenoid valves.
   c. Hot-gas bypass valves.
   d. Filter dryers.
   e. Strainers.
   f. Pressure-regulating valves.
2. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
   a. Shop Drawing Scale: 1/4 inch equals 1 foot (1:50).
   b. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
3. Welding certificates.
4. Field quality-control test reports.
5. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

E. Quality Assurance
1. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
2. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
3. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

F. Product Storage And Handling
1. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.2 PRODUCTS

A. Copper Tube And Fittings
1. Copper Tube: ASTM B 88, Type K or L (ASTM B 88M, Type A or B) **OR** ASTM B 280, Type ACR, **as directed**.
2. Wrought-Copper Fittings: ASME B16.22.
3. Wrought-Copper Unions: ASME B16.22.
4. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
5. Brazing Filler Metals: AWS A5.8.
6. Flexible Connectors:
   a. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
   b. End Connections: Socket ends.
   c. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch- (180-mm-) long assembly.
   d. Pressure Rating: Factory test at minimum 500 psig (3450 kPa).
   e. Maximum Operating Temperature: 250 deg F (121 deg C).

B. Steel Pipe And Fittings
1. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; Type, Grade, and wall thickness as selected in Part 3 piping applications articles.
2. Wrought-Steel Fittings: ASTM A 234/A 234M, for welded joints.
3. Steel Flanges and Flanged Fittings: ASME B16.5, steel, including bolts, nuts, and gaskets, bevel-welded end connection, and raised face.
4. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
5. Flanged Unions:
   a. Body: Forged-steel flanges for NPS 1 to NPS 1-1/2 (DN 25 to DN 40) and ductile iron for NPS 2 to NPS 3 (DN 50 to DN 80). Apply rust-resistant finish at factory.
   b. Gasket: Fiber asbestos free.
   c. Fasteners: Four plated-steel bolts, with silicon bronze nuts. Apply rust-resistant finish at factory.
   d. End Connections: Brass tailpiece adapters for solder-end connections to copper tubing.
   e. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch- (180-mm-) long assembly.
   f. Pressure Rating: Factory test at minimum 400 psig (2760 kPa).
   g. Maximum Operating Temperature: 330 deg F (165 deg C).
6. Flexible Connectors:
   a. Body: Stainless-steel bellows with woven, flexible, stainless-steel-wire-reinforced protective jacket
   b. End Connections:
      1) NPS 2 (DN 50) and Smaller: With threaded-end connections.
      2) NPS 2-1/2 (DN 65) and Larger: With flanged-end connections.

c. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch- (180-mm-) long assembly.
d. Pressure Rating: Factory test at minimum 500 psig (3450 kPa).
e. Maximum Operating Temperature: 250 deg F (121 deg C).

C. Valves And Specialties
1. Diaphragm Packless Valves:
a. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
b. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
c. Operator: Rising stem and hand wheel.
d. Seat: Nylon.
e. End Connections: Socket, union, or flanged.
f. Working Pressure Rating: 500 psig (3450 kPa).
g. Maximum Operating Temperature: 275 deg F (135 deg C).
2. Packed-Angle Valves:
a. Body and Bonnet: Forged brass or cast bronze.
b. Packing: Molded stem, back seating, and replaceable under pressure.
c. Operator: Rising stem.
d. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
e. Seal Cap: Forged-brass or valox hex cap.
f. End Connections: Socket, union, threaded, or flanged.
g. Working Pressure Rating: 500 psig (3450 kPa).
h. Maximum Operating Temperature: 275 deg F (135 deg C).
3. Check Valves:
a. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
b. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
c. Piston: Removable polytetrafluoroethylene seat.
d. Closing Spring: Stainless steel.
e. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
f. End Connections: Socket, union, threaded, or flanged.
g. Maximum Opening Pressure: 0.50 psig (3.4 kPa).
h. Working Pressure Rating: 500 psig (3450 kPa).
i. Maximum Operating Temperature: 275 deg F (135 deg C).
4. Service Valves:
a. Body: Forged brass with brass cap including key end to remove core.
b. Core: Removable ball-type check valve with stainless-steel spring.
c. Seat: Polytetrafluoroethylene.
d. End Connections: Copper spring.
e. Working Pressure Rating: 500 psig (3450 kPa).
5. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.
a. Body and Bonnet: Plated steel.
b. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
c. Seat: Polytetrafluoroethylene.
d. End Connections: Threaded.
e. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter, and 24 **OR** 115 **OR** 208, **as directed**,-V ac coil.
f. Working Pressure Rating: 400 psig (2760 kPa).
g. Maximum Operating Temperature: 240 deg F (116 deg C).
h. Manual operator.
6. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
a. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
b. Piston, Closing Spring, and Seat Insert: Stainless steel.
c. Seat Disc: Polytetrafluoroethylene.
d. End Connections: Threaded.

e. Working Pressure Rating: 400 psig (2760 kPa).
f. Maximum Operating Temperature: 240 deg F (116 deg C).

7. Thermostatic Expansion Valves: Comply with ARI 750.
   a. Body, Bonnet, and Seal Cap: Forged brass or steel.
   b. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
   c. Packing and Gaskets: Non-asbestos.
   d. Capillary and Bulb: Copper tubing filled with refrigerant charge.
   e. Suction Temperature: 40 deg F (4.4 deg C).
   f. Superheat: Adjustable **OR** Nonadjustable, **as directed**.
   g. Reverse-flow option (for heat-pump applications).
   h. End Connections: Socket, flare, or threaded union.
   i. Working Pressure Rating: 700 psig (4820 kPa) **OR** 450 psig (3100 kPa), **as directed**.
8. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.
   a. Body, Bonnet, and Seal Cap: Ductile iron or steel.
   b. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
   c. Packing and Gaskets: Non-asbestos.
   d. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
   e. Seat: Polytetrafluoroethylene.
   f. Equalizer: Internal **OR** External, **as directed**.
   g. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter, and 24 **OR** 115 **OR** 208, **as directed**,-V ac coil.
   h. End Connections: Socket.
   i. Set Pressure: as directed by the Owner.
   j. Throttling Range: Maximum 5 psig (34 kPa).
   k. Working Pressure Rating: 500 psig (3450 kPa).
   l. Maximum Operating Temperature: 240 deg F (116 deg C).
9. Straight-Type Strainers:
   a. Body: Welded steel with corrosion-resistant coating.
   b. Screen: 100-mesh stainless steel.
   c. End Connections: Socket or flare.
   d. Working Pressure Rating: 500 psig (3450 kPa).
   e. Maximum Operating Temperature: 275 deg F (135 deg C).
10. Angle-Type Strainers:
   a. Body: Forged brass or cast bronze.
   b. Drain Plug: Brass hex plug.
   c. Screen: 100-mesh monel.
   d. End Connections: Socket or flare.
   e. Working Pressure Rating: 500 psig (3450 kPa).
   f. Maximum Operating Temperature: 275 deg F (135 deg C).
11. Moisture/Liquid Indicators:
   a. Body: Forged brass.
   b. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
   c. Indicator: Color coded to show moisture content in ppm.
   d. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
   e. End Connections: Socket or flare.
   f. Working Pressure Rating: 500 psig (3450 kPa).
   g. Maximum Operating Temperature: 240 deg F (116 deg C).
12. Replaceable-Core Filter Dryers: Comply with ARI 730.
   a. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
   b. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
   c. Desiccant Media: Activated alumina **OR** charcoal, **as directed**.
   d. Designed for reverse flow (for heat-pump applications).
   e. End Connections: Socket.

f. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
g. Maximum Pressure Loss: 2 psig (14 kPa).
h. Rated Flow: as directed by the Owner.
i. Working Pressure Rating: 500 psig (3450 kPa).
j. Maximum Operating Temperature: 240 deg F (116 deg C).

13. Permanent Filter Dryers: Comply with ARI 730.
    a. Body and Cover: Painted-steel shell.
    b. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
    c. Desiccant Media: Activated alumina **OR** charcoal, **as directed**.
    d. Designed for reverse flow (for heat-pump applications).
    e. End Connections: Socket.
    f. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
    g. Maximum Pressure Loss: 2 psig (14 kPa).
    h. Rated Flow: as directed by the Owner.
    i. Working Pressure Rating: 500 psig (3450 kPa).
    j. Maximum Operating Temperature: 240 deg F (116 deg C).
14. Mufflers:
    a. Body: Welded steel with corrosion-resistant coating.
    b. End Connections: Socket or flare.
    c. Working Pressure Rating: 500 psig (3450 kPa).
    d. Maximum Operating Temperature: 275 deg F (135 deg C).
15. Receivers: Comply with ARI 495.
    a. Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
    b. Comply with UL 207; listed and labeled by an NRTL.
    c. Body: Welded steel with corrosion-resistant coating.
    d. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
    e. End Connections: Socket or threaded.
    f. Working Pressure Rating: 500 psig (3450 kPa).
    g. Maximum Operating Temperature: 275 deg F (135 deg C).
16. Liquid Accumulators: Comply with ARI 495.
    a. Body: Welded steel with corrosion-resistant coating.
    b. End Connections: Socket or threaded.
    c. Working Pressure Rating: 500 psig (3450 kPa).
    d. Maximum Operating Temperature: 275 deg F (135 deg C).

D. Refrigerants
1. ASHRAE 34, R-22: Monochlorodifluoromethane.
2. ASHRAE 34, R-134a: Tetrafluoroethane.
3. ASHRAE 34, R-407C: Difluoromethane/Pentafluoroethane/1,1,1,2-Tetrafluoroethane.
4. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

1.3 EXECUTION

A. Piping Applications For Refrigerant R-22
1. Suction Lines NPS 1-1/2 (DN 40) and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.
   OR
   Suction Lines NPS 4 (DN 100) and Smaller **OR** NPS 2 to NPS 4 (DN 50 to DN 100), **as directed**, for Conventional Air-Conditioning Applications: Copper, Type ACR **OR** L (B), **as directed**, drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

2. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications, **as directed**: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.
   OR
   Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications, **as directed**: Copper, Type ACR **OR** K (A) **OR** L (B, **as directed**, drawn-temper tubing and wrought-copper fittings with soldered joints.
   OR
   Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications, **as directed**:
   a. NPS 1-1/2 (DN 40) and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.
      OR
      NPS 1-1/2 (DN 40) and Smaller: Copper, Type ACR **OR** L (B), **as directed,** drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.
   b. NPS 2 to NPS 3 (DN 50 to DN 80): Copper, Type K (A), annealed- or drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.
   c. NPS 4 (DN 100): Copper, Type ACR **OR** K (A) **OR** L (B), **as directed**, drawn-temper tubing and wrought-copper fittings with soldered joints.
3. Safety-Relief-Valve Discharge Piping: Schedule 40, black-steel and wrought-steel fittings with welded joints.
   OR
   Safety-Relief-Valve Discharge Piping: Copper, Type ACR **OR** K (A) **OR** L (B), **as directed**, drawn-temper tubing and wrought-copper fittings with soldered joints.
   OR
   Safety-Relief-Valve Discharge Piping:
   a. NPS 1-1/2 (DN 40) and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.
      OR
      NPS 1-1/2 (DN 40) and Smaller: Copper, Type ACR **OR** L (B), **as directed**, drawn-temper tubing and wrought-copper fittings with brazed joints.
   b. NPS 2 to NPS 3 (DN 50 to DN 80): Copper, Type K (A), annealed- or drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.
   c. NPS 4 (DN 100): Copper, Type ACR **OR** K (A) **OR** L (B), **as directed**, drawn-temper tubing and wrought-copper fittings with soldered joints.

B. Piping Applications For Refrigerant R-134a
1. Suction Lines NPS 1-1/2 (DN 40) and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed,** joints.
   OR
   Suction Lines NPS 4 (DN 100) and Smaller **OR** NPS 2 to NPS 4 (DN 50 to DN 100), **as directed**, for Conventional Air-Conditioning Applications: Copper, Type ACR **OR** L (B), **as directed**, drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed,** joints.
2. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications, **as directed**: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed,** joints.
   OR
   Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications, **as directed**: Copper, Type ACR **OR** K (A) **OR** L (B), **as directed**, drawn-temper tubing and wrought-copper fittings with soldered joints.
   OR
   Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications, **as directed**:
   a. NPS 1-1/2 (DN 40) and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed,** joints.
      OR

NPS 1-1/2 (DN 40) and Smaller: Copper, Type ACR **OR** K (A) **OR** L (B), **as directed**, drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

b. NPS 4 (DN 100): Copper, Type ACR **OR** K (A) **OR** L (B), **as directed**, drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

3. Safety-Relief-Valve Discharge Piping: Schedule 40, black-steel and wrought-steel fittings with welded joints.

OR

Safety-Relief-Valve Discharge Piping: Copper, Type ACR **OR** K (A) **OR** L (B), **as directed**, drawn-temper tubing and wrought-copper fittings with soldered joints.

OR

Safety-Relief-Valve Discharge Piping:

a. NPS 1-1/2 (DN 40) and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

OR

NPS 1-1/2 (DN 40) and Smaller: Copper, Type ACR **OR** L (B), **as directed**, drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

b. NPS 4 (DN 100): Copper, Type ACR **OR** K (A) **OR** L (B), **as directed**, drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

C. Piping Applications For Refrigerant R-407c

1. Suction Lines NPS 1-1/2 (DN 40) and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings

OR

Suction Lines NPS 4 (DN 100) and Smaller **OR** NPS 2 to NPS 4 (DN 50 to DN 100), **as directed**, for Conventional Air-Conditioning Applications: Copper, Type ACR **OR** L (B), **as directed**, drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

2. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications, **as directed**: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

OR

Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications, **as directed**: Copper, Type ACR **OR** K (A) **OR** L (B), **as directed**, drawn-temper tubing and wrought-copper fittings with soldered joints.

OR

Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications, **as directed**:

a. NPS 1 (DN 25) and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

OR

NPS 1 (DN 25) and Smaller: Copper, Type ACR **OR** L (B), **as directed**, drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

b. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): Copper, Type K (A), annealed- or drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

c. NPS 4 (DN 100): Copper, Type ACR **OR** K (A) **OR** L (B), **as directed**, drawn-temper tubing and wrought-copper fittings with soldered joints.

3. Safety-Relief-Valve Discharge Piping: Schedule 40, black-steel and wrought-steel fittings with welded joints.

OR

Safety-Relief-Valve Discharge Piping: Copper, Type ACR **OR** K (A) **OR** L (B**)**, **as directed**, drawn-temper tubing and wrought-copper fittings with soldered joints.

OR

Safety-Relief-Valve Discharge Piping:

a. NPS 1 (DN 25) and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed **OR** soldered joints.

OR

NPS 1 (DN 25) and Smaller: Copper, Type ACR **OR** L (B), **as directed**, drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

b. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): Copper, Type K (A), annealed- or drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

c. NPS 4 (DN 100): Copper, Type ACR **OR** K (A) **OR** L (B), **as directed**, drawn-temper tubing and wrought-copper fittings with soldered joints.

D. Piping Applications For Refrigerant R-410a

1. Suction Lines NPS 1-1/2 (DN 40) and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

OR

Suction Lines NPS 3-1/2 (DN 90) and Smaller **OR** NPS 2 to NPS 3-1/2 (DN 50 to DN 90), **as directed**, for Conventional Air-Conditioning Applications: Copper, Type ACR **OR** L (B), **as directed,** drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

OR

Suction Lines NPS 4 (DN 100) and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR **OR** K (A) **OR** L (B), **as directed**, drawn-temper tubing and wrought-copper fittings with soldered joints.

2. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications, **as directed**: Copper, Type ACR **OR** L (B), **as directed**, annealed- or drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

OR

Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications, **as directed** Copper, Type K (A), annealed- or drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

OR

Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications, **as directed**: Copper, Type ACR **OR** K (A) **OR** L (B), **as directed**, drawn-temper tubing and wrought-copper fittings with 95-5 tin-antimony soldered joints.

OR

Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications, **as directed**: Copper, Type ACR **OR** K (A) **OR** L (B), **as directed**, drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.

OR

Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications, **as directed**:

a. NPS 5/8 (DN 18) and Smaller: Copper, Type ACR **OR** L (B), **as directed**, annealed- or drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

b. NPS 3/4 to NPS 1 (DN 20 to DN 25) and Smaller: Copper, Type K (A), annealed- or drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

c. NPS 1-1/4 (DN 32) and Smaller: Copper, Type ACR **OR** K (A) **OR** L (B), **as directed**, drawn-temper tubing and wrought-copper fittings with 95-5 tin-antimony soldered joints.

d. NPS 1-1/2 to NPS 2 (DN 40 to DN 50): Copper, Type ACR **OR** K (A) **OR** L (B), **as directed**, drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.

OR

Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications, **as directed**, NPS 2 to NPS 4 (DN 50 to DN 100): Schedule 40, black-steel and wrought-steel fittings with welded joints.

3. Safety-Relief-Valve Discharge Piping: Copper, Type ACR **OR** L (B), **as directed**, annealed- or drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

OR

Safety-Relief-Valve Discharge Piping: Copper, Type K (A), annealed- or drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

OR
Safety-Relief-Valve Discharge Piping: Copper, Type ACR **OR** K (A) **OR** L (B), **as directed**, drawn-temper tubing and wrought-copper fittings with 95-5 tin-antimony soldered joints.
OR
Safety-Relief-Valve Discharge Piping: Copper, Type ACR **OR** K (A) **OR** L (B), **as directed**, drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.
OR
Safety-Relief-Valve Discharge Piping:
a. NPS 5/8 (DN 18) and Smaller: Copper, Type ACR **OR** L (B), **as directed**, annealed- or drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.
b. NPS 3/4 to NPS 1 (DN 20 to DN 25) and Smaller: Copper, Type K (A), annealed- or drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.
c. NPS 1-1/4 (DN 32) and Smaller: Copper, Type ACR **OR** K (A) **OR** L (B), **as directed**, drawn-temper tubing and wrought-copper fittings with 95-5 tin-antimony soldered joints.
d. NPS 1-1/2 to NPS 2 (DN 40 to DN 50): Copper, Type ACR **OR** K (A) **OR** L (B), **as directed**, drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.

OR
Safety-Relief-Valve Discharge Piping NPS 2 to NPS 4 (DN 50 to DN 100): Schedule 40, black-steel and wrought-steel fittings with welded joints.

E. Valve And Specialty Applications
1. Install diaphragm packless **OR** packed-angle, **as directed**, valves in suction and discharge lines of compressor.
2. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
3. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
4. Except as otherwise indicated, install diaphragm packless **OR** packed-angle, **as directed**, valves on inlet and outlet side of filter dryers.
5. Install a full-sized, three-valve bypass around filter dryers.
6. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.
7. Install thermostatic expansion valves as close as possible to distributors on evaporators.
   a. Install valve so diaphragm case is warmer than bulb.
   b. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
   c. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
8. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
9. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
10. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
    a. Solenoid valves.
    b. Thermostatic expansion valves.
    c. Hot-gas bypass valves.
    d. Compressor.
11. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor, **as directed**.
12. Install receivers sized to accommodate pump-down charge.
13. Install flexible connectors at compressors.

F. Piping Installation

1. 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 Shop Drawings.
2. Install refrigerant piping according to ASHRAE 15.
3. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
4. 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.
5. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
6. Install piping adjacent to machines to allow service and maintenance.
7. Install piping free of sags and bends.
8. Install fittings for changes in direction and branch connections.
9. Select system components with pressure rating equal to or greater than system operating pressure.
10. Refer to Division 15 Section(s) "Hvac Instrumentation And Controls" AND "Sequence Of Operation" for solenoid valve controllers, control wiring, and sequence of operation.
11. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
12. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors And Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
13. Install refrigerant piping in protective conduit where installed belowground.
14. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
15. Slope refrigerant piping as follows:
    a. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
    b. Install horizontal suction lines with a uniform slope downward to compressor.
    c. Install traps and double risers to entrain oil in vertical runs.
    d. Liquid lines may be installed level.
16. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
17. Before installation of steel refrigerant piping, clean pipe and fittings using the following procedures:
    a. Shot blast the interior of piping.
    b. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through tubing by means of a wire or electrician's tape.
    c. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
    d. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
    e. Finally, draw a clean, dry, lintless cloth through the tube or pipe.
    f. Safety-relief-valve discharge piping is not required to be cleaned but is required to be open to allow unrestricted flow.
18. Install pipe sleeves at penetrations in exterior walls and floor assemblies.
19. Seal penetrations through fire and smoke barriers according to Division 07 Section "Through-penetration Firestop Systems".
20. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
21. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

22. Seal pipe penetrations through exterior walls according to Division 07 Section "Joint Sealants" for materials and methods.
23. Identify refrigerant piping and valves according to Division 15 Section "Identification For Hvac Piping And Equipment".

G. Pipe Joint Construction
1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
3. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.
4. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
5. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
   a. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
   b. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.
6. Threaded Joints: Thread steel 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:
   a. Apply appropriate tape or thread compound to external pipe threads unless dry-seal threading is specified.
   b. 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.
7. Steel pipe can be threaded, but threaded joints must be seal brazed or seal welded.
8. Welded Joints: Construct joints according to AWS D10.12/D10.12M.
9. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

H. Hangers And Supports
1. Hanger, support, and anchor products are specified in Division 15 Section "Hangers And Supports For Hvac Piping And Equipment".
2. Install the following pipe attachments:
   a. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6 m) long.
   b. Roller hangers and spring hangers for individual horizontal runs 20 feet (6 m) or longer.
   c. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
   d. Spring hangers to support vertical runs.
   e. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
3. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
   a. NPS 1/2 (DN 15): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
   b. NPS 5/8 (DN 18): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
   c. NPS 1 (DN 25): Maximum span, 72 inches (1800 mm); minimum rod size, 1/4 inch (6.4 mm).
   d. NPS 1-1/4 (DN 32): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
   e. NPS 1-1/2 (DN 40): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
   f. NPS 2 (DN 50): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
   g. NPS 2-1/2 (DN 65): Maximum span, 108 inches (2700 mm); minimum rod size, 3/8 inch (9.5 mm).
   h. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (9.5 mm).
   i. NPS 4 (DN 100): Maximum span, 12 feet (3.7 m); minimum rod size, 1/2 inch (13 mm).

4. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
   a. NPS 2 (DN 50): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (9.5 mm).
   b. NPS 2-1/2 (DN 65): Maximum span, 11 feet (3.4 m); minimum rod size, 3/8 inch (9.5 mm).
   c. NPS 3 (DN 80): Maximum span, 12 feet (3.7 m); minimum rod size, 3/8 inch (9.5 mm).
   d. NPS 4 (DN 100): Maximum span, 14 feet (4.3 m); minimum rod size, 1/2 inch (13 mm).
5. Support multifloor vertical runs at least at each floor.

I. Field Quality Control
1. Perform tests and inspections and prepare test reports.
2. Tests and Inspections:
   a. Comply with ASME B31.5, Chapter VI.
   b. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
   c. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
      1) Fill system with nitrogen to the required test pressure.
      2) System shall maintain test pressure at the manifold gage throughout duration of test.
      3) Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
      4) Remake leaking joints using new materials, and retest until satisfactory results are achieved.

J. System Charging
1. Charge system using the following procedures:
   a. Install core in filter dryers after leak test but before evacuation.
   b. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.
   c. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).
   d. Charge system with a new filter-dryer core in charging line.

K. Adjusting
1. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
2. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
3. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
4. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
   a. Open shutoff valves in condenser water circuit.
   b. Verify that compressor oil level is correct.
   c. Open compressor suction and discharge valves.
   d. Open refrigerant valves except bypass valves that are used for other purposes.
   e. Check open compressor-motor alignment and verify lubrication for motors and bearings.
5. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 15061e

SECTION 15061f - FACILITY FUEL-OIL PIPING

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for facility fuel-oil piping. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. This Section includes fuel-oil, fuel-oil and diesel-fuel-oil, and diesel-fuel-oil distribution systems and the following:
   a. Pipes, tubes, and fittings.
   b. Piping and tubing joining materials.
   c. Piping specialties.
   d. Valves.
   e. Vertical, steel, fuel-oil ASTs.
   f. Horizontal, steel, fuel-oil ASTs.
   g. Containment-dike, steel, fuel-oil ASTs.
   h. Insulated, steel, fuel-oil ASTs.
   i. Concrete-vaulted, steel, fuel-oil ASTs.
   j. Steel, fuel-oil USTs with STI-P3.
   k. Composite, steel, fuel-oil USTs.
   l. Jacketed, steel, fuel-oil USTs.
   m. FRP fuel-oil USTs.
   n. Fuel-oil AST accessories.
   o. Fuel-oil UST accessories.
   p. Fuel-oil storage tank piping specialties.
   q. Fuel-oil storage tank pumps.
   r. Fuel-transfer pumps.
   s. Fuel maintenance system.
   t. Liquid-level gage system.
   u. Leak-detection and monitoring system.
   v. Mechanical sleeve seals.
   w. Grout.
   x. Concrete bases.

C. Definitions
1. AST: Aboveground storage tank.
2. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
3. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
4. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
5. FPM: Vinylidene fluoride-hexafluoropropylene copolymer rubber.
6. FRP: Glass-fiber-reinforced plastic.
7. UST: Underground storage tank.

D. Performance Requirements
1. Maximum Operating-Pressure Ratings: 3-psig (21-kPa) fuel-oil supply pressure at oil-fired appliances.

2. Delegated Design: Design restraint and anchors for fuel-oil piping, ASTs, and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
3. Seismic Performance: Factory-installed support attachments for AST shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
   a. 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, **as directed**."

E. Submittals
1. Product Data: For each type of product indicated.
2. Shop Drawings: For facility fuel-oil piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
3. Delegated-Design Submittal: For fuel-oil piping and equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   a. Detail fabrication and assembly of anchors and seismic restraints.
   b. Design Calculations: Calculate requirements for selecting seismic restraints.
   c. Detail fabrication and assembly of pipe anchors, hangers, supports for multiple pipes, and attachments of the same to building structure.
4. Seismic Qualification Certificates: For ASTs, accessories, and components, from manufacturer.
   a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   b. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   c. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
5. Brazing certificates.
6. Welding certificates.
7. Field quality-control reports.
8. Operation and Maintenance Data.
9. Warranty: Sample of special warranty.

F. Quality Assurance
1. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
2. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
3. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
4. 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.
5. Comply with ASME B31.9, "Building Services Piping," for fuel-oil piping materials, installation, testing, and inspecting.
6. Comply with requirements of the EPA and of state and local authorities having jurisdiction. Include recording of fuel-oil storage tanks and monitoring of tanks and piping.

G. Delivery, Storage, And Handling
1. Lift and support fuel-oil storage tanks only at designated lifting or supporting points, as shown on Shop Drawings. Do not move or lift tanks unless empty.
2. 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.

3. Store pipes and tubes with protective PE coating to avoid damaging the coating and to protect from direct sunlight.
4. Store PE pipes and valves protected from direct sunlight.

H. Warranty
1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-oil storage tanks and flexible, double-containment piping and related equipment that fail in materials or workmanship within specified warranty period.
   a. Storage Tanks:
      1) Failures include, but are not limited to, the following when used for storage of fuel oil at temperatures not exceeding 150 deg F (66 deg C):
         a) Structural failures including cracking, breakup, and collapse.
         b) Corrosion failure including external and internal corrosion of steel tanks.
      2) Warranty Period: 30 years from date of Substantial Completion.
   b. Flexible, Double-Containment Piping and Related Equipment:
      1) Failures due to defective materials or workmanship for materials installed together, including piping, dispenser sumps, entry boots, and sump mounting adapters.
      2) Warranty Period: 10 **OR** 30, **as directed**, years from date of Substantial Completion.

1.2 PRODUCTS

A. Pipes, Tubes, And Fittings
1. See Part 1.3 piping schedule articles for where pipes, tubes, fittings, and joining materials are applied in various services.
2. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
   a. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
   b. Wrought-Steel Welding Fittings: ASTM A 234/A 234M, for butt and socket welding.
   c. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
   d. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
      1) Material Group: 1.1.
      2) End Connections: Threaded or butt welding to match pipe.
      3) Lapped Face: Not permitted underground.
      4) Gasket Materials: Asbestos free, ASME B16.20 metallic, or ASME B16.21 nonmetallic, gaskets compatible with fuel oil.
      5) Bolts and Nuts: ASME B18.2.1, cadmium-plated steel.
   e. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
      1) Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
3. Drawn-Temper Copper Tube: Comply with ASTM B 88, Type K (ASTM B 88M, Type A) **OR** ASTM B 88, Type L (ASTM B 88M, Type B), **as directed**.
   a. Copper Fittings: ASME B16.22, wrought copper, streamlined pattern.
   b. Bronze Flanges and Flanged Fittings: ASME B16.24, Class 150.
      1) Gasket Material: Asbestos free, ASME B16.20, metallic, or ASME B16.21 nonmetallic, gaskets compatible with fuel oil.
      2) Bolts and Nuts: ASME B18.2.1, cadmium-plated steel.
4. Annealed-Temper Copper Tube: Comply with ASTM B 88, Type K (ASTM B 88M, Type A) **OR** ASTM B 88, Type L (ASTM B 88M, Type B), **as directed**.
   a. Copper Fittings: ASME B16.22, wrought copper, streamlined pattern.
   b. Flare Fittings: Comply with ASME B16.26 and SAE J513.
      1) Copper fittings with long nuts.
      2) Metal-to-metal compression seal without gasket.
      3) Dryseal threads complying with ASME B1.20.3.

B. Double-Containment Pipe And Fittings
1. Flexible, Double-Containment Piping: Comply with UL 971.
a. Pipe Materials: PVDF complying with ASTM D 3222 for carrier pipe with mechanical couplings to seal carrier, and PE pipe complying with ASTM D 4976 for containment piping.
b. Fiberglass **OR** PE, **as directed**, sumps.
c. Watertight sump entry boots, pipe adapters with test ports and tubes, coaxial fittings, and couplings.
d. Minimum Operating Pressure Rating: 10 psig (69 kPa).
e. Plastic to Steel Pipe Transition Fittings: Factory-fabricated fittings with plastic end matching or compatible with carrier piping, and steel pipe end complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
f. Include design and fabrication of double-containment pipe and fitting assemblies with provision for field installation of cable leak-detection system in annular space between carrier and containment piping.
2. Rigid, Double-Containment Piping: Comply with UL 971.
a. RTRP: ASTM D 2996 or ASTM D 2997 carrier and containment piping and mechanical couplings to seal carrier and containment piping or individually bonded joints.
1) Minimum Operating-Pressure Rating for RTRP NPS 2 and NPS 3 (DN 50 and DN 80): 150 psig (1035 kPa).
2) Minimum Operating-Pressure Rating for RTRP NPS 4 and NPS 6 (DN 100 and DN 150): 125 psig (860 kPa). Compliance with UL 971 is not required for NPS 6 (DN 150) and larger piping.
3) Fittings: RTRF complying with ASTM D 2996 or ASTM D 2997, and made by RTRP manufacturer; watertight sump entry boots, termination, or other end fittings.
b. Include design and fabrication of double-containment pipe and fitting assemblies with provision for field installation of cable leak-detection system in annular space between carrier and containment piping.

C. Piping Specialties
1. Flexible Connectors: Comply with UL 567.
a. Metallic Connectors:
1) Listed and labeled for aboveground and underground applications by an NRTL acceptable to authorities having jurisdiction.
2) Stainless-steel bellows with woven, flexible, bronze or stainless-steel, wire-reinforcing protective jacket.
3) Minimum Operating Pressure: 150 psig (1035 kPa).
4) End Connections: Socket, flanged, or threaded end to match connected piping.
5) Maximum Length: 30 inches (762 mm).
6) Swivel end, 50-psig (345-kPa) maximum operating pressure.
7) Factory-furnished anode.
b. Nonmetallic Connectors:
1) Listed and labeled for underground applications by an NRTL acceptable to authorities having jurisdiction.
2) PFTE bellows with woven, flexible, bronze or stainless-steel, wire-reinforcing protective jacket.
3) Minimum Operating Pressure: 150 psig (1035 kPa).
4) End Connections: Socket, flanged, or threaded end to match connected piping.
5) Maximum Length: 30 inches (762 mm).
6) Swivel end, 50-psig (345-kPa) maximum operating pressure.
7) Factory-furnished anode.
2. Y-Pattern Strainers:
a. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
b. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.

c. Strainer Screen: 60 **OR** 80, **as directed**,-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
d. CWP Rating: 125 psig (860 kPa).

3. Basket Strainers:
a. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
b. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
c. Strainer Screen: 60 **OR** 80, **as directed**,-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
d. CWP Rating: 125 psig (860 kPa).

4. T-Pattern Strainers:
a. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
b. End Connections: Grooved ends.
c. Strainer Screen: 60 **OR** 80, **as directed**,-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
d. CWP Rating: 750 psig (5170 kPa).

5. Manual Air Vents:
a. Body: Bronze.
b. Internal Parts: Nonferrous.
c. Operator: Screwdriver or thumbscrew.
d. Inlet Connection: NPS 1/2 (DN 15).
e. Discharge Connection: NPS 1/8 (DN 6).
f. CWP Rating: 150 psig (1035 kPa).
g. Maximum Operating Temperature: 225 deg F (107 deg C).

D. Joining Materials
1. Joint Compound and Tape: Suitable for fuel oil.
2. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
3. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F (540 deg C) complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.
4. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.

E. Manual Fuel-Oil Shutoff Valves
1. See valve schedule in Part 1.3 for where each valve type is applied in various services.
2. General Requirements for Metallic Valves, NPS 2 (DN 50) and Smaller for Liquid Service: Comply with UL 842.
a. CWP Rating: 125 psig (860 kPa).
b. Threaded Ends: Comply with ASME B1.20.1.
c. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
d. Tamperproof Feature: Locking feature for valves indicated in the valve schedule.
e. Service Mark: Initials "WOG" shall be permanently marked on valve body.

3. General Requirements for Metallic Valves, NPS 2-1/2 (DN 65) and Larger: Comply with UL 842.
a. CWP Rating: 125 psig (860 kPa).
b. Flanged Ends: Comply with ASME B16.5 for steel flanges.
c. Tamperproof Feature: Locking feature for valves indicated in the valve schedule.
d. Service Mark: Initials "WOG" shall be permanently marked on valve body.

4. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.
a. Body: Bronze, complying with ASTM B 584.
b. Ball: Chrome-plated brass.
c. Stem: Bronze; blowout proof.
d. Seats: Reinforced TFE; blowout proof.
e. Packing: Separate packnut with adjustable-stem packing threaded ends.

f. Ends: Threaded, flared, or socket as indicated in the valve schedule.
g. CWP Rating: 600 psig (4140 kPa).
h. Service Mark: Initials "WOG" shall be permanently marked on valve body.

5. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
   a. Body: Bronze, complying with ASTM B 584.
   b. Ball: Chrome-plated bronze.
   c. Stem: Bronze; blowout proof.
   d. Seats: Reinforced TFE; blowout proof.
   e. Packing: Threaded-body packnut design with adjustable-stem packing.
   f. Ends: Threaded, flared, or socket as indicated in the valve schedule.
   g. CWP Rating: 600 psig (4140 kPa).
   h. Service Mark: Initials "WOG" shall be permanently marked on valve body.
6. Two-Piece, Regular-Port Bronze Ball Valves with Bronze Trim: MSS SP-110.
   a. Body: Bronze, complying with ASTM B 584.
   b. Ball: Chrome-plated bronze.
   c. Stem: Bronze; blowout proof.
   d. Seats: Reinforced TFE.
   e. Packing: Threaded-body packnut design with adjustable-stem packing.
   f. Ends: Threaded, flared, or socket as indicated in the valve schedule.
   g. CWP Rating: 600 psig (4140 kPa).
   h. Service Mark: Initials "WOG" shall be permanently marked on valve body.

F. Specialty Valves
1. Pressure Relief Valves: Comply with UL 842.
   a. Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.
   b. Body: Brass, bronze, or cast steel.
   c. Springs: Stainless steel, interchangeable.
   d. Seat and Seal: Nitrile rubber.
   e. Orifice: Stainless steel, interchangeable.
   f. Factory-Applied Finish: Baked enamel.
   g. Maximum Inlet Pressure: 150 psig (1035 kPa).
   h. Relief Pressure Setting: 60 psig (414 kPa).
2. Oil Safety Valves: Comply with UL 842.
   a. Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.
   b. Body: Brass, bronze, or cast steel.
   c. Springs: Stainless steel.
   d. Seat and Diaphragm: Nitrile rubber.
   e. Orifice: Stainless steel, interchangeable.
   f. Factory-Applied Finish: Baked enamel.
   g. Manual override port.
   h. Maximum Inlet Pressure: 60 psig (414 kPa).
   i. Maximum Outlet Pressure: 3 psig (21 kPa).
3. Emergency Shutoff Valves: Comply with UL 842.
   a. Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.
   b. Single **OR** Double, **as directed**, poppet valve.
   c. Body: ASTM A 126, cast iron.
   d. Disk: FPM.
   e. Poppet Spring: Stainless steel.
   f. Stem: Plated brass.
   g. O-Ring: FPM.
   h. Packing Nut: PTFE-coated brass.
   i. Fusible link to close valve at 165 deg F (74 deg C).

j. Thermal relief to vent line pressure buildup due to fire.
k. Air test port.
l. Maximum Operating Pressure: 0.5 psig (3.45 kPa).

4. Mechanical Leak Detector: Comply with UL 842.
   a. Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.
   b. Body: ASTM A 126, cast iron.
   c. O-Rings: Elastomeric compatible with fuel oil.
   d. Piston and Stem Seals: PTFE.
   e. Stem and Spring: Stainless steel.
   f. Piston Cylinder: Burnished brass.
   g. Indicated Leak Rate: Maximum 3 gph (3 mL/s) at 10 psig (69 kPa).
   h. Leak Indication: Reduced flow.

G. Vertical, Steel, Fuel-Oil AST
1. Description:
   a. UL 142, single-wall, vertical, steel tank.
   b. UL 142 and STI F921, **as directed**, double-wall, vertical, steel tank; with primary- and secondary-containment walls and interstitial space.
2. Construction: Fabricated with welded, carbon steel suitable for operation at atmospheric pressure and for storing fuel oil with specific gravity up to 1.1 and maintained temperature up to 150 deg F (66 deg C).

H. Horizontal, Steel, Fuel-Oil AST
1. Description:
   a. UL 142, single-wall, horizontal, steel tank.
   b. UL 142 and STI F921, **as directed**, double-wall, horizontal, steel tank; with primary- and secondary-containment walls and interstitial space.
2. Construction: Fabricated with welded, carbon steel; suitable for operation at atmospheric pressure and for storing fuel oil with specific gravity up to 1.1 and with maintained temperature up to 150 deg F (66 deg C).
3. Supports:
   a. Manufacturer's standard structural steel welded to tank.
   b. Manufacturer's standard type and number, steel or cast-iron cradles, for field installation.

I. Containment-Dike, Steel, Fuel-Oil AST
1. Description: UL 142 and STI F911, single-wall, horizontal, steel tank; with open or enclosed **OR** enclosed, **as directed**, secondary-containment dike with capacity greater than tank capacity.
2. Construction: Fabricated with welded, carbon steel; suitable for operation at atmospheric pressure and for storing fuel oil with specific gravity up to 1.1 and with maintained temperature up to 150 deg F (66 deg C).

J. Insulated, Steel, Fuel-Oil AST
1. Description: UL 142 and UL 2085 **OR** UL 142, UL 2085, and STI F941, **as directed**, thermally insulated and fire-resistant, double-wall, horizontal, steel tank; with primary- and secondary-containment walls and insulation and with interstitial space.
2. Construction: Fabricated with welded, carbon steel and insulation; suitable for operation at atmospheric pressure and for storing fuel oil with specific gravity up to 1.1 and with test temperature according to UL 2085.

K. Concrete-Vaulted, Steel, Fuel-Oil AST
1. Description: UL 142 and UL 2085 **OR** UL 142, UL 2085, and STI F941, **as directed**; thermally insulated, fire-resistant and protected, double-wall, horizontal, steel tank; with primary- and secondary-containment walls and insulation and with interstitial space.

2. Construction: Fabricated with welded, carbon steel and insulation and encased in concrete that will protect from bullets; suitable for operation at atmospheric pressure and for storing fuel oil with specific gravity up to 1.1 and with test temperature according to UL 2085.

L. Steel, Fuel-Oil UST With STI-P3
1. Description: UL 58 and STI P3, double-wall, horizontal, steel tank; with cathodic protection and electrical isolation.
   a. Containment Method: STI-P3, Type I, with primary and secondary walls in contact **OR** Type II, with interstitial space, **as directed**.
2. Construction: Fabricated with welded steel; suitable for operation at atmospheric pressure and for storing liquids with specific gravity up to 1.1; fabricated for the following loads:
   a. Depth of Bury: 3 feet (1 m) from top of tank to finished surface.
   b. External Hydrostatic Pressure: To withstand general buckling with safety factor of 2:1 if hole is fully flooded.
   c. Surface Loads: AASHTO's "Specifications for Highway Bridges," H-20 axle loads of 32,000 lb (14 515 kg).
3. Corrosion-Protection System: Protect tank and factory-installed piping by engineered and installed corrosion-protection system according to STI P3, with means of monitoring cathodic protection.

M. Composite, Steel, Fuel-Oil UST
1. Description: UL 58, double-wall, horizontal, composite tank; with coating complying with UL 1746 and STI F894.
   a. Containment Method: STI F894, Type I, with primary and secondary walls in contact **OR** Type II, with interstitial space, **as directed**.
2. Construction: Fabricated with welded steel and factory coating according to UL 1746 and STI F894; suitable for operation at atmospheric pressure and for storing liquids with specific gravity up to 1.1; fabricated for the following loads:
   a. Depth of Bury: 3 feet (1 m) from top of tank to finished surface.
   b. External Hydrostatic Pressure: To withstand general buckling with safety factor of 2:1 if hole is fully flooded.
   c. Surface Loads: AASHTO's "Specifications for Highway Bridges," H-20 axle loads of 32,000 lb (14 515 kg).

N. Jacketed, Steel, Fuel-Oil UST
1. Description: Jacketed, horizontal, steel tank; complying with UL 58, and with plastic or fiberglass jacket and corrosion-protection system according to UL 1746 and STI F922, **as directed**.
2. Construction: Tank fabricated with welded carbon steel, and jacket fabricated with plastic or fiberglass and vacuum-sealed interstitial space; suitable for operation at atmospheric pressure and with integral leak-detection device. Tank fabricated for the following loads:
   a. Depth of Bury: 3 feet (1 m) from top of tank to finished surface.
   b. External Hydrostatic Pressure: To withstand general buckling with safety factor of 2:1 if hole is fully flooded.
   c. Surface Loads: AASHTO's "Specifications for Highway Bridges," H-20 axle loads of 32,000 lb (14 515 kg).

O. FRP Fuel-Oil UST
1. Description: Horizontal, FRP UST; UL 1316, double wall, with interstitial space and integral, hydrostatic, leak-detection and monitoring system, **as directed**.
2. Construction: Fabricated with fiberglass-reinforced polyester resins; suitable for operation at atmospheric pressure; fabricated for the following loads:
   a. Depth of Bury: 3 feet (1 m) from top of tank to finished surface.
   b. External Hydrostatic Pressure: To withstand general buckling with safety factor of 2:1 if hole is fully flooded.

c. Surface Loads: AASHTO's "Specifications for Highway Bridges," H-20 axle loads of 32,000 lb (14 515 kg).

P. Shop Painting Of AST
1. Apply manufacturer's standard prime coat to exterior steel surface of AST and supports.
2. Prepare exterior steel surface of AST and tank supports.
3. Shop Cleaning: After fabrication, blast clean according to SSPC-SP 6/NACE No. 3 **OR** SSPC-SP 10/NACE No. 2, **as directed**.
4. After cleaning, remove dust or residue from cleaned surfaces.
5. If surface develops rust before prime coat is applied, repeat surface preparation.
6. Apply manufacturer's standard prime coat to shop-cleaned, dry surface same day as surface preparation.
7. Apply manufacturer's standard two-component, epoxy finish coats.

Q. Fuel-Oil AST Accessories
1. Tank Manholes (for horizontal tanks and some vertical tanks): 22-inch- (560-mm-) minimum diameter; bolted, flanged, and gasketed; centered on top of tank.
2. Tank Manholes (for vertical tanks): 22-inch- (560-mm-) minimum diameter; bolted, flanged, and gasketed; on top and at side of tank.
3. For Horizontal Tanks: Threaded pipe connection fittings on top of tank, for fill, supply, return, vent, sounding, and gaging. Include cast-iron plugs for shipping.
4. For Vertical Tanks: Threaded pipe connection fittings on top or sides of tank as indicated, for fill, supply, return, vent, sounding, and gaging. Include cast-iron plugs for shipping.
5. Striker Plates: Inside tank, on bottom below fill, vent, sounding, gage, and other tube openings.
6. Lifting Lugs: For handling and installation.
7. Ladders (for horizontal tanks and some vertical tanks): Carbon-steel ladder inside tank, anchored to top and bottom, and located as indicated. Include reinforcement of tank at bottom of ladder.
8. Ladders (for vertical tanks): Carbon-steel ladder outside tank, anchored to top and side wall. Comply with requirements in Division 05 Section "Metal Fabrications" for exterior steel ladder.
   a. Cage: Include welded steel cage around ladders for tanks 20 feet (6 m) high or higher.
9. Supply Tube: Extension of supply piping fitting into tank, terminating 6 inches (150 mm) above tank bottom and cut at a 45-degree angle (1:1 slope).
10. Sounding and Gage Tubes: Extension of fitting into tank, terminating 6 inches (150 mm) above tank bottom and cut at a 45-degree angle (1:1 slope).

R. Fuel-Oil UST Accessories
1. Tank Manholes: 22-inch- (560-mm-) minimum diameter; bolted, flanged, and gasketed, with extension collar; for access to inside of tank.
2. Steel Tank Masonry Supports: Two 6-by-6-by-3/8-inch (150-by-150-by-10-mm) steel angles, 72 inches (1800 mm) long, located longitudinally on tank on each side of manholes and continuously welded in place.
3. Threaded pipe connection fittings on top of tank for fill, supply, return, vent, sounding, and gaging, in locations and of sizes indicated. Include cast-iron plugs for shipping.
4. Striker Plates: Inside tank, on bottom below fill, vent, sounding, gage, and other tube openings.
5. Lifting Lugs: For handling and installation.
6. Ladders: Carbon-steel ladder inside tank, anchored to top and bottom. Include reinforcement of tank at bottom of ladder.
7. Supply Tube: Extension of supply piping fitting into tank, terminating 6 inches (150 mm) above tank bottom and cut at a 45-degree angle (1:1 slope).
8. Sounding and Gage Tubes: Extension of fitting into tank, terminating 6 inches (150 mm) above tank bottom and cut at a 45-degree angle (1:1 slope).
9. Containment Sumps: Fiberglass **OR** PE, **as directed**, with sump base, add-on extension pieces as required, sump top, lid, and gasket-seal joints. Include sump entry boots for pipe penetrations through sidewalls.

10. Sump Entry Boots: Two-part pipe fitting for field assembly and of size required to fit over pipe. Include gaskets shaped to fit sump sidewall, sleeves, seals, and clamps as required for liquid-tight pipe penetrations.
11. Anchor Straps: Storage tank manufacturer's standard anchoring system, with straps, strap-insulating material, cables and turnbuckles, of strength at least one and one-half times maximum uplift force of empty tank without backfill in place.
12. Filter Mat: Geotextile woven or spun filter fabric, in 1 or more layers, for minimum total weight of 3 oz./sq. yd. (101.7 g/sq. m).
13. Overfill Prevention Valves: Factory fabricated or shop or field assembled from manufacturer's standard components. Include drop tube, cap, fill nozzle adaptor, check valve mechanism or other devices, and vent if required to restrict flow at 95 percent of tank capacity and to provide complete shutoff of filling at 98 **OR** 99, **as directed**, percent of tank capacity.

S. Fuel-Oil Storage Tank Piping Specialties
1. Fitting Materials: Cast iron, malleable iron, brass, or corrosion-resistant metal; suitable for fuel-oil service.
   a. Surface, Flush-Mounted Fittings: Waterproof and suitable for truck traffic.
   b. Aboveground-Mounted Fittings: Weatherproof.
2. Spill-Containment Fill Boxes: Flush mounting, with drainage feature to drain oil into tank, threaded fill-pipe connection, and wrench operation.
3. Fill Boxes: Flush mounting, with threaded fill-pipe connection and wrench operation.
4. Locking Fill Boxes: Flush mounting, with locking-type inner fill cap for standard padlock and threaded fill-pipe connection.
5. Supply and Sounding Drop Tubes: Fuel-oil supply piping or fitting, inside tank, terminating 6 inches (150 mm) above bottom of tank, and with end cut at a 45-degree angle (1:1 slope).
6. Pipe Adapters and Extensions: Compatible with piping and fittings.
7. Suction Strainers and Check Valves: Bronze or corrosion-resistant metal components.
8. Foot Valves and Antisiphon Valves: Poppet-type, bronze or corrosion-resistant metal components.
9. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.
10. Metal Manholes: 22-inch- (560-mm-) minimum diameter frame and cover. Furnish manhole units of adequate size for access to fittings if size is not indicated.
11. Monitoring Well Caps: Locking pipe plug and manhole.

T. Submersible Fuel-Oil Pumps
1. Description: Comply with UL 79, UL 87, and UL 343.
   a. Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.
   b. Impeller: Turbine.
   c. Housing and Volute: Cast iron.
   d. Bearings: Bronze, self-lubricating.
   e. Seals: Mechanical.
   f. Shaft: Polished steel.
   g. Suspension Piping: Telescoping to accommodate tank diameter and depth of bury.
   h. Base: Steel.
   i. Pressure Relief: Built in.
   j. Discharge Check Valve: Built in.
   k. Drive: Direct, close coupled.
2. Controls: Pump controller panel complying with UL 353 and UL 508C and with interlock and terminals for connections to fuel-oil-burning equipment **OR** diesel-driven fire pumps **OR** diesel-driven emergency generators **OR** diesel-fuel-oil dispenser, **as directed**.
   a. Run pumps to maintain minimum manifold pressure with outdoor-air temperature less than 60 deg F (16 deg C).

b. Run pumps on seven-day schedule.
c. Stage pumps on pressure at a common supply manifold.
d. Alternate pumps to equalize run time.
e. Alarm motor failure.
f. Manual reset dry-run protection. Stop pumps if fuel level falls below pump suction.
g. Deenergize and alarm pump locked rotor condition.
h. Alarm open circuit, high and low voltage.
i. Indicating lights for power on, run, and off normal conditions.
j. Interface with automatic control system is specified in Division 15 Section "Hvac Instrumentation And Controls" to control and indicate the following:
1) Start/stop pump set when required by schedule, fuel-fired appliance operation, day tank level control, or weather conditions.
2) Operating status.
3) Alarm off-normal status.

3. Motor: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 15 Section "Common Motor Requirements For Hvac Equipment".
a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
b. Thermal-Overload Protection: Motor-winding temperature sensor.
c. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 15.

U. Simplex Fuel-Oil Transfer Pumps
1. Description: Comply with UL 343, and HI M109.
a. Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.
b. Type: Positive-displacement, rotary type.
c. Impeller: Steel gear with crescent **OR** Carbon vane, **as directed**.
d. Housing: Cast-iron foot mounted.
e. Bearings: Bronze, self-lubricating.
f. Shaft: Polished steel.
g. Seals: Mechanical.
h. Base: Steel.
i. Pressure Relief: Built in.
j. Discharge Check Valve: Built in.
2. Drive: V-belt with guard; gear reducer; or direct, close coupled **OR** V-belt with guard **OR** Gear reducer **OR** Direct, close coupled, **as directed**.
3. Controls:
a. Run pump to maintain minimum manifold pressure with outdoor-air temperature less than 60 deg F (16 deg C).
b. Run pump on seven-day schedule.
c. Alarm motor failure.
d. Manual reset dry-run protection. Stop pump if fuel level falls below pump suction.
e. Deenergize and alarm pump locked rotor condition.
f. Alarm open circuit, high and low voltage.
g. Indicating lights for power on, run, and off normal conditions.
h. Interface with automatic control system is specified in Division 15 Section "Hvac Instrumentation And Controls" to control and indicate the following:
1) Start/stop pump set when required by schedule, fuel-fired appliance operation, day tank level control, or weather conditions.
2) Operating status.
3) Alarm off-normal status.
4. Motor: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 15 Section "Common Motor Requirements For Hvac Equipment".

a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
b. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 15.

V. Duplex **OR** Triplex, **as directed**, Fuel-Oil Transfer Pump Sets
1. Description: Comply with HI M109.
a. Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.
b. Type: Positive-displacement, rotary type.
c. Impeller: Steel gear with crescent **OR** Carbon vane, **as directed**.
d. Housing: Cast-iron foot mounted.
e. Bearings: Bronze, self-lubricating.
f. Shaft: Polished steel.
g. Seals: Mechanical.
h. Base: Steel.
i. Pressure Relief: Built in.
j. Discharge Check Valve: Built in.
2. Drive: V-belt with guard, gear reducer, or direct close coupled **OR** V-belt with guard **OR** Gear reducer **OR** Direct close coupled, **as directed**.
3. Controls:
a. Run pumps to maintain minimum manifold pressure with outdoor-air temperature less than 60 deg F (16 deg C).
b. Run pumps on seven-day schedule.
c. Stage pumps on pressure at a common supply manifold.
d. Alternate pumps to equalize run time.
e. Alarm motor failure.
f. Manual reset dry-run protection. Stop pumps if fuel level falls below pump suction.
g. Deenergize and alarm pump locked rotor condition.
h. Alarm open circuit, high and low voltage.
i. Indicating lights for power on, run, and off normal conditions.
j. Interface with automatic control system is specified in Division 15 Section "Hvac Instrumentation And Controls" to control and indicate the following:
1) Start/stop pump set when required by schedule, fuel-fired appliance operation, day tank level control, or weather conditions.
2) Operating status.
3) Alarm off-normal status.
4. Motor: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 15 Section "Common Motor Requirements For Hvac Equipment".
a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
b. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 15.
5. Piping Furnished with Pumps: Steel with ferrous fittings and threaded or welded joints.
6. Strainers Furnished with Pumps: Duplex, basket type with corrosion-resistant-metal-screen baskets.

W. Fuel Maintenance System
1. Description: Factory fabricated and wired fuel maintenance system for fuel-oil filtration; with enclosure, filter, fuel-oil pump, and controls; FMG approved, listed, and labeled by an NRTL acceptable to authorities having jurisdiction.
a. Enclosure: NEMA 250, Type 3R, painted steel containing pumps, filters, accessories, and controls. Hinged door on the front of enclosure.

b. Pump: Comply with HI M109, steel-gear-with-crescent, positive-displacement, direct-coupled, rotary-type.
c. Materials: Cast-iron housing; bronze bearings; steel shaft; mechanical seals; and built-in, pressure relief bypass valve.
d. Motor: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 15 Section "Common Motor Requirements For Hvac Equipment".
   1) Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
   2) Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 15.
e. Piping: Steel with malleable-iron fittings and threaded joints or wrought-steel fittings and welded joints.
f. Multistage Filter: Spin-on, replaceable types.
   1) Stage 1: 100-mesh strainer.
   2) Stage 2: Centrifuge to separate particulates and water from oil.
   3) Stage 3: Coalescing water and particulate filter.
   4) Stage 4: 30-micron particulate removal.
   5) Stage 5: 10-micron particulate removal.
   6) Stage 6: Minimum 99.5 percent water removal with see-through bowl and water-sensor probe.
   7) Stage 7: 1.5 **OR** 3, **as directed**,-micron particulate removal.
g. Multiple-Tank Manifolds:
   1) Manifold fabricated of Schedule 80, black steel pipe and threaded nipples for two **OR** three **OR** four, **as directed**, tanks.
   2) Solenoid valves for supply and return piping to each tank.
   3) Strainers for each tank supply connection.
h. Programmable Logic Controller:
   1) Alarm on maximum 15-in. Hg (51-kPa) vacuum at pump suction indicating plugged filter.
   2) Alarm on high water level in filter.
   3) Alarm leak in enclosure.
   4) Touch screen; with minimum 2-line, 20-character, backlit, LCD display.
   5) Controller strip heater with thermostat.
i. Interface with automatic control system is specified in Division 15 Section "Hvac Instrumentation And Controls" to control and indicate the following:
   1) Start/stop system when required by schedule.
   2) Operating status.
   3) Alarm off-normal status.

X. Liquid-Level Gage System
   1. Description: Calibrated, liquid-level gage system complying with UL 180 with floats **OR** UL 1238 with probes, **as directed**, or other sensors and remote annunciator panel.
   2. Annunciator Panel: With visual and audible, high-tank-level and low-tank-level alarms, fuel indicator with registration in gallons (liters), and overfill alarm. Include gage volume range that covers fuel-oil storage capacity.
   3. Controls: Electrical, operating on 120-V ac.

Y. Leak-Detection And Monitoring System
   1. Cable and Sensor System: Comply with UL 1238.
      a. Calibrated, leak-detection and monitoring system with probes and other sensors and remote alarm panel for fuel-oil storage tanks and fuel-oil piping.
      b. Include fittings and devices required for testing.
      c. Controls: Electrical, operating on 120-V ac.
      d. Calibrated, liquid-level gage complying with UL 180 with floats **OR** UL 1238 with probes, **as directed,** or other sensors and remote annunciator panel.

e. Remote Annunciator Panel: With visual and audible, high-tank-level and low-tank-level alarms, fuel indicator with registration in gallons (liters), and overfill alarm. Include gage volume range that covers fuel-oil storage capacity.
f. Controls: Electrical, operating on 120-V ac.

2. Hydrostatic System: Comply with UL 1238.
   a. Calibrated, leak-detection and monitoring system with brine antifreeze solution, reservoir sensor, and electronic control panel to monitor leaks in inner and outer tank walls.
   b. Include fittings and devices required for testing.
   c. Controls: Electrical, operating on 120-V ac.
   d. Calibrated, liquid-level gage complying with UL 180 with floats **OR** UL 1238 with probes, **as directed**, or other sensors and remote annunciator panel.
   e. Remote Annunciator Panel: With visual and audible, high-tank-level and low-tank-level alarms, fuel indicator with registration in gallons (liters), and overfill alarm. Include gage volume range that covers fuel-oil storage capacity.
   f. Controls: Electrical, operating on 120-V ac.

Z. Fuel Oil
1. Fuel Oil: ASTM D 396, Grade No. 1 **OR** No. 2, **as directed**.
2. Diesel Fuel Oil: ASTM D 975, Grade Low Sulfur **OR** No. 1-D, special-purpose **OR** No. 2-D, general-purpose, **as directed**, high volatility.

AA. Sleeves
1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

BB. Mechanical Sleeve Seals
1. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
   a. Sealing Elements: EPDM **OR** NBR, **as directed**, interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe and sleeve.
   b. Pressure Plates: Plastic **OR** Carbon steel **OR** Stainless steel, **as directed**.
   c. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating **OR** Stainless steel, **as directed**, of length required to secure pressure plates to sealing elements. Include one nut and bolt for each sealing element.

CC. Escutcheons
1. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to fit around pipe or tube and with OD that completely covers opening.
2. One-Piece, Deep-Pattern Escutcheons: Deep-drawn brass with polished chrome-plated finish.
3. One-Piece, Cast-Brass Escutcheons: With set screw.
   a. Finish: Polished chrome-plated **OR** Rough brass, **as directed**.
4. Split-Casting, Cast-Brass Escutcheons: With concealed hinge and set screw.
   a. Finish: Polished chrome-plated **OR** Rough brass, **as directed**.
5. One-Piece, Stamped-Steel Escutcheons: With set screw **OR** spring clips, **as directed**, and chrome-plated finish.
6. Split-Plate, Stamped-Steel Escutcheons: With concealed **OR** exposed-rivet, **as directed**, hinge, set screw **OR** spring clips, **as directed**, and chrome-plated finish.
7. One-Piece, Floor-Plate Escutcheons: Cast-iron floor plate.
8. Split-Casting, Floor-Plate Escutcheons: Cast brass with concealed hinge and set screw.

DD. Grout
1. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

a. Characteristics: Posthardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
b. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
c. Packaging: Premixed and factory packaged.

EE. Labeling And Identifying
1. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (152 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (762 mm) deep; colored yellow.

FF. Concrete Manholes
1. Precast Concrete Manhole Sections: ASTM C 478 (ASTM C 478M), base and concentric-cone sections with integral ladder or steps.
2. Cast-Iron Frame and Cover: Heavy-duty, water-resistant, cast-iron manhole frame, gasket, and bolted cover; 24-inch- (609-mm-) diameter, inside opening dimension; 8-inch (203-mm) frame riser height.

GG. Source Quality Control
1. Pressure test and inspect fuel-oil storage tanks, after fabrication and before shipment, according to ASME and the following:
a. Vertical **OR** Horizontal, **as directed**, Single-Wall Steel ASTs: UL 142.
b. Vertical **OR** Horizontal, **as directed**, Double-Wall Steel ASTs: UL 142, STI F921, and STI R931.
c. Horizontal, Containment-Dike, Steel ASTs: UL 142 and STI F911.
d. Horizontal, Concrete-Vaulted **OR** Concrete-Vaulted and Insulated **OR** Insulated, **as directed**, Steel ASTs: UL 142 and UL 2085.
e. Horizontal, Steel USTs with the STI-P3 Corrosion-Protection System: UL 58 and STI P3.
f. Composite **OR** Composite and Jacketed **OR** Jacketed, **as directed**, Steel USTs: UL 58.
g. FRP USTs: UL 1316.
2. Affix standards organization's code stamp.

1.3 EXECUTION

A. Earthwork
1. Comply with requirements in Division 02 Section "Earthwork" for excavating, trenching, and backfilling.

B. Preparation
1. Close equipment shutoff valves before turning off fuel oil to premises or piping section.
2. Comply with NFPA 30 and NFPA 31 requirements for prevention of accidental ignition.

C. Outdoor Piping Installation
1. Install underground fuel-oil piping buried at least 18 inches (457 mm) below finished grade. Comply with requirements in Division 02 Section "Earthwork" for excavating, trenching, and backfilling.
a. If fuel-oil piping is installed with less than 12 inches (305 mm) of cover to finished grade, install in containment piping.
2. Steel Piping with Protective Coating:
a. Apply joint cover kits to pipe after joining, to cover, seal, and protect joints.
b. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer. Review protective coating damage prior to repair.
OR
Replace pipe having damaged PE coating with new pipe.

3. Install double-containment, fuel-oil pipe at a minimum slope of 1 percent downward toward fuel-oil storage tank sump.
4. Install vent pipe at a minimum slope of 2 percent downward toward fuel-oil storage tank sump.
5. Assemble and install entry boots for pipe penetrations through sump sidewalls for liquid-tight joints.
6. Install metal pipes and tubes, fittings, valves, and flexible connectors at piping connections to AST and UST.
7. Install fittings for changes in direction in rigid pipe.
8. Install system components with pressure rating equal to or greater than system operating pressure.
9. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Install sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
10. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
11. Mechanical Sleeve Seal Installation: 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.
12. Install pressure gage on suction **OR** suction and discharge, **as directed**, from each pump. Pressure gages are specified in Division 15 Section "Meters And Gages For Hvac Piping".

D. Indoor Piping Installation
1. 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, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
2. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
3. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
4. 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.
5. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
6. Install piping free of sags and bends.
7. Install fittings for changes in direction and branch connections.
8. Install escutcheons for penetrations of walls, ceilings, and floors.
   a. New Piping:
      1) Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      2) Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
         OR
         Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
      3) Piping at Ceiling Penetrations in Finished Spaces: One-piece **OR** Split-casting, **as directed**, cast-brass type with polished chrome-plated finish.
         OR
         Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type **OR** Split-plate, stamped-steel type with concealed hinge, **as directed**, and set screw.
      4) Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated **OR** rough-brass, **as directed**, finish.
         OR

Piping in Unfinished Service Spaces: One-piece, stamped-steel type with set screw **OR** spring clips, **as directed**.

5) Piping in Equipment Rooms: One-piece, cast-brass type.
OR
Piping in Equipment Rooms: One-piece, stamped-steel type with set screw **OR** spring clips, **as directed**.

6) Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

9. Existing Piping:
   1) Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
   OR
   Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
   2) Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
   OR
   Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
   3) Piping in Unfinished Service Spaces: Split-casting, cast-brass type with polished chrome-plated **OR** rough-brass, **as directed**, finish.
   OR
   Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed **OR** exposed-rivet, **as directed**, hinge and set screw or spring clips.
   4) Piping in Equipment Rooms: Split-casting, cast-brass type.
   OR
   Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
   5) Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.
10. 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 "Through-penetration Firestop Systems".
11. Verify final equipment locations for roughing-in.
12. Comply with requirements for equipment specifications in Division 14 AND Division 15 for roughing-in requirements.
13. Conceal pipe installations in walls, pipe spaces, or utility spaces; above ceilings; below grade or floors; and in floor channels unless indicated to be exposed to view.
14. Prohibited Locations:
    a. Do not install fuel-oil piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
    b. Do not install fuel-oil piping in solid walls or partitions.
15. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
16. Connect branch piping from top or side of horizontal piping.
17. Install unions in pipes NPS 2 (DN 50) and smaller at final connection to each piece of equipment and elsewhere as indicated. Unions are not required on flanged devices.
18. Do not use fuel-oil piping as grounding electrode.
19. Install Y-pattern **OR** basket **OR** T-pattern, **as directed**, strainer on inlet side of fuel-oil pump.

E. Valve Installation
1. Install manual fuel-oil shutoff valves on branch connections to fuel-oil appliance.
2. Install valves in accessible locations.
3. Protect valves from physical damage.
4. Install metal tag attached with metal chain indicating fuel-oil piping systems.
5. Identify valves as specified in Division 15 Section "Identification For Hvac Piping And Equipment".
6. Install oil safety valves at inlet of each oil-fired appliance.

7. Install pressure relief valves in distribution piping between the supply and return lines.
8. Install one-piece, bronze ball valve with hose end connection at low points in fuel-oil piping.
9. Install manual air vents at high points in fuel-oil piping.
10. Install emergency shutoff valves at dispensers (for systems with fuel-oil or diesel-fuel-oil dispensers).

F. Piping Joint Construction
1. Ream ends of pipes and tubes and remove burrs.
2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
3. 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:
   a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   b. 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.
4. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to "Quality Assurance" Article.
   a. Bevel plain ends of steel pipe.
   b. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
5. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
6. Flanged Joints: Install gasket material, size, type, and thickness for service application. Install gasket concentrically positioned.
7. Flared Joints: Comply with SAE J513. Tighten finger tight, then use wrench according to fitting manufacturer's written recommendations. Do not overtighten.
8. Fiberglass-Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

G. Fuel-Oil AST Installation
1. Install tank bases and supports.
2. Connect piping and vent fittings.
3. Install ground connections.
4. Install tank leak-detection and monitoring devices.
5. Install steel ASTs according to STI R912.
6. Install insulated and concrete-vaulted, steel ASTs according to STI R942.
7. Fill storage tanks with fuel oil.

H. Fuel-Oil UST Installation
1. Excavate to sufficient depth for a minimum of 3 feet (1 m) of earth cover from top of tank to finished grade. Allow for cast-in-place, concrete-ballast base plus 6 inches (150 mm) of sand or pea gravel between ballast base and tank. Extend excavation at least 12 inches (300 mm) around perimeter of tank.
2. Set tie-down eyelets for hold-down straps in concrete-ballast base and tie to reinforcing steel.
3. Place 6 inches (152 mm) of clean sand or pea gravel on top of concrete-ballast base.
4. Set tank on fill materials and install hold-down straps.
5. Connect piping.
6. Install tank leak-detection and monitoring devices.
7. Install containment sumps.
8. Backfill excavation with clean sand or pea gravel in 12-inch (305-mm) lifts and tamp backfill lift to consolidate.
9. Install filter mat between top of backfill material and earth fill.
10. Install steel USTs with the STI-P3 corrosion-protection system according to STI R821 and STI R891. Protect anodes during tank placement and backfilling operations.

11. Install composite, steel USTs according to STI R913 and STI R891.
12. Install jacketed, steel USTs according to STI R923 and STI R891.
13. Install FRP USTs with FRP hold-down straps, manhole extensions, and manhole risers.
14. Fill storage tanks with fuel oil.

I. Hanger And Support Installation
1. Pipe hanger and support and equipment support materials and installation requirements are specified in Division 15 Section "Hangers And Supports For Hvac Piping And Equipment".
2. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
   a. NPS 1-1/4 (DN 32) and Smaller: Maximum span, 84 inches (2130 mm); minimum rod size, 3/8 inch (10 mm).
   b. NPS 1-1/2 (DN 40): Maximum span, 108 inches (2740 mm); minimum rod size, 3/8 inch (10 mm).
   c. NPS 2 (DN 50): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).
   d. NPS 2-1/2 (DN 65): Maximum span, 11 feet (3.4 m); minimum rod size, 1/2 inch (13 mm).
   e. NPS 3 (DN 80): Maximum span, 12 feet (3.7 m); minimum rod size, 1/2 inch (13 mm).
   f. NPS 4 (DN 100): Maximum span, 13 feet (4 m); minimum rod size, 5/8 inch (16 mm).
3. Support vertical steel pipe at each floor and at spacing not greater than 15 feet (4.5 m).
4. Install hangers for horizontal, drawn-temper copper tubing with the following maximum spacing and minimum rod sizes:
   a. NPS 3/4 (DN 20) and Smaller: Maximum span, 60 inches (1524 mm); minimum rod size, 3/8 inch (10 mm).
   b. NPS 1 (DN 25): Maximum span, 72 inches (1830 mm); minimum rod size, 3/8 inch (10 mm).
   c. NPS 1-1/4 (DN 32): Maximum span, 84 inches (2130 mm); minimum rod size, 3/8 inch (10 mm).
   d. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): Maximum span, 96 inches (2440 mm); minimum rod size, 3/8 inch (10 mm).
   e. NPS 2-1/2 (DN 65): Maximum span, 108 inches (2740 mm); minimum rod size, 1/2 inch (13 mm).
   f. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod size, 1/2 inch (13 mm).
   g. NPS 4 (DN 100): Maximum span, 11 feet (3.4 m); minimum rod size, 5/8 inch (16 mm).
5. Support vertical copper tube at each floor and at spacing not greater than 10 feet (3 m).

J. Fuel-Oil Pump Installation
1. Submersible Pumps:
   a. Suspend pumps from supply piping and anchored to bottom of tank.
2. Transfer Pumps:
   a. Install pumps with access space for periodic maintenance including removal of motors, impellers, and accessories.
   b. Set pumps on and anchor to concrete base.
3. Install two-piece, full-port ball valves at suction and discharge of pumps.
4. Install mechanical leak-detector valves at pump discharge.
5. Install Y-pattern **OR** basket **OR** T-pattern, **as directed**, strainer on inlet side of simplex fuel-oil pumps.
6. Install check valve on discharge of simplex fuel-oil pumps.
7. Install suction piping with minimum fittings and change of direction.
8. Install vacuum and pressure gage, upstream and downstream respectively, at each pump to measure the differential pressure across the pump. Pressure gages are specified in Division 15 Section "Meters And Gages For Hvac Piping".

K. Fuel Maintenance System Installation
1. Install suction line, with foot valve, at one end of storage tank, 1 inch (25 mm) from the bottom of tank.
2. Install return line at the opposite end of storage tank from suction line.

L. Liquid-Level Gage System Installation
   1. Install liquid-level gage system. Locate panel inside building where indicated.

M. Leak-Detection And Monitoring System Installation
   1. Install leak-detection and monitoring system. Install alarm panel inside building where indicated.
      a. Double-Wall, Fuel-Oil Storage Tanks: Install probes **OR** Install probes or use factory-installed integral probes **OR** Use factory-installed integral probes, **as directed**, in interstitial space.
      b. Single-Wall, Fuel-Oil Storage Tanks: Install probes as indicated.
      c. Double-Containment, Fuel-Oil Piping: Install leak-detection sensor probes in fuel-oil storage tank containment sumps and at low points in piping **OR** cable probes in interstitial space of double-containment piping, **as directed**.
      d. Install liquid-level gage.

N. Connections
   1. Install piping adjacent to equipment to allow service and maintenance.
   2. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment having threaded pipe connection.
   3. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.
   4. Connect piping to equipment with ball valve and union. Install union between valve and equipment.
   5. Install flexible piping connectors at final connection to burners or oil-fired appliances that must be moved for maintenance access.

O. Labeling And Identifying
   1. Nameplates, pipe identification, and signs are specified in Division 15 Section "Identification For Hvac Piping And Equipment".
      OR
      Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on or near each service regulator, service meter, and earthquake valve.
      a. Text: In addition to identifying unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
   2. Install detectable warning tape directly above fuel-oil piping, 12 inches (304 mm) below finished grade, except 6 inches (152 mm) below subgrade under pavements and slabs. Terminate tracer wire in an accessible area, and identify as "tracer wire" for future use with plastic-laminate sign.
      a. Piping: Over underground fuel-oil distribution piping.
      b. Fuel-Oil Storage Tanks: Over edges of each UST.

P. Field Painting Of AST
   1. If shop painting AST, prepare and touch up damaged exterior surface of AST and supports, **as directed**, as specified in "Shop Painting of AST" Article.
   2. If field painting AST, prepare exterior steel surface of AST and tank supports, **as directed**.
   3. Field Cleaning: After fabrication, blast clean according to SSPC-SP 6/NACE No. 3 **OR** SSPC-SP 10/NACE No. 2, **as directed**.
   4. After cleaning, remove dust or residue from cleaned surfaces.
   5. If surfaces develop rust before prime coat is applied, repeat surface preparation.
   6. Prepare surface of AST and supports, **as directed**, and apply painting systems according to specifications in Division 09 Section "High-performance Coatings" for severe **OR** moderate **OR** mild, **as directed**, environment high-gloss **OR** semigloss, **as directed**, finish for ferrous metal.

Q. Field Painting Of Aboveground Piping
   1. Comply with requirements in Division 07 for painting interior and exterior fuel-oil piping.

2. Paint exposed, exterior metal piping, valves, and piping specialties, except components with factory-applied paint or protective coating.
   a. Alkyd System: MPI EXT 5.1D.
      1) Prime Coat: Alkyd anticorrosive metal primer.
      2) Intermediate Coat (for a Premium Grade system): Exterior alkyd enamel matching topcoat.
      3) Topcoat: Exterior alkyd enamel (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
      4) Color: Gray, **as directed**.
3. Paint exposed, interior metal piping, valves, and piping specialties, except components with factory-applied paint or protective coating.
   a. Latex Over Alkyd Primer System: MPI INT 5.1Q.
      1) Prime Coat: Alkyd anticorrosive **OR** Quick-drying alkyd, **as directed**, metal primer.
      2) Intermediate Coat (for a Premium Grade system): Interior latex matching topcoat.
      3) Topcoat: Interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (satin) **OR** (semigloss) **OR** (gloss), **as directed**.
      4) Color: Gray, **as directed**.
   b. Alkyd System: MPI INT 5.1E.
      1) Prime Coat: Alkyd anticorrosive **OR** Quick-drying alkyd, **as directed**, metal primer.
      2) Intermediate Coat (for a Premium Grade system): Interior alkyd matching topcoat.
      3) Topcoat: Interior alkyd (flat) **OR** (eggshell) **OR** (semigloss) **OR** (gloss), **as directed**.
      4) Color: Gray, **as directed**.
4. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

R. Concrete Bases
1. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
   a. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
   b. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (457-mm) centers around the full perimeter of the base.
   c. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
   d. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   e. Install anchor bolts to elevations required for proper attachment to supported equipment.
   f. Use 3000-psig (20.7-MPa), **unless directed otherwise**, 28-day, compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-place Concrete".

S. Field Quality Control
1. Perform tests and inspections.
   a. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
2. Tests and Inspections:
   a. Tanks: Minimum hydrostatic or compressed-air test pressures for fuel-oil storage tanks that have not been factory tested and do not bear the ASME code stamp or a listing mark acceptable to authorities having jurisdiction:
      1) Single-Wall Tanks: Minimum 3 psig (20.7 kPa) and maximum 5 psig (34.5 kPa).
      2) Double-Wall Tanks:
         a) Inner Tanks: Minimum 3 psig (20.7 kPa) and maximum 5 psig (34.5 kPa).
         b) Interstitial Space: Minimum 3 psig (20.7 kPa) and maximum 5 psig (34.5 kPa), or 5.3-in. Hg (18-kPa) vacuum.

3) Where vertical height of fill and vent pipes is such that the static head imposed on the bottom of the tank is greater than 10 psig (69 kPa), hydrostatically test the tank and fill and vent pipes to a pressure equal to the static head thus imposed.
4) Maintain the test pressure for one hour.

b. Piping: Minimum hydrostatic or pneumatic test-pressures measured at highest point in system:
1) Fuel-Oil Distribution Piping: Minimum 5 psig (34.5 kPa) for minimum 30 minutes.
2) Fuel-Oil, Double-Containment Piping:
a) Carrier Pipe: Minimum 5 psig (34.5 kPa) for minimum 30 minutes.
b) Containment Conduit: Minimum 5 psig (34.5 kPa) for minimum 60 minutes.
3) Suction Piping: Minimum 20-in. Hg (68 kPa) for minimum 30 minutes.
4) Isolate storage tanks if test pressure in piping will cause pressure in storage tanks to exceed 10 psig (69 kPa).

c. Inspect and test fuel-oil piping according to NFPA 31, "Tests of Piping" Paragraph; and according to requirements of authorities having jurisdiction.

d. Test liquid-level gage for accuracy by manually measuring fuel-oil levels at not less than three **OR** four **OR** five, **as directed**, different depths while filling tank and checking against gage indication.

e. Test leak-detection and monitoring system for accuracy by manually operating sensors and checking against alarm panel indication.

f. Start fuel-oil transfer pumps to verify for proper operation of pump and check for leaks.

g. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

h. Bleed air from fuel-oil piping using manual air vents.

3. Fuel-oil piping and equipment will be considered defective if it does not pass tests and inspections.

4. Prepare test and inspection reports.

T. Outdoor Piping Schedule

1. Underground fuel-oil piping shall be one of the following. Size indicated is carrier-pipe size.
a. Flexible, double-containment piping.
b. Rigid, double-containment piping.

2. Underground fuel-oil-tank fill and vent piping shall be one of the following:
a. NPS 2 (DN 50) and Smaller: Steel pipe, steel or malleable-iron threaded fittings, and threaded joints. Coat pipe and fittings with protective coating for steel piping.
b. NPS 2-1/2 (DN 65) and Larger: Steel pipe, steel welding fittings, and welded joints. Coat pipe and fittings with protective coating for steel piping.

3. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

4. Aboveground fuel-oil piping shall be one of the following:
a. NPS 2 (DN 50) and Smaller: Steel pipe, steel or malleable-iron threaded fittings, and threaded joints.
b. NPS 2-1/2 (DN 65) and Larger: Steel pipe, steel welding fittings, and welded joints.
c. Annealed **OR** Drawn, **as directed**,-temper copper tube with wrought-copper fittings and brazed joints.

U. Indoor Piping Schedule

1. Aboveground fuel-oil piping shall be one of the following:
a. NPS 1/2 (DN 15) and Smaller: Steel pipe, steel or malleable-iron threaded fittings, and threaded joints **OR** Annealed-temper copper pipe, wrought copper fittings, and brazed or flared joints, **as directed**.
b. NPS 5/8 to NPS 2 (DN 18 to DN 50): Steel pipe, steel or malleable-iron threaded fittings, and threaded joints **OR** Drawn temper copper pipe, wrought copper fittings, and brazed joints, **as directed**.

c. NPS 2-1/2 (DN 65) and Larger: Steel pipe, steel fittings, and welded or flanged joints **OR** Drawn temper copper pipe, wrought copper fittings, and brazed or flanged joints, **as directed**.
d. Steel pipe with malleable-iron fittings and threaded joints.
e. Steel pipe with wrought-steel fittings and welded joints.
f. Annealed-temper copper tube, brass fittings, and flared joints.
g. Drawn-temper copper tubing, copper fittings, and brazed joints.

V. Aboveground Manual Fuel-Oil Shutoff Valve Schedule
1. Distribution piping valves for pipe NPS 2 (DN 50) and smaller shall be one of the following:
   a. One-piece, bronze ball valve with bronze trim.
   b. Two-piece, full **OR** regular, **as directed**,-port, bronze ball valves with bronze trim.
2. Distribution piping valves for pipe NPS 2-1/2 (DN 65) and larger shall be one of the following:
   a. Two-piece, full **OR** regular, **as directed**,-port, bronze ball valves with bronze trim.
   b. Bronze, nonlubricated **OR** lubricated, **as directed**, plug valve.
3. Valves in branch piping for single appliance shall be one of the following:
   a. One-piece, bronze ball valve with bronze trim.
   b. Two-piece, full **OR** regular, **as directed**,-port, bronze ball valves with bronze trim.

END OF SECTION 15061f

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SECTION 15061g - GENERAL-SERVICE COMPRESSED-AIR PIPING

1.1 GENERAL

A. Description Of Work:
1. This specification covers the furnishing and installation of materials for general-service compressed-air piping. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. This Section includes piping and related specialties for general-service compressed-air systems operating at 200 psig (1380 kPa) or less.

C. Definitions
1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CR: Chlorosulfonated polyethylene synthetic rubber.
3. EPDM: Ethylene-propylene-diene terpolymer rubber.
4. HDPE: High-density polyethylene plastic.
5. NBR: Acrylonitrile-butadiene rubber.
6. PE: Polyethylene plastic.
7. PVC: Polyvinyl chloride plastic.
8. High-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures between 150 and 200 psig (1035 and 1380 kPa).
9. Low-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures of 150 psig (1035 kPa) or less.

D. Performance Requirements
1. Seismic Performance: Compressed-air piping and support and installation shall withstand effects of seismic events determined according to SEI/ASCE 7, "Minimum Design Loads for Buildings and Other Structures.".

E. Submittals
1. Product Data: For the following:
   a. Plastic pipes, fittings, and valves.
   b. Dielectric fittings.
   c. Flexible pipe connectors.
   d. Safety valves.
   e. Pressure regulators. Include rated capacities and operating characteristics.
   f. Automatic drain valves.
   g. Filters. Include rated capacities and operating characteristics.
   h. Lubricators. Include rated capacities and operating characteristics.
   i. Quick couplings.
   j. Hose assemblies.
2. Brazing **OR** Welding, **as directed**, certificates.
3. Field quality-control test reports.
4. Operation and maintenance data.

F. Quality Assurance
1. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or to AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."
2. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

3. ASME Compliance:
   a. Comply with ASME B31.1, "Power Piping," for high-pressure compressed-air piping.
   b. Comply with ASME B31.9, "Building Services Piping," for low-pressure compressed-air piping.

G. Project Conditions
1. Interruption of Existing Compressed-Air Service: Do not interrupt compressed-air service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary compressed-air service according to requirements indicated:
   a. Notify Owner no fewer than two days in advance of proposed interruption of compressed-air service.
   b. Do not proceed with interruption of compressed-air service without Owner's written permission.

1.2 PRODUCTS

A. Pipes, Tubes, And Fittings
1. Schedule 40, Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B, black or hot-dip zinc coated with ends threaded according to ASME B1.20.1.
   a. Steel 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.
   b. Malleable-Iron Fittings: ASME B16.3, Class 150 or 300, threaded.
   c. Malleable-Iron Unions: ASME B16.39, Class 150 or 300, threaded.
   d. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel, threaded.
   e. Wrought-Steel Butt-Welding Fittings: ASME B16.9, Schedule 40.
   f. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel.
   g. Grooved-End Fittings and Couplings:
      1) Grooved-End Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron casting; with grooves according to AWWA C606 and dimensions matching steel pipe.
      2) Couplings: AWWA C606 or UL 213, for steel-pipe dimensions and rated for 300-psig (2070-kPa) minimum working pressure. Include ferrous housing sections, gasket suitable for compressed air, and bolts and nuts. Provide EDPM gaskets for oil-free compressed air. Provide NBR gaskets if compressed air contains oil or oil vapor.
2. Schedule 5, Steel Pipe: ASTM A 135, carbon steel with plain ends and zinc-plated finish.
   a. Pressure-Seal Fittings: Listed and labeled by a qualified testing agency and FMG-approved, carbon-steel, pressure-seal housing with O-ring end seals suitable for compressed-air piping and rated for 300-psig (2070-kPa) minimum working pressure. Provide EDPM seals for oil-free compressed air. Provide NBR seals if compressed air contains oil or oil vapor.
3. Copper Tube: ASTM B 88, Type K or L (ASTM B 88M, Type A or B) and ASTM B 88, Type M (ASTM B 88M, Type C) seamless, drawn-temper, water tube.
   a. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type or MSS SP-73, wrought copper with dimensions for brazed joints.
   b. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150 or 300.
   c. Copper Unions: ASME B16.22 or MSS SP-123.
   d. Press-Type Fittings, NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
   e. Press-Type Fittings, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
   f. Extruded-Tee Outlets: Procedure for making branch outlets in copper tube according to ASTM F 2014.

g. Grooved-End Fittings and Couplings:
   1) Grooved-End Fittings: ASTM B 75 (ASTM B 75M), copper tube or ASTM B 584, bronze castings.
   2) Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for compressed air, and bolts and nuts. Provide EDPM gasket for oil-free compressed air. Provide NBR gasket if compressed air contains oil or oil vapor.

4. Transition Couplings for Metal Piping: Metal coupling or other manufactured fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
5. PVC Pipe: ASTM D 1785, Schedule 40.
   a. PVC Fittings: ASTM D 2466, Schedule 40, socket type.
6. Blue ABS Piping System: Made of ASTM D 3965, ABS-resin modified to provide shatter-resistant pipe for compressed-air service. Pipe and fittings are light blue and sizes are in millimeters.
   a. Transition Fittings, 20 to 63 mm: Composite union with ABS socket end, CR O-ring, and malleable-iron union nut and threaded end; with construction similar to MSS SP-107, transition union.
   b. Transition Fittings, 90 to 110 mm: Flange assembly with ABS flange, CR gasket, and metal flange of material matching piping to be connected.
   c. Valves, 20 to 63 mm: ABS union ball valve with socket ends.
   d. Valves, 90 to 110 mm: ABS butterfly valve with lever handle.
7. Green ABS Piping System: Made of ASTM D 3965, ABS-resin modified to provide shatter-resistant pipe for compressed-air service. Pipe and fittings are dark green with SDR of 9.0 and same OD as ASTM A 53/A 53M, steel pipe.
   a. Transition Fittings, NPS 1/2 to NPS 2 (DN 15 to DN 50): Composite union with ABS socket end, CR O-ring, ABS union nut, and brass solder-joint end; with construction similar to MSS SP-107, transition union.
   b. Transition Fittings, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): ABS flange, CR gasket, and metal flange of material matching piping to be connected.
   c. Valves, NPS 1/2 to NPS 2 (DN 15 to DN 50): Union ball valve with socket ends.
   d. Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Union ball valve with flanged ends. Include safety exhaust feature in Part 3 "Valve Applications" Article if required.
8. HDPE Piping System: Made of ASTM D 1248, HDPE resin to provide shatter-resistant pipe for compressed-air service. Pipe and fittings are dark blue with pipe dimensions about the same OD as ASTM D 3035, PE pipe.
   a. Transition Fittings, NPS 1/2 to NPS 2 (DN 15 to DN 50): HDPE adapter with one socket end and one end with threaded brass insert.
   b. Transition Fittings, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): HDPE flange, CR gasket, and metal flange of material matching piping to be connected.
   c. Valves, NPS 1/2 to NPS 3 (DN 15 to DN 80): HDPE union ball valve with socket ends.

B. Joining Materials
1. Pipe-Flange Gasket Materials: Suitable for compressed-air piping system contents.
   a. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
      1) Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      2) Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
3. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
4. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
5. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated.
6. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
7. Solvent Cements for Joining Plastic Piping:

a. ABS Piping: ASTM D 2235.
b. PVC Piping: ASTM D 2564. Include primer complying with ASTM F 656.

C. Valves
1. Metal Ball, Butterfly, Check, Gate, and Globe Valves: Comply with requirements in Division 15 Section "General-duty Valves For Plumbing Piping".

D. Dielectric Fittings
1. General Requirements for Dielectric Fittings: Combination fitting of copper alloy and ferrous materials with insulating material; suitable for system fluid, pressure, and temperature. Include threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
2. Dielectric Unions: Factory-fabricated union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
3. Dielectric Flanges: Factory-fabricated companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
4. 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.
   a. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure where required to suit system pressures.

E. Flexible Pipe Connectors
1. Bronze-Hose Flexible Pipe Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
   a. Working-Pressure Rating: 200 psig (1380 kPa) **OR** 250 psig (1725 kPa), **as directed**, minimum.
   b. End Connections, NPS 2 (DN 50) and Smaller: Threaded copper pipe or plain-end copper tube.
   c. End Connections, NPS 2-1/2 (DN 65) and Larger: Flanged copper alloy.
2. Stainless-Steel-Hose Flexible Pipe Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
   a. Working-Pressure Rating: 200 psig (1380 kPa) **OR** 250 psig (1725 kPa), **as directed**, minimum.
   b. End Connections, NPS 2 (DN 50) and Smaller: Threaded steel pipe nipple.
   c. End Connections, NPS 2-1/2 (DN 65) and Larger: Flanged steel nipple.

F. Sleeves
1. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
2. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
   a. Underdeck Clamp: Clamping ring with set screws.

G. Escutcheons
1. General Requirements: Manufactured wall and ceiling escutcheons and floor plates, with ID to closely fit around pipe and tube and OD that completely covers opening.
2. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with polished chrome-plated finish.
3. One-Piece, Cast-Brass Escutcheons: With set screw.
   a. Finish: Polished chrome-plated **OR** Rough brass, **as directed**.
4. Split-Casting, Cast-Brass Escutcheons: With concealed hinge and set screw.
   a. Finish: Polished chrome-plated **OR** Rough brass, **as directed**.
5. One-Piece, Stamped-Steel Escutcheons: With set screw **OR** spring clips, **as directed**, and chrome-plated finish.

6. Split-Plate, Stamped-Steel Escutcheons: With concealed **OR** exposed-rivet, **as directed**, hinge, set screw **OR** spring clips, **as directed**, and chrome-plated finish.
7. One-Piece, Floor-Plate Escutcheons: Cast iron.
8. Split-Casting, Floor-Plate Escutcheons: Cast brass with concealed hinge and set screw.

H. Specialties
1. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet-type safety valve for compressed-air service.
   a. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.
2. Air-Main Pressure Regulators: Bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 250-psig (1725-kPa) inlet pressure, unless otherwise indicated.
   a. Type: Pilot operated.
3. Air-Line Pressure Regulators: Diaphragm **OR** Pilot, **as directed**, operated, bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200-psig (1380-kPa) minimum inlet pressure, unless otherwise indicated.
   OR
   Air-Line Pressure Regulators: Diaphragm operated, aluminum alloy or plastic body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200-psig (1380-kPa) minimum inlet pressure, unless otherwise indicated.
4. Automatic Drain Valves: Stainless-steel body and internal parts, rated for 200-psig (1380-kPa) minimum working pressure, capable of automatic discharge of collected condensate. Include mounting bracket if wall mounting is indicated, **as directed**.
5. Coalescing Filters: Coalescing type with activated carbon capable of removing water and oil aerosols; with color-change dye to indicate when carbon is saturated and warning light to indicate when selected maximum pressure drop has been exceeded. Include mounting bracket if wall mounting is indicated, **as directed**.
6. Mechanical Filters: Two-stage, mechanical-separation-type, air-line filters. Equip with deflector plates, resin-impregnated-ribbon-type filters with edge filtration, and drain cock. Include mounting bracket if wall mounting is indicated, **as directed**.
7. Air-Line Lubricators: With drip chamber and sight dome for observing oil drop entering air stream; with oil-feed adjustment screw and quick-release collar for easy bowl removal. Include mounting bracket if wall mounting is indicated, **as directed**.
   a. Provide with automatic feed device for supplying oil to lubricator.

I. Quick Couplings
1. General Requirements for Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.
2. Automatic-Shutoff Quick Couplings: Straight-through brass body with O-ring or gasket seal and stainless-steel or nickel-plated-steel operating parts.
   a. Socket End: With one-way valve and threaded inlet for connection to piping or threaded hose fitting.
   b. Plug End: Flow-sensor-bleeder, check-valve **OR** Straight-through, **as directed**, type with barbed outlet for attaching hose.
3. Valveless Quick Couplings: Straight-through brass body with stainless-steel or nickel-plated-steel operating parts.
   a. Socket End: With O-ring or gasket seal, without valve, and with barbed inlet for attaching hose.
   b. Plug End: With barbed outlet for attaching hose.

J. Hose Assemblies
1. Description: Compatible hose, clamps, couplings, and splicers suitable for compressed-air service, of nominal diameter indicated, and rated for 300-psig (2070-kPa) minimum working pressure, unless otherwise indicated.

a. Hose: Reinforced single **OR** double, **as directed**,-wire-braid, CR-covered hose for compressed-air service.
b. Hose Clamps: Stainless-steel clamps or bands.
c. Hose Couplings: Two-piece, straight-through, threaded brass or stainless-steel O-ring or gasket-seal swivel coupling with barbed ends for connecting two sections of hose.
d. Hose Splicers: One-piece, straight-through brass or stainless-steel fitting with barbed ends for connecting two sections of hose.

K. Grout
1. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
a. Characteristics: Post-hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
b. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
c. Packaging: Premixed and factory packaged.

1.3 EXECUTION

A. Piping Applications
1. Compressed-Air Piping between Air Compressors and Receivers: Use one of the following piping materials for each size range:
a. NPS 2 (DN 50) and Smaller: Schedule 40, black **OR** galvanized, **as directed**,-steel pipe; threaded, malleable-iron fittings; and threaded joints.
b. NPS 2 (DN 50) and Smaller: Schedule 5, galvanized-steel pipe; pressure-seal fittings; and pressure-sealed joints.
c. NPS 2 (DN 50) and Smaller: Schedule 40, black-steel pipe; wrought-steel fittings; and welded joints.
d. NPS 2 (DN 50) and Smaller: Type K or L (Type A or B), copper tube; wrought-copper fittings; and brazed joints.
e. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Schedule 40, black **OR** galvanized, **as directed**,-steel pipe; threaded, malleable-iron fittings; and threaded joints.
f. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Schedule 40, black **OR** galvanized, **as directed**,-steel pipe; grooved-end fittings; couplings; and grooved joints.
g. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Schedule 40, black-steel pipe; wrought-steel fittings; and welded joints.
h. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Type K or L (Type A or B), copper tube; wrought-copper fittings; and brazed joints.
i. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Type K or L (Type A or B), copper tube; grooved-end copper fittings; couplings; and grooved joints.
j. NPS 5 (DN 125) and Larger: Schedule 40, black **OR** galvanized, **as directed**,-steel pipe; threaded, malleable-iron fittings; and threaded joints.
k. NPS 5 (DN 125) and Larger: Schedule 40, black **OR** galvanized, **as directed**,-steel pipe; grooved-end fittings; couplings; and grooved joints.
l. NPS 5 (DN 125) and Larger: Schedule 40, black-steel pipe; wrought-steel fittings; and welded joints.
m. NPS 5 (DN 125) and Larger: Grooved-end, Type K or L (ASTM B 88M Type A or B), copper tube; grooved-end copper fittings; couplings; and grooved joints.
2. Low-Pressure Compressed-Air Distribution Piping: Use one of the following piping materials for each size range:
a. NPS 2 (DN 50) and Smaller: Schedule 40, black **OR** galvanized, **as directed**,-steel pipe; threaded, malleable-iron fittings; and threaded joints.
b. NPS 2 (DN 50) and Smaller: Schedule 5, galvanized-steel pipe; pressure-seal fittings; and pressure-sealed joints.
c. NPS 2 (DN 50) and Smaller: Type K or L (Type A or B), copper tube; wrought-copper fittings; and brazed **OR** soldered, **as directed**, joints.

d. NPS 2 (DN 50) and Smaller: Type K or L (Type A or B), copper tube; press-type fittings; and pressure-sealed joints.
e. NPS 2 (DN 50) and Smaller: 63-mm and smaller, blue ABS pipe and fittings; transition fittings; valves; and solvent-cemented joints.
f. NPS 2 (DN 50) and Smaller: Green ABS pipe and fittings, transition fittings, and valves; and solvent-cemented joints.
g. NPS 2 (DN 50) and Smaller: HDPE pipe, fittings, and valves; and heat-fusion joints.
h. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Schedule 40, black **OR** galvanized, **as directed**,-steel pipe; threaded, malleable-iron fittings; and threaded joints.
i. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Schedule 40, black **OR** galvanized, **as directed**,-steel pipe; grooved-end fittings; couplings; and grooved joints.
j. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Type K or L (Type A or B), copper tube; wrought-copper fittings; and brazed **OR** soldered, **as directed**, joints.
k. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Type K or L (Type A or B), copper tube; grooved-end copper fittings; couplings; and grooved joints.
l. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Type K or L (Type A or B), copper tube; press-type fittings; and pressure-sealed joints.
m. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): 90- and 110-mm, blue ABS pipe and fittings; transition fittings; and solvent-cemented joints. Include butterfly valves and flanged joints.
n. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): NPS 3 and NPS 4 (DN 80 and DN 100), green ABS pipe and fittings; transition fittings; and solvent-cemented joints. Include ball valves and flanged joints.
o. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): NPS 3 and NPS 4 (DN 80 and DN 100), HDPE pipe and fittings; valves; and heat-fusion joints.
p. NPS 5 and NPS 6 (DN 125 and DN 150): Schedule 40, black **OR** galvanized, **as directed**,-steel pipe; threaded, malleable-iron fittings; and threaded joints.
q. NPS 5 (DN 125) and Larger: Schedule 40, black **OR** galvanized, **as directed**,-steel pipe; grooved-end fittings; couplings; and grooved joints.
r. NPS 5 to NPS 8 (DN 125 to DN 200): Type K or L (Type A or B), copper tube; grooved-end copper fittings; couplings; and grooved joints.

3. High-Pressure Compressed-Air Distribution Piping: Use one of the following piping materials for each size range:
   a. NPS 2 (DN 50) and Smaller: Schedule 40, black **OR** galvanized, **as directed**,-steel pipe; threaded, malleable-iron fittings; and threaded joints.
   b. NPS 2 (DN 50) and Smaller: Schedule 5, galvanized-steel pipe; pressure-seal fittings; and pressure-sealed joints.
   c. NPS 2 (DN 50) and Smaller: Schedule 40, black-steel pipe; wrought-steel fittings; and welded joints.
   d. NPS 2 (DN 50) and Smaller: Type K or L (Type A or B), copper tube; wrought-copper fittings; and brazed **OR** soldered, **as directed**, joints.
   e. NPS 2-1/2 to NPS 6 (DN 65 to DN 150): Schedule 40, black **OR** galvanized, **as directed**,-steel pipe; threaded, malleable-iron fittings; and threaded joints.
   f. NPS 2-1/2 to NPS 6 (DN 65 to DN 150): Schedule 40, black **OR** galvanized, **as directed**,-steel pipe; grooved-end fittings; couplings; and grooved joints.
   g. NPS 2-1/2 to NPS 6 (DN 65 to DN 150): Schedule 40, black-steel pipe; wrought-steel fittings; and welded joints.
   h. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Type K or L (Type A or B), copper tube; wrought-copper fittings; and brazed **OR** soldered, **as directed**, joints.
   i. NPS 2-1/2 to NPS 6 (DN 65 to DN 150): Type K or L (Type A or B), copper tube; wrought-copper fittings; and brazed joints.
   j. NPS 2-1/2 to NPS 6 (DN 65 to DN 150): Type K or L (Type A or B), copper tube; grooved-end copper fittings; couplings; and grooved joints.
   k. NPS 8 (DN 200) and Larger: Schedule 40, black **OR** galvanized, **as directed**,-steel pipe; grooved-end fittings; couplings; and grooved joints.
   l. NPS 8 (DN 200) and Larger: Schedule 40, black-steel pipe; wrought-steel fittings; and welded joints.

m. NPS 8 (DN 200): Type K or L (Type A or B), copper tube; grooved-end copper fittings; couplings; and grooved joints.

4. Drain Piping: Use one of the following piping materials:
   a. NPS 2 (DN 50) and Smaller: Type M (Type C) copper tube; wrought-copper fittings; and brazed or soldered joints.
   b. NPS 2 (DN 50) and Smaller: PVC pipe and fittings; and solvent-cemented joints.

B. Valve Applications
1. General-Duty Valves: Comply with requirements in Division 15 Section "General-duty Valves For Plumbing Piping" for metal general-duty valves. Use metal valves, unless otherwise indicated.
   a. Metal General-Duty Valves: Use valve types specified in "Valve Applications" Article in Division 15 Section "General-duty Valves For Plumbing Piping" according to the following:
      1) Low-Pressure Compressed Air: Valve types specified for low-pressure compressed air.
      2) High-Pressure Compressed Air: Valve types specified for medium-pressure compressed air.
      3) Equipment Isolation NPS 2 (DN 50) and Smaller: Safety-exhaust, copper-alloy ball valve with exhaust vent and pressure rating at least as great as piping system operating pressure.
      4) Grooved-end valves may be used with grooved-end piping and grooved joints.
   b. Plastic General-Duty Valves: Provide valves, made by piping manufacturer, that are compatible with piping. Do not use plastic valves between air compressors and receivers.
      1) Blue ABS Piping System: Ball and butterfly valves.
      2) Green ABS Piping System: Ball valves.
      3) HDPE Piping System: Ball valves.

C. Piping Installation
1. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
2. Install piping concealed from view and protected from physical contact by building occupants, unless otherwise indicated and except in equipment rooms and service areas.
3. 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 otherwise indicated.
4. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and to coordinate with other services occupying that space.
5. Install piping adjacent to equipment and machines to allow service and maintenance.
6. Install air and drain piping with 1 percent slope downward in direction of flow.
7. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating, unless otherwise indicated.
8. Equipment and Specialty Flanged Connections:
   a. Use steel companion flange with gasket for connection to steel pipe.
   b. Use cast-copper-alloy companion flange with gasket and brazed **OR** soldered, **as directed**, joint for connection to copper tube. Do not use soldered joints for connection to air compressors or to equipment or machines producing shock or vibration.
9. Flanged joints may be used instead of specified joint for any piping or tubing system.
10. Extended-tee outlets with brazed branch connection may be used for copper tubing, within extruded-tee connection diameter to run tube diameter ratio for tube type, according to Extruded Tee Connections Sizes and Wall Thickness for Copper Tube (Inches) Table in ASTM F 2014.
11. Install eccentric reducers where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
12. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.

13. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver. Comply with requirements in Division 15 Section "Meters And Gages For Plumbing Piping".
14. Install piping to permit valve servicing.
15. Install piping free of sags and bends.
16. Install fittings for changes in direction and branch connections.
17. Install seismic restraints on piping. Seismic-restraint devices are specified in Division 15 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment".

D. Joint Construction
1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
3. 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:
   a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   b. 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.
4. Welded Joints for Steel Piping: Join according to AWS D10.12/D10.12M.
5. Brazed Joints for Copper Tubing: Join according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
6. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Join according to ASTM B 828 or CDA's "Copper Tube Handbook."
7. Extruded-Tee Outlets for Copper Tubing: Form branches according to ASTM F 2014, with tools recommended by procedure manufacturer, and using operators qualified according to Part 1 "Quality Assurance" Article.
8. Flanged Joints: Use asbestos-free, nonmetallic gasket suitable for compressed air. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.
9. Grooved Joints: Assemble couplings with housing, gasket, lubricant, and bolts. Join according to AWWA C606 for grooved joints. Do not apply lubricant to prelubricated gaskets.
10. Heat-Fusion Joints for PE Piping: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657 for socket-fusion joints.
11. Pressure-Sealed Joints: Join with tools recommended by fitting manufacturer, using operators qualified according to Part 1 "Quality Assurance" Article.
12. Solvent-Cemented Joints for ABS Piping: Clean and dry joining surfaces. Join according to the following:
    a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
    b. Join according to ASME B31.9 for solvent-cemented joints and to ASTM D 2235 Appendix.
13. Solvent-Cemented Joints for PVC Piping: Clean and dry joining surfaces. Join according to the following:
    a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
    b. Apply primer and join according to ASME B31.9 for solvent-cemented joints and to ASTM D 2672.
14. Dissimilar Metal Piping Material Joints: Use dielectric fittings.

E. Valve Installation
1. General-Duty Valves: Comply with requirements in Division 15 Section "General-duty Valves For Plumbing Piping".
2. Install shutoff valves and unions or flanged joints at compressed-air piping to air compressors.
3. Install shutoff valve at inlet to each automatic drain valve, filter, lubricator, and pressure regulator.
4. Install check valves to maintain correct direction of compressed-air flow to and from compressed-air piping specialties and equipment.

F. Dielectric Fitting Installation
   1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
   2. NPS 2 (DN 50) and Smaller: Use dielectric unions.
   3. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges.
   4. NPS 5 (DN 125)and Larger: Use dielectric flange kits.

G. Flexible Pipe Connector Installation
   1. Install flexible pipe connectors in discharge piping and in inlet air piping from remote air-inlet filter, **as directed**, of each air compressor.
   2. Install bronze-hose flexible pipe connectors in copper compressed-air tubing.
   3. Install stainless-steel-hose flexible pipe connectors in steel compressed-air piping.

H. Specialty Installation
   1. Install safety valves on receivers in quantity and size to relieve at least the capacity of connected air compressors.
   2. Install air-main pressure regulators in compressed-air piping at or near air compressors.
   3. Install air-line pressure regulators in branch piping to equipment and tools, **as directed**.
   4. Install automatic drain valves on aftercoolers, receivers, and dryers. Discharge condensate onto nearest floor drain.
   5. Install coalescing filters in compressed-air piping at or near air compressors and upstream from mechanical filters. Mount on wall at locations indicated, **as directed**.
   6. Install mechanical filters in compressed-air piping at or near air compressors and downstream from coalescing filters. Mount on wall at locations indicated, **as directed**.
   7. Install air-line lubricators in branch piping to machine tools. Mount on wall at locations indicated, **as directed**.
   8. Install quick couplings at piping terminals for hose connections.
   9. Install hose assemblies at hose connections.

I. Connections
   1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment and machine.
   2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment and machine.

J. Sleeve Installation
   1. Sleeves are not required for core-drilled holes.
   2. Permanent sleeves are not required for holes formed by removable PE sleeves.
   3. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs using galvanized-steel pipe **OR** galvanized-steel sheet **OR** stack sleeve fittings **OR** PVC pipe, **as directed**.
      OR
      Install sleeves for pipes passing through concrete and masonry walls, gypsum board partitions, and concrete floor and roof slabs.
      a. Wall Penetrations: Cut sleeves to length for mounting flush with both surfaces.
      b. Floor Penetrations: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
   4. Install sleeves in new walls and slabs as new walls and slabs are constructed.
   5. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
      a. PVC **OR** Steel, **as directed**, 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 (50 mm) above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing And Trim" for flashing.

1) Seal space outside of sleeve fittings with grout.

6. 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 "Through-penetration Firestop Systems".

K. Escutcheon Installation

1. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
   a. 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 **OR** stamped steel with set screw **OR** stamped steel with set screw or spring clips **OR** stamped steel with spring clips, **as directed**.
      3) Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish **OR** One piece or split-casting, cast brass with polished chrome-plated finish **OR** Split casting, cast brass with polished chrome-plated finish **OR** One piece, stamped steel with set screw **OR** One piece or split plate, stamped steel with set screw **OR** Split plate, stamped steel with set screw, **as directed**.
      4) Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish **OR** cast brass with rough-brass finish **OR** stamped steel with set screw **OR** stamped steel with spring clips **OR** stamped steel with set screw or spring clips, **as directed**.
      5) Bare Piping in Equipment Rooms: One piece, cast brass **OR** stamped steel with set screw **OR** stamped steel with spring clips **OR** stamped steel with set screw or spring clips, **as directed**.
      6) Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.
   b. Existing Piping:
      1) Chrome-Plated Piping: Split-casting, cast brass with chrome-plated finish.
      2) Insulated Piping: Split-plate, stamped steel with concealed **OR** exposed-rivet, **as directed**, hinge and spring clips.
      3) Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish **OR** plate, stamped steel with concealed hinge and spring clips, **as directed**.
      4) Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish **OR** plate, stamped steel with concealed hinge and set screw, **as directed**.
      5) Bare Piping in Unfinished Service Spaces: Split casting, cast brass with polished chrome-plated finish **OR** casting, cast brass with rough-brass finish **OR** plate, stamped steel with concealed hinge and set screw or spring clips **OR** plate, stamped steel with concealed or exposed-rivet hinge and set screw or spring clips **OR** plate, stamped steel with exposed-rivet hinge and set screw or spring clips, **as directed**.
      6) Bare Piping in Equipment Rooms: Split casting, cast brass **OR** plate, stamped steel with set screw or spring clips, **as directed**.
      7) Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.

L. Hanger And Support Installation

1. Comply with requirements in Division 15 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment" for seismic-restraint devices.
2. Comply with requirements in Division 15 Section "Hangers And Supports For Plumbing Piping And Equipment" for pipe hanger and support devices.
3. Vertical Piping: MSS Type 8 or 42, clamps.
4. Individual, Straight, Horizontal Piping Runs:
   a. 100 Feet (30 m) or Less: MSS Type 1, adjustable, steel clevis hangers.

b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.

5. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
6. Base of Vertical Piping: MSS Type 52, spring hangers.
7. Support horizontal piping within 12 inches (300 mm) of each fitting and coupling.
8. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
9. Install hangers for Schedule 40, steel piping with the following maximum horizontal spacing and minimum rod diameters:
   a. NPS 1/4 to NPS 1/2 (DN 8 to DN 15): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
   b. NPS 3/4 to NPS 1-1/4 (DN 20 to DN 32): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
   c. NPS 1-1/2 (DN 40): 12 feet (3.7 m) with 3/8-inch (10-mm) rod.
   d. NPS 2 (DN 50): 13 feet (4 m) with 3/8-inch (10-mm) rod.
   e. NPS 2-1/2 (DN 65): 14 feet (4.3 m) with 1/2-inch (13-mm) rod.
   f. NPS 3 (DN 80): 15 feet (4.6 m) with 1/2-inch (13-mm) rod.
   g. NPS 3-1/2 (DN 90): 16 feet (4.9 m) with 1/2-inch (13-mm) rod.
   h. NPS 4 (DN 100): 17 feet (5.2 m) with 5/8-inch (16-mm) rod.
   i. NPS 5 (DN 125): 19 feet (5.8 m) with 5/8-inch (16-mm) rod.
   j. NPS 6 (DN 150): 21 feet (6.4 m) with 3/4-inch (19-mm) rod.
   k. NPS 8 (DN 200): 24 feet (7.3 m) with 3/4-inch (19-mm) rod.
   l. NPS 10 (DN 250): 26 feet (7.9 m) with 7/8-inch (22-mm) rod.
   m. NPS 12 (DN 300): 30 feet (9.1 m) with 7/8-inch (22-mm) rod.
10. Install supports for vertical, Schedule 40, steel piping every 15 feet (4.6 m).
11. Install hangers for Schedule 5, steel piping with the following maximum horizontal spacing and minimum rod diameters:
   a. NPS 1/2 (DN 15): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
   b. NPS 3/4 (DN 20): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
   c. NPS 1 (DN 25): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
   d. NPS 1-1/4 (DN 32): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
   e. NPS 1-1/2 (DN 40): 10 feet (3 m) with 3/8-inch (10-mm) rod.
   f. NPS 2 (DN 50): 11 feet (3.4 m) with 3/8-inch (10-mm) rod.
12. Install supports for vertical, Schedule 5, steel piping every 10 feet (3 m).
13. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   a. NPS 1/4 (DN 8): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
   b. NPS 3/8 and NPS 1/2 (DN 10 and DN 15): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
   c. NPS 3/4 (DN 20): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
   d. NPS 1 (DN 25): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
   e. NPS 1-1/4 (DN 32): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
   f. NPS 1-1/2 (DN 40): 10 feet (3 m) with 3/8-inch (10-mm) rod.
   g. NPS 2 (DN 50): 11 feet (3.4 m) with 3/8-inch (10-mm) rod.
   h. NPS 2-1/2 (DN 65): 13 feet (4 m) with 1/2-inch (13-mm) rod.
   i. NPS 3 (DN 80): 14 feet (4.3 m) with 1/2-inch (13-mm) rod.
   j. NPS 3-1/2 (DN 90): 15 feet (4.6 m) with 1/2-inch (13-mm) rod.
   k. NPS 4 (DN 100): 16 feet (4.9 m) with 1/2-inch (13-mm) rod.
   l. NPS 5 (DN 125): 18 feet (5.5 m) with 1/2-inch (13-mm) rod.
   m. NPS 6 (DN 150): 20 feet (6 m) with 5/8-inch (16-mm) rod.
   n. NPS 8 (DN 200): 23 feet (7 m) with 3/4-inch (19-mm) rod.
14. Install supports for vertical copper tubing every 10 feet (3 m).
15. Install vinyl-coated hangers for ABS piping with the following maximum horizontal spacing and minimum rod diameters:
   a. All Sizes: Install continuous support for piping with compressed air at normal operating temperature above 100 deg F (38 deg C).
   b. NPS 3/8 and NPS 1/2 (DN 10 and DN 15): 30 inches (760 mm) with 3/8-inch (10-mm) rod.

c. NPS 3/4 (DN 20): 38 inches (975 mm) with 3/8-inch (10-mm) rod.
d. NPS 1 (DN 25): 40 inches (1015 mm) with 3/8-inch (10-mm) rod.
e. NPS 1-1/4 (DN 32): 45 inches (1140 mm) with 3/8-inch (10-mm) rod.
f. NPS 1-1/2 (DN 40): 52 inches (1330 mm) with 3/8-inch (10-mm) rod.
g. NPS 2 (DN 50): 58 inches (1470 mm) with 3/8-inch (10-mm) rod.
h. NPS 3 (DN 80): 68 inches (1730 mm) with 1/2-inch (13-mm) rod.
i. NPS 4 (DN 100): 76 inches (1900 mm) with 1/2-inch (13-mm) rod.

16. Install supports for vertical ABS piping every 48 inches (1220 mm).
17. Install vinyl-coated hangers for HDPE piping with the following maximum horizontal spacing and minimum rod diameters:
    a. All Sizes: Install continuous support for piping with compressed air at normal operating temperature above 100 deg F (38 deg C).
    b. NPS 1/2 (DN 15): 30 inches (760 mm) with 3/8-inch (10-mm) rod.
    c. NPS 3/4 (DN 20): 35 inches (890 mm) with 3/8-inch (10-mm) rod.
    d. NPS 1 (DN 25): 40 inches (1015 mm) with 3/8-inch (10-mm) rod.
    e. NPS 1-1/4 (DN 32): 43 inches (1090 mm) with 3/8-inch (10-mm) rod.
    f. NPS 1-1/2 (DN 40): 49 inches (1245 mm) with 3/8-inch (10-mm) rod.
    g. NPS 2 (DN 50): 55 inches (1400 mm) with 3/8-inch (10-mm) rod.
    h. NPS 3 and NPS 4 (DN 80 and DN 100): 96 inches (2440 mm) with 1/2-inch (13-mm) rod.
18. Install supports for vertical HDPE piping every 48 inches (1220 mm).

M. Labeling And Identification
1. Install identifying labels and devices for general-service compressed-air piping, valves, and specialties. Comply with requirements in Division 15 Section "Identification For Plumbing Piping And Equipment".

N. Field Quality Control
1. Perform field tests and inspections.
2. Tests and Inspections:
    a. Piping Leak Tests for Metal Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig (345 kPa) above system operating pressure, but not less than 150 psig (1035 kPa). Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
    b. Piping Leak Tests for ABS Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen, at temperature of 110 deg F (43 deg C) or less, to pressure of 40 psig (275 kPa) above system operating pressure, but not less than 80 psig (550 kPa) **OR** 100 psig (690 kPa), **as directed**, or more than 120 psig (825 kPa). Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
    c. Piping Leak Tests for HDPE Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen, at temperature of 100 deg F (38 deg C) or less, to pressure of 40 psig (275 kPa) above system operating pressure, but not less than 100 psig (690 kPa) **OR** 125 psig (860 kPa) **OR** 150 psig (1035 kPa), **as directed**, or more than 180 psig (1240 kPa). Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
    d. Repair leaks and retest until no leaks exist.
    e. Inspect filters, lubricators, and pressure regulators for proper operation.
3. Prepare test reports.

END OF SECTION 15061g

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Task	Specification	Specification Description
15061	02456b	Steam Distribution
15061	02441a	Common Work Results for Fire Suppression
15061	02441b	Common Work Results for Plumbing
15061	02441c	Common Work Results for HVAC
15061	02551	Facility Natural-Gas Piping
15061	02551a	Facility Liquefied-Petroleum Gas Piping
15062	02455a	Sanitary Sewerage
15062	02441a	Common Work Results for Fire Suppression
15062	02441b	Common Work Results for Plumbing
15062	02441c	Common Work Results for HVAC
15062	15061a	Sanitary Waste And Vent Piping
15062	15061b	Storm Drainage Piping
15062	15061g	General-Service Compressed-Air Piping

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SECTION 15063 - COMPRESSED-AIR PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for compressed-air piping for laboratory and healthcare facilities. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. This Section includes the following:
   a. Compressed-air piping and specialties for nonmedical laboratory facilities, designated "laboratory air," operating at 50 psig (345 kPa) **OR** 100 psig (690 kPa) **OR** 125 psig (860 kPa), **as directed**.
   b. Medical air piping and specialties, designated "medical air," operating at 50 to 55 psig (345 to 380 kPa).
   c. Dental air piping and specialties, designated "dental air," operating at 80 to 100 psig (550 to 690 kPa).
   d. Gas-powered-tool air piping and specialties, designated "instrument air," operating at 175 psig (1200 kPa).
   e. Healthcare laboratory air piping and specialties, designated "medical laboratory air," operating at 100 psig (690 kPa).

C. Definitions
1. D.I.S.S.: Diameter-index safety system.
2. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
3. Medical Compressed-Air Piping Systems: Include medical air, dental air, instrument air, and medical laboratory air piping systems.

D. Submittals
1. Product Data: For the following:
   a. Compressed-air tubes and fittings.
   b. Compressed-air valves and valve boxes.
   c. Medical compressed-air service connections.
   d. Medical compressed-air pressure control panels.
   e. Medical compressed-air manifolds.
   f. Medical compressed-air alarm system components.
2. Shop Drawings: Diagram power, signal, and control wiring.
3. Piping Material Certification: Signed by Installer certifying that medical compressed-air piping materials comply with NFPA 99 requirements.
4. Brazing certificates.
5. Field quality-control test reports.
6. Operation and maintenance data.

E. Quality Assurance
1. Installer Qualifications:
   a. Medical Compressed-Air Piping Systems for Healthcare Facilities: Qualify installers according to ASSE Standard #6010.
   b. Pressure-Seal Joining Procedure for Copper Tubing: Qualify operators according to training provided by Viega; Plumbing and Heating Systems.

2. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum piping testing indicated, that is a member of the Medical Gas Professional Healthcare Organization **OR** is an NRTL, **as directed**, and that is acceptable to authorities having jurisdiction.
   a. Qualify testing personnel according to ASSE Standard #6020 for inspectors and ASSE Standard #6030 for verifiers.
3. Source Limitations: Obtain compressed-air service connections of same type and from same manufacturer as service connections provided for in Division 15 Section "Gas Piping For Laboratory And Healthcare Facilities".
4. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."
5. 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.
6. ASME Compliance:
   a. Comply with ASME B31.1, "Power Piping," for laboratory compressed-air piping operating at more than 150 psig (1035 kPa).
   b. Comply with ASME B31.9, "Building Services Piping," for laboratory compressed-air piping operating at 150 psig (1035 kPa) or less.
7. Comply with NFPA 99, "Health Care Facilities," for medical compressed-air system materials and installation in healthcare facilities.

F. Project Conditions
1. Interruption of Existing Laboratory and Medical Compressed-Air Service(s): Do not interrupt laboratory or medical compressed-air service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
   a. Notify Owner no fewer than two days in advance of proposed interruption of laboratory and medical compressed-air service(s).
   b. Do not proceed with interruption of laboratory and medical compressed-air service(s) without Owner's written permission.

1.2 PRODUCTS

A. Pipes, Tubes, And Fittings
1. Copper Medical Gas Tube: ASTM B 819, Type K **OR** Type L, **as directed**, seamless, drawn temper, that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in green for Type K tube and in blue for Type L tube.
   a. General Requirements for Copper Fittings: Manufacturer cleaned, purged, and bagged for oxygen service according to CGA G-4.1.
   b. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type or MSS SP-73, with dimensions for brazed joints.
   c. Copper Unions: ASME B16.22 or MSS SP-123, wrought copper or cast-copper alloy.
   d. Press-Type Fittings:
      1) NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
      2) NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
2. Memory-Metal Couplings: Cryogenic compression fitting made of ASTM F 2063, nickel-titanium, shape-memory alloy, and that has been manufacturer cleaned, purged, and sealed for oxygen service according to CGA G-4.1.

3. Copper Water Tube: ASTM B 88, Type M (ASTM B 88M, Type C), seamless, drawn temper.
   a. Copper Fittings: ASME B16.18, cast-copper or ASME B16.22, wrought-copper, solder-joint pressure type.
   b. Press-Type Fittings:
      1) NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
      2) NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
4. PVC Pipe: ASTM D 1785, Schedule 40.
   a. PVC Fittings: ASTM D 2466, Schedule 40, socket type.

B. Joining Materials
1. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
2. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
3. Threaded-Joint Tape: PTFE.
4. Solvent Cement for Joining PVC Piping: ASTM D 2564. Include primer complying with ASTM F 656.

C. Valves
1. General Requirements for Valves: Manufacturer cleaned, purged, and bagged according to CGA G-4.1 for oxygen service.
2. Ball Valves: MSS SP-110, 3-piece body, brass or bronze.
   a. Pressure Rating: 300 psig (2070 kPa) minimum.
   b. Ball: Full-port, chrome-plated brass.
   c. Seats: PTFE or TFE.
   d. Handle: Lever type with locking device, **as directed**.
   e. Stem: Blowout proof with PTFE or TFE seal.
   f. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.
3. Check Valves: In-line pattern, bronze.
   a. Pressure Rating: 300 psig (2070 kPa) minimum.
   b. Operation: Spring loaded.
   c. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.
4. Zone Valves: MSS SP-110, 3-piece-body, brass or bronze ball valve with gage.
   a. Pressure Rating: 300 psig (2070 kPa) minimum.
   b. Ball: Full-port, chrome-plated brass.
   c. Seats: PTFE or TFE.
   d. Handle: Lever type with locking device, **as directed**.
   e. Stem: Blowout proof with PTFE or TFE seal.
   f. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.
   g. Pressure Gage: Manufacturer installed on one copper-tube extension.
5. Zone Valve Boxes: Formed steel with anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gages and in sizes required to permit manual operation of valves.
   a. Interior Finish: Factory-applied white enamel.
   b. Cover Plate: Aluminum or extruded-anodized aluminum **OR** Satin-chrome finish steel **OR** Stainless steel with NAAMM AMP 503, No. 4 finish, **as directed**, with frangible or removable windows.
   c. Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.

   OR

   Zone Valve Boxes: Formed or extruded aluminum with anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gages and in sizes required to permit manual operation of valves.

a. Interior Finish: Factory-applied white enamel.
b. Cover Plate: Aluminum or extruded-anodized aluminum **OR** Stainless steel with NAAMM AMP 503, No. 4 finish, **as directed**, with frangible or removable windows.
c. Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.

6. Safety Valves: Bronze-body, ASME-construction, poppet, pressure-relief type with settings to match system requirements.
7. Pressure Regulators: Bronze body and trim; spring-loaded, diaphragm-operated relieving type; manual pressure-setting adjustment; rated for 250-psig (1725-kPa) minimum inlet pressure; and capable of controlling delivered air pressure within 0.5 psig for each 10-psig (5.0 kPa for each 100-kPa) inlet pressure.
8. Automatic Drain Valves: Stainless-steel body and internal parts, rated for 200-psig (1380-kPa) minimum working pressure, capable of automatic discharge of collected condensate. Include mounting bracket where wall mounting is indicated, **as directed**.

D. Medical Compressed-Air Service Connections

1. Connection Devices: For specific medical compressed-air pressure and service listed. Include roughing-in assemblies, finishing assemblies, and cover plates. Individual cover plates are not required if service connection is in multiple unit or assembly with cover plate. Furnish recessed-type units made for concealed piping unless otherwise indicated.
   a. Roughing-in Assembly:
      1) Steel outlet box for recessed mounting and concealed piping.
      2) Brass-body outlet block with secondary check valve that will prevent gas flow when primary valve is removed.
      3) Double seals that will prevent air leakage.
      4) ASTM B 819, NPS 3/8 (DN 10) copper outlet tube brazed to valve with service marking and tube-end dust cap.
   b. Finishing Assembly:
      1) Brass housing with primary check valve.
      2) Double seals that will prevent air leakage.
      3) Cover plate with gas-service label.
   c. Quick-Coupler Service Connections: Pressure outlet with noninterchangeable keyed indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment, and with positive-locking ring that retains equipment stem in valve during use.
   d. D.I.S.S. Service Connections: Pressure outlets, complying with CGA V-5, with threaded indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment.
      1) Medical Air Service Connections: CGA V-5, D.I.S.S. No. 1160.
      2) Instrument Air Service Connections: CGA V-5, D.I.S.S. No. 1160.
   e. Cover Plates: One piece, stainless steel, with NAAMM AMP 503, No. 4 finish **OR** metal, with chrome-plated finish **OR** anodized aluminum, **as directed**, and permanent, color-coded, identifying label matching corresponding service.

E. Medical Compressed-Air Pressure Control Panels

1. Description: Steel box and support brackets for recessed roughing in with stainless-steel or anodized-aluminum cover plate with printed operating instructions. Include manifold assembly consisting of inlet supply valve, inlet supply pressure gage, line-pressure control regulator, outlet supply pressure gage, D.I.S.S. service connection, and piping outlet for remote service connection.
   a. Minimum Working Pressure: 200 psig (1380 kPa).
   b. Line-Pressure Control Regulator: Self-relieving diaphragm type with precision manual adjustment.
   c. Pressure Gages: 0- to 300-psig (0- to 2070-kPa) range.

d. Service Connection: CGA V-5, D.I.S.S. No. 1160, instrument air outlet.
e. Before final assembly, provide temporary dust shield and U-tube for testing.
f. Label cover plate "Air Pressure Control."

F. Medical Compressed-Air Manifolds
1. General Requirements for Medical Compressed-Air Manifolds: Comply with NFPA 99, Ch. 5, "Manifolds for Gas Cylinders without Reserve Supply."
2. Central Control Panel Unit: Weatherproof cabinet, supply and delivery pressure gages, electrical alarm system connections and transformer, indicator lights or devices, manifold connection, pressure changeover switch, line-pressure regulator, shutoff valves, and safety valve.
3. Manifold and Headers: Duplex, nonferrous-metal header for number of cylinders indicated, divided into two equal banks. Units include design for 2000-psig (13.8-MPa) minimum inlet pressure. Include cylinder bank headers with inlet (pigtail) connections complying with CGA V-1, individual inlet check valves, shutoff valve, pressure regulator, check valve, and pressure gage.
4. Compressed-Air Cylinders: Will be furnished by Owner **OR** Number and type of compressed-air cylinders required for complete manifold systems, **as directed**.
5. Operation: Automatic, pressure-switch-activated changeover from one cylinder bank to the other when first bank becomes exhausted, without line-pressure fluctuation or resetting of regulators and without supply interruption by shutoff of either cylinder bank header.
6. Mounting: Wall with mounting brackets for manifold control cabinet and headers **OR** Floor with support legs for manifold control cabinet, **as directed**.
7. Label manifold control unit with permanent label identifying compressed air and system operating pressure.
8. Medical Air Manifolds: For 4 cylinders and 1250-cu. ft./h (9.85-L/s) **OR** 8 cylinders and 2500-cu. ft./h (19.7-L/s), **as directed**, capacity at 55-psig (380-kPa) line pressure.
9. Instrument Air Manifolds: For 8 cylinders and 2000-cu. ft./h (15.7-L/s) **OR** 12 cylinders and 3000-cu. ft./h (23.6-L/s), **as directed**, capacity at 200-psig (1380-kPa) minimum line pressure.

G. Medical Compressed-Air-Piping Alarm Systems
1. Panels for medical compressed-air piping systems may be combined in single panels with medical vacuum and medical gas piping systems.
2. Components: Designed for continuous service and to operate on power supplied from 120 **OR** 240 **OR** 277, **as directed**,-V ac power source to alarm panels and with connections for low-voltage wiring to remote sensing devices. Include step-down transformers if required.
3. Dew Point Monitors: Continuous line monitoring, having panel with gage or digital display, pipeline sensing element, electrical connections for alarm system, factory- or field-installed valved bypass, and visual and cancelable audio signal for dryer site and master alarm panels. Alarm signals when pressure dew point rises above 39 deg F (4 deg C) at 55 psig (380 kPa).
   a. Operation: Chilled-mirror method **OR** Chilled-mirror method or hygrometer moisture analyzer with sensor probe **OR** Hygrometer moisture analyzer with sensor probe, **as directed**.
4. Pressure Switches or Transducer Sensors: Continuous line monitoring with electrical connections for alarm system.
   a. Low-Pressure Operating Range: 0- to 100-psig (0- to 690-kPa).
   b. High-Pressure Operating Range: Up to 250-psig (1725-kPa).
5. Carbon Monoxide Monitors: Panel with gage or digital display, pipeline sensing element, electrical connections for alarm system, and factory- or field-installed valved bypass. Alarm signals when carbon monoxide level rises above 10 ppm.
6. General Requirements for Medical Compressed-Air Alarm Panels: Factory wired with audible and color-coded visible signals to indicate specified functions.
   a. Mounting: Exposed, surface **OR** Recessed, **as directed**, installation.
   b. Enclosures: Fabricated from minimum 0.047-inch- (1.2-mm-) thick steel or minimum 0.05-inch- (1.27-mm-) thick aluminum, with knockouts for electrical and piping connections.
7. Master Alarm Panels: Separate trouble alarm signals, pressure gages, and indicators for medical compressed-air piping systems.

a. Include alarm signals when the following conditions exist:
   1) Medical Air: Pressure drops below 40 psig (275 kPa) or rises above 60 psig (415 kPa), backup air compressor is in operation, pressure drop across filter assembly increases more than 2 psig (13.8 kPa), dew point rises above 39 deg F (4 deg C) at 55 psig (380 kPa), carbon monoxide level rises above 10 ppm, and high water level is reached in receiver for liquid-ring, medical air compressor systems.
   2) Dental Air: Pressure drops below 65 psig (450 kPa) or rises above 110 psig (760 kPa), backup air compressor is in operation, pressure drop across filter assembly increases more than 2 psig (13.8 kPa), dew point rises above 50 deg F (10 deg C) at 125 psig (860 kPa), and carbon monoxide level rises above 10 ppm.
   3) Instrument Air: Pressure drops below 165 psig (1140 kPa) or rises above 185 psig (1275 kPa).
   4) Medical Laboratory Air: Pressure drops below 90 psig (630 kPa) or rises above 110 psig (760 kPa).

8. Anesthetizing-Area Alarm Panels: Separate trouble alarm signals, pressure gages, and indicators for medical compressed-air piping systems.
   a. Include alarm signals when the following conditions exist:
      1) Medical Air: Pressure drops below 40 psig (275 kPa) or rises above 60 psig (415 kPa).
      2) Instrument Air: Pressure drops below 165 psig (1140 kPa) or rises above 185 psig (1275 kPa).
9. Area Alarm Panels: Separate trouble alarm signals, pressure gages, and indicators for medical compressed-air piping systems.
   a. Include alarm signals when the following condition exists:
      1) Medical Air: Pressure drops below 40 psig (275 kPa) or rises above 60 psig (415 kPa).
10. Dental-Area Alarm Panels: Separate trouble alarm signals, pressure gages, and indicators for medical compressed-air piping systems.
   a. Include alarm signals when the following conditions exist:
      1) Dental Air: Pressure drops below 65 psig (450 kPa) or rises above 110 psig (760 kPa), backup air compressor is in operation, pressure drop across filter assembly increases more than 2 psig (13.8 kPa), dew point rises above 50 deg F (10 deg C) at 125 psig (860 kPa), and carbon monoxide level rises above 10 ppm.
      2) Instrument Air: Pressure drops below 165 psig (1140 kPa) or rises above 185 psig (1275 kPa).
11. Medical Laboratory Area Alarm Panels: Separate trouble alarm signals, pressure gages,; and indicators for medical compressed-air piping systems.
   a. Include alarm signals when the following condition exists:
      1) Medical Laboratory Air: Pressure drops below 90 psig (630 kPa) or rises above 110 psig (760 kPa).

H. Computer Interface Cabinet
   1. Description: Wall-mounting, welded-steel control cabinet with gasketed door, mounting brackets, grounding device, and white-enamel finish for connection of medical compressed-air- piping-system alarms to facility computer. Include factory-installed signal circuit boards, power transformer, circuit breaker, wiring terminal board, and internal wiring capable of interfacing 20, **as directed**, alarm signals.

I. Compressed-Air-Cylinder Storage Racks
   1. Wall Storage Racks: Fabricate racks with chain restraints for upright cylinders as indicated or provide equivalent manufactured wall racks.
   2. Freestanding Storage Racks: Fabricate racks as indicated or provide equivalent manufactured storage racks.

J. Flexible Pipe Connectors
1. Description: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
a. Working-Pressure Rating: 200 psig (1380 kPa) **OR** 250 psig (1725 kPa), **as directed**, minimum.
b. End Connections: Threaded copper pipe or plain-end copper tube.

K. Sleeves
1. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
2. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
a. Underdeck Clamp: Clamping ring with set screws.

L. Escutcheons
1. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to closely fit around pipe and tube and OD that completely covers opening.
2. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with polished chrome-plated finish.
3. One-Piece, Cast-Brass Escutcheons: With set screw.
a. Finish: Polished chrome-plated **OR** Rough brass, **as directed**.
4. Split-Casting, Cast-Brass Escutcheons: With concealed hinge and set screw.
a. Finish: Polished chrome-plated **OR** Rough brass, **as directed**.
5. One-Piece, Stamped-Steel Escutcheons: With set screw **OR** spring clips, **as directed**, and chrome-plated finish.
6. Split-Plate, Stamped-Steel Escutcheons: With concealed **OR** exposed-rivet, **as directed**, hinge, set screw **OR** spring clips, **as directed**, and chrome-plated finish.
7. One-Piece, Floor-Plate Escutcheons: Cast iron.
8. Split-Casting, Floor-Plate Escutcheons: Cast brass with concealed hinge and set screw.

M. Grout
1. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
a. Characteristics: Post-hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
b. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
c. Packaging: Premixed and factory packaged.

N. Nitrogen
1. Description: Comply with USP 28 - NF 23 for oil-free dry nitrogen.

1.3 EXECUTION

A. Piping Applications
1. Connect new tubing to existing tubing with memory-metal couplings.
2. Laboratory Air Piping: Use one of the following piping materials for each size range:
a. NPS 4 (DN 100) and Smaller: Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.
b. NPS 4 (DN 100) and Smaller: Type L, copper medical gas tube; press-type fittings; and pressure-sealed joints.
c. NPS 5 to NPS 8 (DN 125 to DN 200): Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.
3. Medical Air Piping: Use Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.

4. Dental Air Piping: Use Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.
5. Instrument Air Piping:
   a. NPS 3 (DN 80) and Smaller: Use Type K **OR** Type L, **as directed**, copper medical gas tube; wrought-copper fittings; and brazed joints.
   b. NPS 3-1/2 (DN 90) and Larger: Use Type K, copper medical gas tube; wrought-copper fittings; and brazed joints.
6. Medical Laboratory Air Piping: Use Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.
7. Drain Piping: Use one of the following piping materials:
   a. Copper water tube, cast- or wrought-copper fittings, and soldered **OR** press-type fittings, and pressure-sealed, **as directed**, joints.
   b. PVC pipe, PVC fittings, and solvent-cemented joints.

B. Piping Installation
1. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
2. Comply with ASSE Standard #6010 for installation of compressed-air piping.
3. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
4. 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.
5. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.
6. Install piping adjacent to equipment and specialties to allow service and maintenance.
7. Install air and drain piping with 1 percent slope downward in direction of flow.
8. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications below unless otherwise indicated.
9. Install eccentric reducers, if available, where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
10. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.
11. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver. Comply with requirements in Division 15 Section "Meters And Gages For Plumbing Piping".
12. Install piping to permit valve servicing.
13. Install piping free of sags and bends.
14. Install fittings for changes in direction and branch connections.
15. Install medical compressed-air piping to medical compressed-air service connections specified in this Section, to medical compressed-air service connections in equipment specified in Division 15 Section "Gas Piping For Laboratory And Healthcare Facilities", and to equipment specified in other Sections requiring medical compressed-air service.
16. Install seismic restraints on compressed-air piping. Seismic-restraint devices are specified in Division 15 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment".
17. Install compressed-air service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.
18. Connect compressed-air piping to air compressors and to compressed-air outlets and equipment requiring compressed-air service.
19. Install unions in copper compressed-air tubing adjacent to each valve and at final connection to each piece of equipment, machine, and specialty.

C. Valve Installation
1. Install shutoff valve at each connection to and from compressed-air equipment and specialties.
2. Install check valves to maintain correct direction of compressed-air flow from compressed-air equipment.
3. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.
4. Install zone valves and gages in valve boxes. Rotate valves to angle that prevents closure of cover when valve is in closed position.
5. Install safety valves on compressed-air receivers where required by NFPA 99 and where recommended by specialty manufacturers.
6. Install pressure regulators on compressed-air piping where reduced pressure is required.
7. Install automatic drain valves on equipment, specialties, and piping with drain connection. Run drain piping to floor drain so contents spill over or into it.
8. Install flexible pipe connectors in discharge piping and in inlet air piping from remote air-inlet filter, **as directed**, of each air compressor.

D. Joint Construction
1. Ream ends of PVC pipes and remove burrs.
2. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.
3. Threaded Joints: Apply appropriate tape to external pipe threads.
4. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter. Continuously purge joint with oil-free dry nitrogen during brazing.
5. Soldered Joints: Apply ASTM B 813, water-flushable flux to tube end. Join copper tube and fittings according to ASTM B 828.
6. Pressure-Sealed Joints: Join copper tube and press-type fittings with tools recommended by fitting manufacturer.
7. Memory-Metal Coupling Joints: Join new copper tube to existing tube according to procedures developed by fitting manufacturer for installation of memory-metal coupling joints.
8. Solvent-Cemented Joints: Clean and dry joining surfaces. Join PVC pipe and fittings according to the following:
   a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   b. Apply primer and join according to ASME B31.9 for solvent-cemented joints, and ASTM D 2672.

E. Compressed-Air Service Component Installation
1. Install compressed-air pressure control panel in walls. Attach to substrate.
2. Install compressed-air manifolds on concrete base, **as directed**, anchored to substrate.
3. Install compressed-air cylinders and connect to manifold piping.
4. Install compressed-air manifolds with seismic restraints as indicated.
5. Install compressed-air-cylinder wall storage racks attached to substrate.

F. Medical Compressed-Air-Piping Alarm System Installation
1. Alarm panels for medical compressed-air piping systems may be combined in single panels with medical vacuum piping systems and medical gas piping systems.
2. Install alarm system components for medical compressed-air-piping according to and in locations required by NFPA 99.
3. Install area and master alarm panels for medical compressed-air piping system where indicated.
4. Install computer interface cabinet with connection to medical compressed-air-piping alarm system and to facility computer.

G. Sleeve Installation
1. Sleeves are not required for core-drilled holes.
2. Permanent sleeves are not required for holes formed by removable PE sleeves.

3. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs using galvanized-steel pipe **OR** galvanized-steel sheet **OR** stack sleeve fittings **OR** PVC pipe, **as directed**.
   a. Wall Penetrations: Cut sleeves to length for mounting flush with both surfaces.
   b. Floor Penetrations: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

   OR

   Install sleeves in new walls and slabs as new walls and slabs are constructed.
4. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
   a. PVC **OR** Steel, **as directed**, 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 (50 mm) above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing And Trim" for flashing.
      1) Seal space outside of sleeve fittings with grout.
5. 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 "Through-penetration Firestop Systems".

H. Escutcheon Installation
1. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
   a. 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 **OR** stamped steel with set screw **OR** stamped steel with set screw or spring clips **OR** stamped steel with spring clips, **as directed**.
      3) Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish **OR** One piece or split casting, cast brass with polished chrome-plated finish **OR** Split casting, cast brass with polished chrome-plated finish **OR** One piece, stamped steel with set screw **OR** One piece or split plate, stamped steel with set screw **OR** Split plate, stamped steel with set screw, **as directed**.
      4) Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish **OR** cast brass with rough-brass finish **OR** stamped steel with set screw **OR** stamped steel with spring clips **OR** stamped steel with set screw or spring clips, **as directed**.
      5) Bare Piping in Equipment Rooms: One piece, cast brass **OR** stamped steel with set screw **OR** stamped steel with spring clips **OR** stamped steel with set screw or spring clips, **as directed**.
      6) Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.
   b. Existing Piping:
      1) Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.
      2) Insulated Piping: Split plate, stamped steel with concealed **OR** exposed-rivet, **as directed**, hinge and spring clips.
      3) Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish **OR** plate, stamped steel with concealed hinge and spring clips, **as directed**.

4) Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish **OR** plate, stamped steel with concealed hinge and set screw, **as directed**.
5) Bare Piping in Unfinished Service Spaces: Split casting, cast brass with polished chrome-plated finish **OR** casting, cast brass with rough-brass finish **OR** plate, stamped steel with concealed hinge and set screw or spring clips **OR** plate, stamped steel with concealed or exposed-rivet hinge and set screw or spring clips **OR** plate, stamped steel with exposed-rivet hinge and set screw or spring clips, **as directed**.
6) Bare Piping in Equipment Rooms: Split casting, cast brass **OR** plate, stamped steel with set screw or spring clips, **as directed**.
7) Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.

I. Hanger And Support Installation
1. Comply with requirements in Division 15 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment" for seismic-restraint devices.
2. Comply with requirements in Division 15 Section "Hangers And Supports For Plumbing Piping And Equipment" for pipe hanger and support devices.
3. Vertical Piping: MSS Type 8 or 42, clamps.
4. Individual, Straight, Horizontal Piping Runs:
   a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel, clevis hangers.
   b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable, roller hangers.
5. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Division 15 Section "Hangers And Supports For Plumbing Piping And Equipment" for trapeze hangers.
6. Base of Vertical Piping: MSS Type 52, spring hangers.
7. Support horizontal piping within 12 inches (300 mm) of each fitting and coupling.
8. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
9. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   a. NPS 1/4 (DN 8): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
   b. NPS 3/8 and NPS 1/2 (DN 10 and DN 15): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
   c. NPS 3/4 (DN 20): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
   d. NPS 1 (DN 25): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
   e. NPS 1-1/4 (DN 32): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
   f. NPS 1-1/2 (DN 40): 10 feet (3 m) with 3/8-inch (10-mm) rod.
   g. NPS 2 (DN 50): 11 feet (3.4 m) with 3/8-inch (10-mm) rod.
   h. NPS 2-1/2 (DN 65): 13 feet (4 m) with 1/2-inch (13-mm) rod.
   i. NPS 3 (DN 80): 14 feet (4.3 m) with 1/2-inch (13-mm) rod.
   j. NPS 3-1/2 (DN 90): 15 feet (4.6 m) with 1/2-inch (13-mm) rod.
   k. NPS 4 (DN 100): 16 feet (4.9 m) with 1/2-inch (13-mm) rod.
   l. NPS 5 (DN 125): 18 feet (5.5 m) with 1/2-inch (13-mm) rod.
   m. NPS 6 (DN 150): 20 feet (6 m) with 5/8-inch (16-mm) rod.
   n. NPS 8 (DN 200): 23 feet (7 m) with 3/4-inch (19-mm) rod.
10. Install supports for vertical copper tubing every 10 feet (3 m).

J. Labeling And Identification
1. Install identifying labels and devices for nonmedical laboratory compressed-air piping, valves, and specialties. Comply with requirements in Division 15 Section "Identification For Plumbing Piping And Equipment".
2. Install identifying labels and devices for medical compressed-air piping systems according to NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:
   a. Medical Air: Black letters on yellow background.

b. Dental Air: Black letters on yellow-and-white diagonal stripe background.
c. Instrument Air: White letters on red background.
d. Medical Laboratory Air: Black letters on yellow-and-white checkerboard background.

K. Field Quality Control For Compressed-Air Piping In Nonmedical Laboratory Facilities
1. Perform tests and inspections of compressed-air piping in nonmedical laboratory facilities and prepare test reports.
2. Tests and Inspections:
a. Piping Leak Tests for Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry nitrogen to pressure of 50 psig (345 kPa) above system operating pressure, but not less than 150 psig (1035 kPa). Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
b. Repair leaks and retest until no leaks exist.
c. Inspect filters and pressure regulators for proper operation.

L. Field Quality Control For Medical Compressed-Air Piping In Healthcare Facilities
1. Perform tests and inspections of medical compressed-air piping systems in healthcare facilities and prepare test reports.
2. Tests and Inspections:
a. Medical Compressed-Air Testing Coordination: Perform tests, inspections, verifications, and certification of medical compressed-air piping systems concurrently with tests, inspections, and certification of medical vacuum piping and medical gas piping systems.
b. Preparation: Perform the following Installer tests according to requirements in NFPA 99 and ASSE Standard #6010:
1) Initial blowdown.
2) Initial pressure test.
3) Cross-connection test.
4) Piping purge test.
5) Standing pressure test for positive-pressure medical compressed-air piping.
6) Repair leaks and retest until no leaks exist.
c. System Verification: Comply with requirements in NFPA 99, ASSE Standard #6020, and ASSE Standard #6030 for verification of medical compressed-air piping systems and perform the following tests and inspections:
1) Standing pressure test.
2) Individual-pressurization **OR** Individual-pressurization or pressure-differential **OR** Pressure-differential, **as directed**, cross-connection test.
3) Valve test.
4) Master and area alarm tests.
5) Piping purge test.
6) Piping particulate test.
7) Piping purity test.
8) Final tie-in test.
9) Operational pressure test.
10) Medical air purity test.
11) Verify correct labeling of equipment and components.
d. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:
1) Inspections performed.
2) Procedures, materials, and gases used.
3) Test methods used.
4) Results of tests.
3. Remove and replace components that do not pass tests and inspections and retest as specified above.

END OF SECTION 15063

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SECTION 15063a - VACUUM PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for vacuum piping for laboratory and healthcare facilities. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. This Section includes the following:
   a. Laboratory low-vacuum piping and specialties, designated "laboratory low vacuum" operating at 12 inches mercury (40.6 kPa vacuum) **OR** 20 inches mercury (67.7 kPa vacuum), **as directed**.
   b. Laboratory high-vacuum piping and specialties, designated "laboratory high vacuum" operating at 24 inches mercury (81.3 kPa vacuum) **OR** 29 inches mercury (98.2 kPa vacuum), **as directed**.
   c. Medical surgical vacuum piping and specialties, designated "medical vacuum" operating at 15 inches mercury (380 mm mercury or 50.7 kPa vacuum) **OR** 20 inches mercury (510 mm mercury or 67.7 kPa vacuum) **OR** 30 inches mercury (760 mm mercury or 101.4 kPa vacuum), **as directed**.
   d. Waste anesthetic gas disposal piping and specialties, designated "WAGD evacuation" operating at 14 inches mercury (355 mm mercury or 47.2 kPa vacuum) **OR** 15 inches mercury (380 mm mercury or 50.7 kPa vacuum), **as directed**.
   e. Dental vacuum piping and specialties, designated "dental vacuum" operating at 10 inches mercury (255 mm mercury or 33.8 kPa vacuum) **OR** 12 inches mercury (305 mm mercury or 40.6 kPa vacuum), **as directed**.
   f. Oral-evacuation piping and specialties, designated "HVE" operating at 5 inches mercury (127 mm mercury or 16.9 kPa vacuum) **OR** 8 inches mercury (203 mm mercury or 27.0 kPa vacuum), **as directed**.
   g. Healthcare laboratory vacuum piping and specialties, designated "medical laboratory vacuum" operating at 12 inches mercury (40.6 kPa vacuum) **OR** 20 inches mercury (67.7 kPa vacuum) **OR** 24 inches mercury (81.3 kPa vacuum), **as directed**.

C. Definitions
1. D.I.S.S.: Diameter-index safety system.
2. HVE: High-volume (oral) evacuation.
3. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
4. WAGD: Waste anesthetic gas disposal.
5. Medical vacuum piping systems include medical vacuum, WAGD evacuation, dental vacuum, HVE, and medical laboratory vacuum piping systems.

D. Submittals
1. Product Data: For the following:
   a. Vacuum pipes **OR** tubes, **as directed**, and fittings.
   b. Vacuum valves and valve boxes.
   c. Medical vacuum service connections and vacuum-bottle brackets.
2. LEED Submittal:
   a. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.
3. Shop Drawings: Diagram power, signal, and control wiring.

4. Piping Material Certification: Signed by Installer certifying that medical vacuum piping materials comply with NFPA 99 requirements.
5. Qualification Data: For Installer and testing agency.
6. Brazing certificates.
7. Field quality-control test reports.
8. Operation and maintenance data.

E. Quality Assurance
1. Installer Qualifications:
   a. Medical Vacuum Piping Systems for Healthcare Facilities: Qualify installers according to ASSE Standard #6010.
   b. Extruded-Tee Outlet Procedure: Qualify operators according to training provided by T-DRILL Industries Inc., for making branch outlets.
   c. Pressure-Seal Joining Procedure for Copper Tubing: Qualify operators according to training provided by Viega; Plumbing and Heating Systems.
2. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum piping testing indicated, that is a member of the Medical Gas Professional Healthcare Organization or is an NRTL, and that is acceptable to authorities having jurisdiction.
   a. Qualify testing personnel according to ASSE Standard #6020 for inspectors and ASSE Standard #6030 for verifiers.
3. Source Limitations: Obtain vacuum service connections of same type and from same manufacture as service connections provided for in Division 15 Section "Gas Piping For Laboratory And Healthcare Facilities".
4. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."
5. 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.
6. Comply with ASME B31.9, "Building Services Piping," for vacuum piping in laboratory facilities.
7. NFPA Compliance: Comply with NFPA 99, "Health Care Facilities," for medical vacuum system materials and installation in healthcare facilities.

F. Project Conditions
1. Interruption of Existing Laboratory or Medical Vacuum Service(s): Do not interrupt laboratory or medical vacuum service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
   a. Notify the Owner no fewer than two days in advance of proposed interruption of laboratory or medical vacuum service(s).
   b. Do not proceed with interruption of laboratory or medical vacuum service(s) without the Owner's written permission.

1.2 PRODUCTS

A. Pipes, Tubes, And Fittings
1. Copper Medical Gas Tube: ASTM B 819, Type L, seamless, drawn temper that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in blue.
   a. General Requirements for Copper Fittings: Manufacturer cleaned, purged, and bagged for oxygen service according to CGA G-4.1.

b. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type or MSS SP-73, with dimensions for brazed joints.
c. Copper Unions: ASME B16.22 or MSS SP-123, wrought copper or cast-copper alloy.
d. Press-Type Fittings:
1) NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
2) NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.

2. Copper Water Tube: ASTM B 88, Type M (ASTM B 88M, Type C), seamless, drawn temper.
a. Cast-Copper Fittings: ASME B16.18, solder-joint pressure type.
b. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type.
c. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150.
d. Copper Unions: ASME B16.22 or MSS SP-123, wrought copper or cast-copper alloy.
e. Press-Type Fittings:
1) NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
2) NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.

3. Extruded-Tee Outlets: ASTM F 2014 procedure for making branch outlets in copper tube.
4. Memory-Metal Couplings: Cryogenic compression fitting made of ASTM F 2063, nickel-titanium, shape-memory alloy, and that has been manufacturer cleaned, purged, and sealed for oxygen service according to CGA G-4.1.
5. PVC Pipe: ASTM D 1785, Schedule 40 and Schedule 80.
a. PVC Pressure Fittings: ASTM D 2466, Schedule 40 and ASTM D 2467, Schedule 80; socket type.

B. Joining Materials
1. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
2. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
3. Threaded-Joint Tape: PTFE.
4. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness, full-face type.
5. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.
6. Solvent Cement for Joining PVC Piping: ASTM D 2564. Include primer complying with ASTM F 656.
a. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
b. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Valves
1. General Requirements for Valves: Manufacturer cleaned, purged, and bagged according to CGA G-4.1 for oxygen service.
a. Exception: Factory cleaning and bagging are not required for valves for WAGD service.
2. Copper-Alloy Ball Valves: MSS SP-110, 3-piece body, brass or bronze.
a. Pressure Rating: 300 psig (2070 kPa) minimum.
b. Ball: Full-port, chrome-plated brass.
c. Seats: PTFE or TFE.
d. Handle: Lever type with locking device, **as directed**.
e. Stem: Blowout proof with PTFE or TFE seal.
f. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.
3. Bronze Check Valves: In-line pattern.
a. Pressure Rating: 300 psig (2070 kPa) minimum.
b. Operation: Spring loaded.

c. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.

4. Zone Valves: MSS SP-110, 3-piece-body, brass or bronze ball valve with gage.
   a. Pressure Rating: 300 psig (2070 kPa) minimum.
   b. Ball: Full-port, chrome-plated brass.
   c. Seats: PTFE or TFE.
   d. Handle: Lever type with locking device, **as directed**.
   e. Stem: Blowout proof with PTFE or TFE seal.
   f. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.
   g. Vacuum Gage: Manufacturer installed on one copper-tube extension.
5. Zone Valve Boxes: Formed steel with anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with vacuum gages and in sizes required to permit manual operation of valves.
   a. Interior Finish: Factory-applied white enamel.
   b. Cover Plate: Aluminum or extruded-anodized aluminum **OR** Satin-chrome finish steel **OR** Stainless steel with NAAMM AMP 503, No. 4 finish, **as directed**, with frangible or removable windows.
   c. Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.
6. Zone Valve Boxes: Formed or extruded aluminum with anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with vacuum gages and in sizes required to permit manual operation of valves.
   a. Interior Finish: Factory-applied white enamel.
   b. Cover Plate: Aluminum or extruded-anodized aluminum **OR** Stainless steel with NAAMM AMP 503, No. 4 finish, **as directed**, with frangible or removable windows.
   c. Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.
7. PVC Ball Valves: MSS SP-122, with union ends and 150-psig (1035-kPa) minimum working-pressure rating and suitable for vacuum service.
8. PVC Butterfly Valves: Lug type with lever handle and 150-psig (1035-kPa) minimum working-pressure rating and suitable for vacuum service.
9. PVC Check Valves: Ball-, in-line-, piston-, or swing-check design with flanged or union ends and 70-psig (480-kPa) **OR** 100-psig (690-kPa), **as directed**, minimum working-pressure rating and suitable for vacuum service.
10. Safety Valves: Bronze-body, ASME-construction, pressure-relief type with settings to match system requirements.
11. Automatic Drain Valves: Stainless-steel body and internal parts, rated for 200-psig (1380-kPa) minimum working pressure, capable of automatic discharge of collected condensate. Include mounting bracket where wall mounting is indicated.

D. Medical Vacuum Service Connections
1. Connection Devices: For specific medical vacuum service listed. Include roughing-in assemblies, finishing assemblies, and cover plates. Individual cover plates are not required if service connection is in multiple unit or assembly with cover plate. Furnish recessed-type units made for concealed piping unless otherwise indicated.
   a. Roughing-in Assembly:
      1) Steel outlet box for recessed mounting and concealed piping.
      2) Brass-body inlet block.
      3) Seals that will prevent vacuum leakage.
      4) ASTM B 819, NPS 3/8 (DN 10) copper outlet tube brazed to valve with service marking and tube-end dust cap.
   b. Finishing Assembly:
      1) Brass housing with primary check valve.
      2) Seals that will prevent vacuum leakage.
      3) Cover plate with gas-service label.

c. Quick-Coupler Service Connections: Suction inlets for medical vacuum **OR** medical vacuum and WAGD evacuation **OR** WAGD evacuation, **as directed**, service outlets with noninterchangeable keyed indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment, and with positive-locking ring that retains equipment stem in valve during use.

d. D.I.S.S. Service Connections: Suction inlets, complying with CGA V-5, with threaded indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment.

1) Medical Vacuum Service Connections: CGA V-5, D.I.S.S. No. 1220.

2) WAGD Evacuation Service Connections: CGA V-5, D.I.S.S. No. 2220.

e. Vacuum Bottle Brackets: One piece, with pattern and finish matching corresponding service cover plate.

f. Cover Plates: One piece, stainless steel, with NAAMM AMP 503, No. 4 finish **OR** metal, with chrome-plated finish **OR** anodized aluminum, **as directed**, and permanent, color-coded, identifying label matching corresponding service.

E. Medical Vacuum Piping Alarm Systems

1. Panels for medical vacuum piping systems may be combined in single panels with medical compressed-air and medical gas piping systems.

2. Components: Designed for continuous service and to operate on power supplied from 120-V **OR** 240-V **OR** 277-V, **as directed**, ac power source to alarm panels and with connections for low-voltage wiring to remote sensing devices. Include step-down transformers if required.

3. Vacuum Switches or Transducer Sensors: Continuous line monitoring with electrical connections for alarm system.

a. Vacuum Operating Range: 0- to 30-in. Hg (0- to 101-kPa vacuum).

4. General Requirements for Medical Vacuum Alarm Panels: Factory wired with audible and color-coded visible signals to indicate specified functions.

a. Mounting: Exposed, surface **OR** Recessed, **as directed**, installation.

b. Enclosures: Fabricated from minimum 0.047-inch- (1.2-mm-) thick steel or minimum 0.05-inch- (1.27-mm-) thick aluminum, with knockouts for electrical and piping connections.

5. Master Alarm Panels: With separate trouble alarm signals, vacuum gages, and indicators for medical vacuum piping systems.

a. Include alarm signals when the following conditions exist:

1) Medical Vacuum: Vacuum drops below 12-in. Hg (40 kPa vacuum) and backup vacuum pump is in operation.

2) WAGD Evacuation: Vacuum drops below 12-in. Hg (40 kPa vacuum).

3) Dental Vacuum: Vacuum drops below 6-in. Hg (20 kPa vacuum) and backup vacuum producer is in operation.

4) HVE: 4-in. Hg (13 kPa vacuum) and backup vacuum producer is in operation.

5) Medical Laboratory Vacuum: Vacuum drops below 10-in. Hg (34 kPa vacuum).

6. Anesthetizing-Area Alarm Panels: Separate trouble alarm signals; vacuum gages; and indicators for medical vacuum piping systems.

a. Include alarm signals when the following conditions exist:

1) Medical Vacuum: Vacuum drops below 12-in. Hg (40 kPa vacuum).

2) WAGD Evacuation: Vacuum drops below 12-in. Hg (40 kPa vacuum).

7. Area Alarm Panels: Separate trouble alarm signals; vacuum gages; and indicators for medical vacuum piping systems.

a. Include alarm signals when the following condition exists:

1) Medical Vacuum: Vacuum drops below 12-in. Hg (40 kPa vacuum).

8. Dental Area Alarm Panels: Separate trouble alarm signals; vacuum gages; and indicators for medical vacuum piping systems.

a. Include alarm signals when the following conditions exist:

1) Dental Vacuum: Vacuum drops below 6-in. Hg (20 kPa vacuum) and backup vacuum producer is in operation.

2) HVE: 4-in. Hg (13 kPa vacuum) and backup vacuum producer is in operation.

9. Medical Laboratory Area Alarm Panels: Separate trouble alarm signals; vacuum gages; and indicators for medical vacuum piping systems.
   a. Include alarm signals when the following condition exists:
      1) Medical Vacuum: Vacuum drops below 12-in. Hg (40 kPa vacuum).

F. Computer Interface Cabinet
   1. Description: Wall-mounting, welded-steel, control cabinet with gasketed door, mounting brackets, grounding device, and white-enamel finish for connection of medical vacuum piping system alarms to facility computer. Include factory-installed signal circuit boards, power transformer, circuit breaker, wiring terminal board, and internal wiring capable of interfacing 20 alarm signals.

G. Flexible Pipe Connectors
   1. Description: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
      a. Working-Pressure Rating: 200 psig (1380 kPa) **OR** 250 psig (1725 kPa), **as directed**, minimum.
      b. End Connections: Threaded copper pipe or plain-end copper tube.

H. Sleeves
   1. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
   2. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
      a. Underdeck Clamp: Clamping ring with set screws.

I. Escutcheons
   1. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to closely fit around pipe and tube and OD that completely covers opening.
   2. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with polished chrome-plated finish.
   3. One-Piece, Cast-Brass Escutcheons: With set screw.
      a. Finish: Polished chrome-plated **OR** Rough brass **OR** Polished chrome-plated and rough brass, **as directed**.
   4. Split-Casting, Cast-Brass Escutcheons: With concealed hinge and set screw.
      a. Finish: Polished chrome-plated **OR** Rough brass **OR** Polished chrome-plated and rough brass, **as directed**.
   5. One-Piece, Stamped-Steel Escutcheons: With set screw **OR** spring clips, **as directed**, and chrome-plated finish.
   6. Split-Plate, Stamped-Steel Escutcheons: With concealed **OR** exposed-rivet, **as directed**, hinge, set screw **OR** spring clips, **as directed**, and chrome-plated finish.
   7. One-Piece, Floor-Plate Escutcheons: Cast iron.
   8. Split-Casting, Floor-Plate Escutcheons: Cast brass with concealed hinge and set screw.

J. Grout
   1. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
      a. Characteristics: Post-hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
      b. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
      c. Packaging: Premixed and factory packaged.

K. Nitrogen
   1. Description: Comply with USP 28 - NF 23 for oil-free dry nitrogen.

1.3 EXECUTION

A. Preparation
1. Cleaning of Medical Gas Tubing: If manufacturer-cleaned and -capped fittings or tubing are not available or if precleaned fittings or tubing must be recleaned because of exposure, have supplier or separate agency acceptable to authorities having jurisdiction perform the following procedures:
   a. Clean medical gas tube and fittings, valves, gages, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service according to CGA G-4.1, "Cleaning Equipment for Oxygen Service."
   b. Wash medical gas tubing and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lb (0.453 kg) of chemical to 3 gal. (11.3 L) of water.
      1) Scrub to ensure complete cleaning.
      2) Rinse with clean, hot water to remove cleaning solution.

B. Piping Applications
1. Connect new copper tubing to existing tubing with memory-metal couplings.
2. Nonhealthcare Laboratory Low Vacuum Piping: Use one of the following piping materials for each size range:
   a. NPS 4 (DN 100) and Smaller: Type L, copper medical gas **OR** M (C) copper water, **as directed**, tube; wrought-copper fittings; and brazed **OR** soldered, **as directed**, joints.
   b. NPS 4 (DN 100) and Smaller: Type L, copper medical gas **OR** M (C) copper water, **as directed**, tube; press-type fittings; and pressure-sealed joints.
   c. NPS 5 to NPS 8 (DN 125 to DN 200): Type L, copper medical gas **OR** M (C) copper water, **as directed**, tube; wrought-copper fittings; and brazed **OR** soldered, **as directed**, joints.
3. Nonhealthcare Laboratory High Vacuum Piping: Use one of the following piping materials for each size range:
   a. NPS 4 (DN 100) and Smaller: Type L, copper medical gas **OR** M (C) copper water, **as directed**, tube; wrought-copper fittings; and brazed **OR** soldered, **as directed**, joints.
   b. NPS 4 (DN 100) and Smaller: Type L, copper medical gas **OR** M (C) copper water, **as directed**, tube; press-type fittings; and pressure-sealed joints.
   c. NPS 5 to NPS 8 (DN 125 to DN 200): Type L, copper medical gas **OR** M (C) copper water, **as directed**, tube; wrought-copper fittings; and brazed **OR** soldered, **as directed**, joints.
4. Medical Vacuum Piping: Use one of the following piping materials for each size range:
   a. NPS 4 (DN 100) and Smaller: Type L, copper medical gas **OR** M (C) copper water, **as directed**, tube; wrought-copper fittings; and brazed joints.
   b. NPS 4 (DN 100) and Smaller: Type L, copper medical gas **OR** M (C) copper water, **as directed**, tube; press-type fittings; and pressure-sealed joints.
   c. NPS 5 to NPS 8 (DN 125 to DN 200): Type L, copper medical gas **OR** M (C) copper water, **as directed**, tube; wrought-copper fittings; and brazed joints.
5. WAGD Evacuation Piping: Use one of the following piping materials for each size range:
   a. NPS 4 (DN 100) and Smaller: Type L, copper medical gas **OR** M (C) copper water, **as directed**, tube; wrought-copper fittings; and brazed joints.
   b. NPS 4 (DN 100) and Smaller: Type L, copper medical gas **OR** M (C) copper water, **as directed**, tube; press-type fittings; and pressure-sealed joints.
   c. NPS 5 to NPS 8 (DN 125 to DN 200): Type L, copper medical gas **OR** M (C) copper water, **as directed**, tube; wrought-copper fittings; and brazed joints.
6. Dental Vacuum Piping: Use one of the following piping materials for each size range:
   a. NPS 4 (DN 100) and Smaller: Type L, copper medical gas **OR** M (C) copper water, **as directed**, tube; wrought-copper fittings; and brazed **OR** soldered, **as directed**, joints.
   b. NPS 4 (DN 100) and Smaller: Type L, copper medical gas **OR** M (C) copper water, **as directed**, tube; press-type fittings; and pressure-sealed joints.
   c. NPS 5 to NPS 8 (DN 125 to DN 200): Type L, copper medical gas **OR** M (C) copper water, **as directed**, tube; wrought-copper fittings; and brazed **OR** soldered, **as directed**, joints.
7. HVE Piping: Use one of the following piping materials for each size range:

a. NPS 4 (DN 100) and Smaller: Type L, copper medical gas **OR** M (C) copper water, **as directed**, tube; wrought-copper fittings; and brazed **OR** soldered, **as directed**, joints.
b. NPS 4 (DN 100) and Smaller: Type L, copper medical gas **OR** M (C) copper water, **as directed**, tube; press-type fittings; and pressure-sealed joints.
c. NPS 4 (DN 100) and Smaller: Schedule 40 PVC pipe, Schedule 40 PVC fittings **OR** Schedule 80 PVC pipe, Schedule 80 PVC fittings, **as directed**, and solvent-cemented joints.
d. NPS 5 to NPS 8 (DN 125 to DN 200): Type L, copper medical gas **OR** M (C) copper water, **as directed**, tube; wrought-copper fittings; and brazed **OR** soldered, **as directed**, joints.
e. NPS 5 to NPS 8 (DN 125 to DN 200): Schedule 40 PVC pipe, Schedule 40 PVC fittings **OR** Schedule 80 PVC pipe, Schedule 80 PVC fittings, **as directed**, and solvent-cemented joints.

8. Medical Laboratory Vacuum Piping: Use one of the following piping materials for each size range:
   a. NPS 4 (DN 100) and Smaller: Type L, copper medical gas **OR** M (C) copper water, **as directed**, tube; wrought-copper fittings; and brazed joints.
   b. NPS 4 (DN 100) and Smaller: Type L, copper medical gas **OR** M (C) copper water, **as directed**, tube; press-type fittings; and pressure-sealed joints.
   c. NPS 5 to NPS 8 (DN 125 to DN 200): Type L, copper medical gas **OR** M (C) copper water, **as directed**, tube; wrought-copper fittings; and brazed joints.
9. Drain Piping: Use one of the following piping materials:
   a. Copper water tube, cast- or wrought-copper fittings, and soldered **OR** press-type fittings, and pressure-sealed, **as directed**, joints.
   b. PVC pipe, PVC fittings, and solvent-cemented joints.

C. Piping Installation
1. Drawing plans, schematics, and diagrams indicate general location and arrangement of vacuum piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
2. Comply with ASSE Standard #6010 for installation of vacuum piping.
3. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
4. 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.
5. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.
6. Install piping adjacent to equipment and specialties to allow service and maintenance.
7. Install vacuum and drain piping with 1 percent slope downward in direction of flow.
8. Install nipples, unions, and special fittings, and valves with pressure ratings same as or higher than piping pressure rating used in applications below unless otherwise indicated.
9. Install eccentric reducers, if available, where vacuum piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
10. Provide drain leg and drain trap at end of each main and branch and at low points.
11. Install thermometer and vacuum gage on inlet piping to each vacuum producer and on each receiver and separator, **as directed**. Comply with requirements in Division 15 Section "Meters And Gages For Plumbing Piping".
12. Install piping to permit valve servicing.
13. Install piping free of sags and bends.
14. Install fittings for changes in direction and for branch connections. Extruded-tee branch outlets in copper tubing may be made where specified.
15. Install medical vacuum piping to medical vacuum service connections specified in this Section and to equipment specified in other Sections requiring medical vacuum service.

16. Install seismic restraints on vacuum piping. Seismic-restraint devices are specified in Division 15 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment".
17. Install medical vacuum service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.
18. Install medical vacuum bottle bracket adjacent to each wall-mounted medical vacuum service connection suction inlet.
19. Connect vacuum piping to vacuum producers and to equipment requiring vacuum service.
20. Install unions, in copper vacuum tubing adjacent to each valve and at final connection to each piece of equipment, machine, and specialty.
21. Install unions, in PVC vacuum piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment, machine, and specialty.
22. Install flanges, in PVC vacuum piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment, machine, and specialty.

D. Valve Applications
1. Valves for Copper Vacuum Tubing: Use copper alloy ball and bronze check types.
2. Valves for PVC Vacuum Piping:
   a. NPS 4 (DN 100) and Smaller: Use copper alloy ball and bronze **OR** PVC ball, butterfly, and, **as directed**, check types.
   b. NPS 5 (DN 125) and Larger: Use PVC butterfly and check types.

E. Valve Installation
1. Install shutoff valve at each connection to and from vacuum equipment and specialties.
2. Install check valves to maintain correct direction of vacuum flow to vacuum-producing equipment.
3. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.
4. Install zone valves and gages in valve boxes. Rotate valves to angle that prevents closure of cover when valve is in closed position.
5. Install safety valves on vacuum receivers, where required by NFPA 99, and where recommended by specialty manufacturers.
6. Install automatic drain valves on equipment, specialties, and piping with drain connection. Run drain piping to floor drain, so contents spill over or into it.
7. Install flexible pipe connectors in suction inlet piping to each vacuum producer.

F. Joint Construction
1. Ream ends of pipes and tubes and remove burrs.
2. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.
3. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
4. Threaded Joints: Apply appropriate tape to external pipe threads.
5. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter. Continuously purge joint with oil-free dry nitrogen during brazing.
6. Soldered Joints: Apply ASTM B 813, water-flushable flux to tube end. Join copper tube and fittings according to ASTM B 828.
7. Extruded-Tee Outlets: Form branches in copper tube according to ASTM F 2014, with tools recommended by procedure manufacture.
8. Flanged Joints:
   a. Copper Tubing: Install flange on copper tubes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.
   b. PVC Piping: Install PVC flange on PVC pipes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.
9. Pressure-Sealed Joints: Join copper tube and copper and copper-alloy fittings with tools recommended by fitting manufacturer.
10. Memory-Metal Coupling Joints: Join new copper tube to existing tube according to procedures developed by fitting manufacturer for installation of memory-metal coupling joints.
11. Solvent-Cemented Joints: Clean and dry joining surfaces. Join PVC pipe and fittings according to the following:

a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
b. Apply primer and join according to ASME B31.9 for solvent-cemented joints and to ASTM D 2672.

G. Medical Vacuum Piping Alarm System Installation
1. Panels for medical vacuum piping systems may be combined in single panels with medical compressed-air piping systems and medical gas piping systems.
2. Install medical vacuum piping system alarm system components in locations required by and according to NFPA 99.
3. Install medical vacuum piping system area and master alarm panels where indicated.
4. Install computer interface cabinet with connection to medical vacuum piping alarm system and to facility computer.

H. Sleeve Installation
1. Sleeves are not required for core-drilled holes.
2. Permanent sleeves are not required for holes formed by removable PE sleeves.
3. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs using galvanized-steel pipe **OR** galvanized-steel sheet **OR** stack sleeve fittings **OR** PVC pipe, **as directed**.
   a. Wall Penetrations: Cut sleeves to length for mounting flush with both surfaces.
   b. Floor Penetrations: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

   OR

   Install sleeves in new walls and slabs as new walls and slabs are constructed.
4. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
   a. PVC **OR** Steel, **as directed**, 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 (50 mm) above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing And Trim" for flashing.
      1) Seal space outside of sleeve fittings with grout.
5. 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 "Through-penetration Firestop Systems".

I. Escutcheon Installation
1. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
   a. 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 **OR** stamped steel with set screw **OR** stamped steel with set screw or spring clips **OR** stamped steel with spring clips, **as directed**.
      3) Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish **OR** One piece or split casting, cast brass with polished chrome-plated finish **OR** Split casting, cast brass with polished chrome-plated finish **OR** One-piece, stamped steel with set screw **OR** One piece or split plate, stamped steel with set screw **OR** Split plate, stamped steel with set screw, **as directed**.

4) Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish **OR** cast brass with rough-brass finish **OR** stamped steel with set screw **OR** stamped steel with spring clips **OR** stamped steel with set screw or spring clips, **as directed**.
5) Bare Piping in Equipment Rooms: One piece, cast brass **OR** stamped steel with set screw **OR** stamped steel with spring clips **OR** stamped steel with set screw or spring clips, **as directed**.
6) Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

b. Existing Piping:
1) Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.
2) Insulated Piping: Split plate, stamped steel with concealed **OR** exposed-rivet, **as directed**, hinge and spring clips.
3) Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish **OR** plate, stamped steel with concealed hinge and spring clips, **as directed**.
4) Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish **OR** plate, stamped steel with concealed hinge and set screw, **as directed**.
5) Bare Piping in Unfinished Service Spaces: Split casting, cast brass with polished chrome-plated finish **OR** casting, cast brass with rough-brass finish **OR** plate, stamped steel with concealed hinge and set screw or spring clips **OR** plate, stamped steel with concealed or exposed-rivet hinge and set screw or spring clips **OR** plate, stamped steel with exposed-rivet hinge and set screw or spring clips, **as directed**.
6) Bare Piping in Equipment Rooms: Split casting, cast brass **OR** plate, stamped steel with set screw or spring clips, **as directed**.
7) Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.

J. Hanger And Support Installation
1. Comply with requirements in Division 15 Section "Hangers And Supports For Plumbing Piping And Equipment" for pipe hanger and support devices.
2. Vertical Piping: MSS Type 8 or 42, clamps.
3. Individual, Straight, Horizontal Piping Runs:
   a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel, clevis hangers.
   b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable, roller hangers.
4. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Division 15 Section "Hangers And Supports For Plumbing Piping And Equipment" for trapeze hangers.
5. Base of Vertical Piping: MSS Type 52, spring hangers.
6. Support horizontal piping within 12 inches (300 mm) of each fitting and coupling.
7. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
8. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   a. NPS 1/4 (DN 8): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
   b. NPS 3/8 and NPS 1/2 (DN 10 and DN 15): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
   c. NPS 3/4 (DN 20): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
   d. NPS 1 (DN 25): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
   e. NPS 1-1/4 (DN 32): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
   f. NPS 1-1/2 (DN 40): 10 feet (3 m) with 3/8-inch (10-mm) rod.
   g. NPS 2 (DN 50): 11 feet (3.4 m) with 3/8-inch (10-mm) rod.
   h. NPS 2-1/2 (DN 65): 13 feet (4 m) with 1/2-inch (13-mm) rod.
   i. NPS 3 (DN 80): 14 feet (4.3 m) with 1/2-inch (13-mm) rod.
   j. NPS 3-1/2 (DN 90): 15 feet (4.6 m) with 1/2-inch (13-mm) rod.
   k. NPS 4 (DN 100): 16 feet (4.9 m) with 1/2-inch (13-mm) rod.
   l. NPS 5 (DN 125): 18 feet (5.5 m) with 1/2-inch (13-mm) rod.

m. NPS 6 (DN 150): 20 feet (6 m) with 5/8-inch (16-mm) rod.
n. NPS 8 (DN 200): 23 feet (7 m) with 3/4-inch (19-mm) rod.

9. Install supports for vertical copper tubing every 10 feet (3 m).
10. Install hangers **OR** vinyl-coated hangers, **as directed**, for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
    a. NPS 1 (DN 25) and Smaller: 30 inches (760 mm) with 3/8-inch (10-mm) rod.
    b. NPS 1-1/2 to NPS 2 (DN 40 to DN 50): 36 inches (900 mm) with 3/8-inch (10-mm) rod.
    c. NPS 2-1/2 and NPS 3 (DN 65 and DN 80): 42 inches (1150 mm) with 1/2-inch (13-mm) rod.
    d. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1220 mm) with 1/2-inch (13-mm) rod.
    e. NPS 6 and NPS 8 (DN 150 and DN 200): 54 inches (1350 mm) with 5/8-inch (16-mm) rod.
11. Install supports for vertical PVC piping every 48 inches (1220 mm).

K. Labeling And Identification
1. Install identifying labels and devices for laboratory vacuum piping, valves, and specialties. Comply with requirements in Division 15 Section "Identification For Plumbing Piping And Equipment".
2. Install identifying labels and devices for medical vacuum piping systems according to NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:
    a. Medical Vacuum: Black letters on white background.
    b. WAGD: White letters on violet background.
    c. Dental Vacuum: Black boxed letters on white-and-black diagonal stripe background.
    d. HVE: Black boxed letters on white-and-black diagonal stripe background.
    e. Medical Laboratory Vacuum: Black boxed letters on white-and-black checkerboard background.

L. Field Quality Control For Laboratory Facility Nonmedical Vacuum Piping
1. Perform tests and inspections of vacuum piping in nonmedical laboratory facilities.
2. Tests and Inspections:
    a. Piping Leak Tests for Vacuum Piping: Test new and modified parts of existing piping. Cap and fill vacuum piping with oil-free, dry nitrogen. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
        1) Test Pressure for Copper Tubing: 100 psig (690 kPa) **OR** 150 psig (1035 kPa), **as directed**.
        2) Test Pressure for PVC Piping: 50 psig (345 kPa) **OR** 100 psig (690 kPa), **as directed**.
    b. Repair leaks and retest until no leaks exist.
    c. Inspect filters for proper operation.
3. Prepare test reports.

M. Field Quality Control For Healthcare Facility Medical Vacuum Piping
1. Perform tests and inspections of medical vacuum piping systems in healthcare facilities and prepare test reports.
2. Tests and Inspections:
    a. Medical Vacuum Testing Coordination: Perform tests, inspections, verifications, and certification of medical vacuum piping systems concurrently with tests, inspections, and certification of medical compressed-air piping and medical gas piping systems.
    b. Perform the following Installer tests according to requirements in NFPA 99 and ASSE Standard #6010:
        1) Initial blow down.
        2) Initial pressure test.
        3) Cross-connection test.
        4) Piping purge test.

5) Standing pressure test for vacuum systems.
6) Repair leaks and retest until no leaks exist.

c. System Verification: Comply with requirements in NFPA 99, ASSE Standard #6020, and ASSE Standard #6030 for verification of medical vacuum piping systems and perform the following tests and inspections:
1) Standing pressure test.
2) Individual-pressurization **OR** Pressure-differential, **as directed**, cross-connection test.
3) Valve test.
4) Master and area alarm tests.
5) Piping purge test.
6) Final tie-in test.
7) Operational vacuum test.
8) Verify correct labeling of equipment and components.

d. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:
1) Inspections performed.
2) Procedures, materials, and gases used.
3) Test methods used.
4) Results of tests.

3. Remove and replace components that do not pass tests and inspections and retest as specified above.

N. Demonstration
1. Train Owner's maintenance personnel to adjust, operate, and maintain medical vacuum alarm systems.

END OF SECTION 15063a

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SECTION 15063b - GAS PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for gas piping for laboratory and healthcare facilities. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. This Section includes the following:
a. Carbon dioxide piping and specialties designated "medical carbon dioxide" operating at 50 to 55 psig (345 to 380 kPa).
b. Helium piping, designated "medical helium" operating at 50 to 55 psig (345 to 380 kPa).
c. Nitrogen piping and specialties designated "medical nitrogen" operating at 160 to 185 psig (1100 to 1275 kPa) **OR** higher than 200 psig (1380 kPa), **as directed**.
d. Nitrous oxide piping and specialties designated "medical nitrous oxide" operating at 50 to 55 psig (345 to 380 kPa).
e. Oxygen piping and specialties designated "medical oxygen" operating at 50 to 55 psig (345 to 380 kPa).

C. Definitions
1. CR: Chlorosulfonated polyethylene synthetic rubber.
2. D.I.S.S.: Diameter-index safety system.
3. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
4. Medical gas piping systems include medical carbon dioxide, medical helium, medical nitrogen, medical nitrous oxide, and medical oxygen nonflammable gas for healthcare facility patient care or for healthcare laboratory applications.
5. Specialty Gas: Gas, other than medical gas, for nonmedical laboratory facility applications.

D. Performance Requirements
1. Seismic Performance: Gas manifolds, Bulk gas storage tanks, Gas manifolds and bulk gas storage tanks, and piping shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
a. 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."

E. Submittals
1. Product Data: For the following:
a. Tubes and fittings.
b. Valves and valve boxes.
c. Medical gas service connections.
d. Electrical service connections.
e. Patient service consoles.
f. Medical nitrogen pressure control panels.
g. Ceiling columns. Include integral service connections.
h. Ceiling hose assemblies. Include integral service connections.
i. Gas manifolds.
j. Bulk gas storage tanks. Include rated capacities and operating weights.
k. Medical gas alarm system components.
l. Gas cylinder storage racks.
2. Shop Drawings: Diagram power, signal, and control wiring.

3. Piping Material Certification: Signed by Installer certifying that medical gas piping materials comply with NFPA 99 requirements.
4. Brazing certificates.
5. Manufacturer Seismic Qualification Certification: Submit certification that gas manifolds and bulk gas storage tanks, accessories, and components will withstand seismic forces defined in Division 15 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment". Include the following:
   a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
6. Certificates of Shop Inspection and Data Report for Bulk Gas Storage Tanks: As required by ASME Boiler and Pressure Vessel Code.
7. Field quality-control test reports.
8. Operation and maintenance data.

F. Quality Assurance
1. Installer Qualifications:
   a. Medical Gas Piping Systems for Healthcare Facilities: Qualify installers according to ASSE Standard #6010 for installers.
2. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the medical gas piping testing indicated, that is a member of the Medical Gas Professional Healthcare Organization or is an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
   a. Qualify testing personnel according to ASSE Standard #6020 for inspectors and ASSE Standard #6030 for verifiers.
3. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications"; or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."
4. 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.
5. ASME Compliance: Fabricate and label bulk medical gas storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
6. NFPA Compliance:
   a. Comply with NFPA 50, "Bulk Oxygen Systems at Consumer Sites," for bulk oxygen storage tanks.
   b. Comply with NFPA 99, "Health Care Facilities," for medical gas piping system materials and installation.
7. CGA Compliance: Comply with CGA G-8.1, "Nitrous Oxide Systems at Consumer Sites," for bulk nitrous oxide storage tanks.
8. UL Compliance:
   a. Comply with UL 498, "Attachment Plugs and Receptacles," for electrical service connections.
   b. Comply with UL 544, "Medical and Dental Equipment," for medical gas specialties.

G. Project Conditions
1. Interruption of Existing Specialty and Medical Gas Service(s): Do not interrupt specialty or medical gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
   a. Notify Owner no fewer than two days in advance of proposed interruption of specialty and medical gas service(s).
   b. Do not proceed with interruption of specialty and medical gas service(s) without Owner's written permission.

1.2 PRODUCTS

A. Pipes, Tubes, And Fittings
1. Copper Medical Gas Tube: ASTM B 819, Type K **OR** Type L, **as directed**, seamless, drawn temper that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in green for Type K tube and blue for Type L tube.
a. General Requirements for Copper Fittings: Manufacturer cleaned, purged, and bagged for oxygen service according to CGA G-4.1.
b. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type or MSS SP-73, with dimensions for brazed joints.
c. Copper Unions: ASME B16.22 or MSS SP-123, wrought copper or cast-copper alloy.
d. Press-Type Fittings:
1) NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
2) NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
e. Memory-Metal Couplings: Cryogenic compression fitting made of ASTM F 2063, nickel-titanium, shape-memory-alloy, and that has been manufacturer cleaned, purged, and sealed for oxygen service according to CGA G-4.1.
2. PVC Pipe: ASTM D 1785, Schedule 40 and Schedule 80.
a. PVC Fittings: ASTM D 2466, Schedule 40 **OR** ASTM D 2467, Schedule 80, **as directed**; socket type.

B. Joining Materials
1. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys.
2. Threaded-Joint Tape: PTFE.
3. Solvent Cement for Joining PVC Piping: ASTM D 2564. Include primer complying with ASTM F 656.

C. Valves
1. General Requirements for Valves: Manufacturer cleaned, purged, and bagged according to CGA G-4.1 for oxygen service.
2. Ball Valves: MSS SP-110, 3-piece body, brass or bronze.
a. Pressure Rating: 300 psig (2070 kPa) minimum.
b. Ball: Full-port, chrome-plated brass.
c. Seats: PTFE or TFE.
d. Handle: Lever type with locking device, **as directed**.
e. Stem: Blowout proof with PTFE or TFE seal.
f. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.
3. Check Valves: In-line pattern, bronze.
a. Pressure Rating: 300 psig (2070 kPa) minimum.
b. Operation: Spring loaded.
c. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.
4. Zone Valves: MSS SP-110, 3-piece-body, brass or bronze ball valve with gage.
a. Pressure Rating: 300 psig (2070 kPa) minimum.
b. Ball: Full-port, chrome-plated brass.
c. Seats: PTFE or TFE.
d. Handle: Lever type with locking device, **as directed**.
e. Stem: Blowout proof with PTFE or TFE seal.
f. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.
g. Pressure Gage: Manufacturer-installed on one copper-tube extension.
5. Zone Valve Boxes: Formed steel with anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gages and in sizes required to permit manual operation of valves.
a. Interior Finish: Factory-applied white enamel.

b. Cover Plate: Aluminum or extruded-anodized aluminum **OR** Satin-chrome finish steel **OR** Stainless steel with NAAMM AMP 503, No. 4 finish, **as directed**, with frangible or removable windows.
c. Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.

OR

Zone Valve Boxes: Formed or extruded aluminum with anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gages and in sizes required to permit manual operation of valves.
a. Interior Finish: Factory-applied white enamel.
b. Cover Plate: Aluminum or extruded-anodized aluminum **OR** Stainless steel with NAAMM AMP 503, No. 4 finish, **as directed**, with frangible or removable windows.
c. Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.

6. Emergency Oxygen Connections: Low-pressure oxygen inlet assembly for connection to building oxygen piping systems.
   a. Enclosure: Weatherproof hinged locking cover with caption similar to "Emergency Low-Pressure Gaseous Oxygen Inlet."
   b. Inlet: Manufacturer-installed, NPS 1 or NPS 1-1/4 (DN 25 or DN 32), ASTM B 819, copper tubing with NPS 1 (DN 25) minimum ball valve and plugged inlet.
   c. Safety Valve: Bronze-body, pressure relief valve set at 75 or 80 psig (520 or 550 kPa).
   d. Instrumentation: Pressure gage.
7. Safety Valves: Bronze-body, ASME-construction, poppet, pressure-relief type with settings to match system requirements.
8. Pressure Regulators: Bronze **OR** Stainless-steel, **as directed**, body and trim; spring-loaded, diaphragm-operated, relieving type; manual pressure-setting adjustment; rated for 250-psig (1725-kPa) minimum inlet pressure; and capable of controlling delivered gas pressure within 0.5 psig for each 10-psig (5.0 kPa for each 100-kPa) inlet pressure.

D. Medical Gas Service Connections
1. General Requirements for Medical Gas Service Connections: For specific medical gas pressure and suction service listed. Include roughing-in assemblies, finishing assemblies, and cover plates. Individual cover plates are not required if service connection is in multiple unit or assembly with cover plate. Furnish recessed-type units made for concealed piping unless otherwise indicated.
   a. Roughing-in Assembly:
      1) Steel outlet box for recessed mounting and concealed piping.
      2) Brass-body outlet block with secondary check valve that will prevent gas flow when primary valve is removed. Suction inlets to be without secondary valve.
      3) Double seals that will prevent gas leakage.
      4) ASTM B 819, NPS 3/8 (DN 10) copper outlet tube brazed to valve with service marking and tube-end dust cap.
   b. Finishing Assembly:
      1) Brass housing with primary check valve.
      2) Double seals that will prevent gas leakage.
      3) Cover plate with gas-service label.
   c. Quick-Coupler Service Connections: Pressure outlets for carbon dioxide, nitrous xide, oxygen, and <**Insert medical gas**> service connections with noninterchangeable keyed indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment, and with positive-locking ring that retains equipment stem in valve during use.
   d. D.I.S.S. Service Connections: Pressure outlets, complying with CGA V-5, with threaded indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment.
      1) Medical Carbon Dioxide Service Connections: D.I.S.S. No. 1080.

2) Medical Helium Service Connections: D.I.S.S. No. 1060.
3) Medical Nitrogen Service Connections: D.I.S.S. No. 1120.
4) Medical Nitrous Oxide Service Connections: D.I.S.S. No. 1040.
5) Medical Oxygen Service Connections: D.I.S.S. No. 1240.

e. Cover Plates: One piece, stainless steel, with NAAMM AMP 503, No. 4 finish **OR** metal, with chrome-plated finish **OR** anodized aluminum, **as directed**, and permanent, color-coded, identifying label matching corresponding service.

E. Electrical Service Connections

1. Power Outlets: UL 498, Hospital Grade, 125-V receptacles; color selected. Include the following configurations complying with NEMA WD 1:
   a. L5-20R, locking type, 20 A, single or duplex.
   b. L5-20R, isolated ground, locking type, 20 A, single or duplex.
   c. Explosion proof, 20 A, 2 pole, 3 wire, single; suitable for Class I, Group C hazardous location and interchangeable with receptacles used in nonhazardous areas; flush mounted.
   d. 5-20R, straight blade, 20 A, duplex.
   e. 5-20R, isolated ground, straight blade, 20 A, duplex.
2. Electrical Accessory Outlets: Provide the following configured receptacles in color selected:
   a. Patient Equipment Ground Jack: Single pole, 30 A.
   b. Patient Monitoring: Single, 5 and 37 pin.
3. Wall Outlet Cover Plates: One piece, stainless steel, with NAAMM AMP 503, No. 4 finish **OR** metal, with chrome-plated finish **OR** anodized aluminum, **as directed**, and permanent identifying label.

F. Patient Service Consoles

1. General Requirements for Patient Service Consoles: Recessed- or semirecessed-mounting wall units with medical gas service connections as specified in "Medical Gas Service Connections" Article and electrical service connections as specified in "Electrical Service Connections" Article, **as directed**. Include labels indicating services, and the following:
   a. Recessed- or semirecessed-mounting steel console box or mounting bracket.
   b. Concealed supplies.
   c. Cover Plate: One piece, anodized aluminum **OR** stainless steel, **as directed**, and permanent identifying label with service connections for the following:
      1) Medical Air: Quick-coupler pressure outlet.
      2) Medical Oxygen: Quick-coupler pressure outlet.
      3) Medical Vacuum: Quick-coupler suction inlet.
      4) Medical vacuum bottle bracket.
      5) L5-20R, locking type, 20 A, single **OR** duplex, **as directed**.

G. Medical Nitrogen Pressure Control Panels

1. Description: Steel box and support brackets for recessed roughing-in with stainless-steel or anodized-aluminum cover plate with printed operating instructions. Include manifold assembly consisting of inlet supply valve, inlet supply pressure gage, line-pressure control regulator, outlet supply pressure gage, D.I.S.S. service connection, and piping outlet for remote service connection.
   a. Minimum Working Pressure: 200 psig (1380 kPa).
   b. Line-Pressure Control Regulator: Self-relieving diaphragm type with precision manual adjustment.
   c. Pressure Gages: 0- to 300-psig (0- to 2070-kPa) range.
   d. Service Connection: CGA V-5, D.I.S.S. No. 1120, nitrogen outlet.
   e. Before final assembly, provide temporary dust shield and U-tube for testing.
   f. Label cover plate "Nitrogen Pressure Control."

H. Ceiling Columns

1. General Requirements for Ceiling Columns: Ceiling-mounting units with medical gas service connections as specified in "Medical Gas Service Connections" Article and electrical service

connections as specified in "Electrical Service Connections" Article, **as directed**. Include labels indicating services, and the following:

a. Ceiling-Mounting Plate: Manufacturer's standard plate or roughing-in assembly.
b. Exposed Surfaces: Minimum 0.0375-inch- (0.95-mm-) thick stainless steel with NAAMM AMP 503, No. 4 directional polish.
c. Servicing: Include access panels or means of removing shroud.
d. Blank cover plates for cutouts not having service connections.
e. ASTM B 819, NPS 3/8 (DN 10) copper-tube extensions for connection to medical gas systems.
f. Service Connections: Type and number indicated.
g. Dust Covers: For medical gas service connection.

2. Rigid Ceiling Columns: 44-inch- (1120-mm-) long, rectangular fixed column section with 2 **OR** 4, **as directed**, double intravenous medication hooks. Include 0.078-inch- (2.0-mm-) thick, stainless-steel bottom plate with the following service connections:
   a. Instrument Air: One D.I.S.S. No. 1160 pressure outlet(s).
   b. Medical Air: One quick-coupler **OR** D.I.S.S. No. 1160, **as directed**, pressure outlet(s).
   c. Medical Carbon Dioxide: One quick-coupler **OR** D.I.S.S. No. 1080, **as directed**, pressure outlet(s).
   d. Medical Helium: One D.I.S.S. No. 1060, pressure outlet(s).
   e. Medical Nitrogen: One D.I.S.S. No. 1120 pressure outlet(s).
   f. Medical Nitrous Oxide: One quick-coupler **OR** D.I.S.S. No. 1040, **as directed**, pressure outlet(s).
   g. Medical Oxygen: Two quick-coupler **OR** D.I.S.S. No. 1240, **as directed**, pressure outlets.
   h. Medical Vacuum: Two quick-coupler **OR** D.I.S.S. No. 1220, **as directed**, suction inlets.
   i. Vacuum Bottle Brackets: Two.
   j. WAGD Evacuation: One quick-coupler **OR** D.I.S.S. No. 2220, **as directed**, suction inlet(s).
   k. Power: 2 **OR** 4, **as directed**, L5-20R, locking-type, 20-A, single receptacles.
   l. Patient Equipment: 2 **OR** 4, **as directed**, ground-jack, single-pole, 30-A receptacles.
3. Retractable Ceiling Columns: Manually adjustable using release and lock handles capable of locking column in all positions from fully retracted to fully extended; 15-inch- (380-mm-) long, rectangular counterbalanced telescoping section with 2 **OR** 4, **as directed**, double intravenous medication hooks; and 36-inch- (915-mm-) long, fixed column section. Include 0.078-inch- (2.0-mm-) thick, stainless-steel bottom plate with the following service connections:
   a. Instrument Air: One D.I.S.S. No. 1160 pressure outlet(s).
   b. Medical Air: One quick-coupler **OR** D.I.S.S. No. 1160, **as directed**, pressure outlet(s).
   c. Medical Carbon Dioxide: One quick-coupler **OR** D.I.S.S. No. 1080, **as directed**, pressure outlet(s).
   d. Medical Helium: One D.I.S.S. No. 1060, pressure outlet(s).
   e. Medical Nitrogen: One D.I.S.S. No. 1120 pressure outlet(s).
   f. Medical Nitrous Oxide: One quick-coupler **OR** D.I.S.S. No. 1040, **as directed**, pressure outlet(s).
   g. Medical Oxygen: Two quick-coupler **OR** D.I.S.S. No. 1240, **as directed**, pressure outlets.
   h. Medical Vacuum: Two quick-coupler **OR** D.I.S.S. No. 1220, **as directed**, suction inlets.
   i. Vacuum Bottle Brackets: Two.
   j. WAGD Evacuation: One quick-coupler **OR** D.I.S.S. No. 2220, **as directed**, suction inlet(s).
   k. Power: 2 **OR** 4, **as directed**, L5-20R, locking-type, 20-A, single receptacles.
   l. Patient Equipment: 2 **OR** 4, **as directed**, ground-jack, single-pole, 30-A receptacles.

I. Ceiling Hose Assemblies
1. Ceiling Hose Assemblies, General: Ceiling-mounting units with medical gas service connections as specified in "Medical Gas Service Connections" Article and electrical service connections as specified in "Electrical Service Connections" Article, **as directed**. Include labels indicating services, and the following:
   a. Ceiling-Mounting Plate: Manufacturer's standard plate or roughing-in assembly.

b. Exposed Surfaces: Minimum 0.0375-inch- (0.95-mm-) thick stainless steel with NAAMM AMP 503, No. 4 directional polish.
c. Servicing: Include access panels or means of removing shroud.
d. Blank cover plates for cutouts not having service connections.
e. ASTM B 819, NPS 3/8 (DN 10) copper-tube extensions for connection to medical gas systems.
f. Service Connections: Type and number indicated.
g. Dust Covers: For medical gas service connection.

2. Hose-Reel Service Assemblies: Individual, concealed, retractable hose-reel units with stainless-steel face plates, steel mounting boxes, factory- or field-fabricated mounting brackets, and color-coded service hoses with adjustable stops and service connections matching hoses. Include 15 feet (4.5 m) minimum of conductive, CR, 1/4- or 5/16-inch- (6.4- or 7.9-mm-) ID, medical gas hoses rated for 200-psig (1380-kPa) minimum working pressure, and the following service connections:
   a. Instrument Air Hose: D.I.S.S. No. 1160 pressure outlet.
   b. Medical Air Hose: Quick-coupler **OR** D.I.S.S. No. 1160, **as directed**, pressure outlet.
   c. Medical Carbon Dioxide Hose: Quick-coupler **OR** D.I.S.S. No. 1080, **as directed**, pressure outlet.
   d. Medical Nitrogen Hose: D.I.S.S. No. 1120 pressure outlet.
   e. Medical Nitrous Oxide Hose: Quick-coupler **OR** D.I.S.S. No. 1040, **as directed**, pressure outlet.
   f. Medical Oxygen Hose: Quick-coupler **OR** D.I.S.S. No. 1240, **as directed**, pressure outlet.
   g. Medical Vacuum Hose: Quick-coupler **OR** D.I.S.S. No. 1220, **as directed**, suction inlet.
   h. WAGD Evacuation Hose: Quick-coupler **OR** D.I.S.S. No. 2220, **as directed**, suction inlet.
   i. Power: L5-20R, locking-type, 20-A, single, power receptacle.
3. Fixed Hose Service Assemblies: Individual, concealed hose connection with stainless-steel face plates, steel mounting boxes, factory- or field-fabricated mounting brackets, and color-coded service hoses with retractor device and service connections matching hoses. Include 72 inches (1830 mm) of conductive, CR, 1/4- or 5/16-inch- (6.4- or 7.9-mm-), ID, medical gas hoses rated for 200-psig (1380-kPa) minimum working pressure, and the following service hose connections:
   a. Instrument Air Hose: D.I.S.S. No. 1160 pressure outlet.
   b. Medical Air Hose: Quick-coupler **OR** D.I.S.S. No. 1160, **as directed**, pressure outlet.
   c. Medical Carbon Dioxide Hose: Quick-coupler **OR** D.I.S.S. No. 1080, **as directed**, pressure outlet.
   d. Medical Nitrogen Hose: D.I.S.S. No. 1120 pressure outlet.
   e. Medical Nitrous Oxide Hose: Quick-coupler **OR** D.I.S.S. No. 1040, **as directed**, pressure outlet.
   f. Medical Oxygen Hose: Quick-coupler **OR** D.I.S.S. No. 1240, **as directed**, pressure outlet.
   g. Medical Vacuum Hose: Quick-coupler **OR** D.I.S.S. No. 1220, **as directed**, suction inlet.
   h. WAGD Evacuation Hose: Quick-coupler **OR** D.I.S.S. No. 2220, **as directed**, suction inlet.
   i. Power: L5-20R, locking-type, 20-A, single, power receptacle.

J. Gas Manifolds
1. Simplex Specialty Gas Manifolds:
   a. Control Panel Unit: Weatherproof cabinet, supply and delivery pressure gages, electrical alarm system connections and transformer, indicator lights or devices, manifold connection, line-pressure regulator, shutoff valves, and safety valve.
   b. Manifold and Header: Nonferrous-metal header for number of cylinders indicated. Units include design for 2000-psig (13.8-MPa) minimum inlet pressure. Include cylinder bank header with inlet (pigtail) connections complying with CGA V-1, individual inlet check valves, shutoff valve, pressure regulator, check valve, and pressure gage.
   c. <**Insert specialty gas**> Manifold: For <**Insert number cylinders**> capacity at 55-psig (380-kPa) line pressure, with electric heater or orifice design that will prevent freezing during high demand.
   d. Specialty Gas Cylinders: Will be furnished by Owner **OR** Number and type of medical gas cylinders required for complete manifold systems, **as directed**.

e. Label manifold control unit with permanent label identifying specialty gas type and system operating pressure.
f. Mounting: Wall with mounting brackets for manifold control cabinet and header **OR** Floor with support legs for manifold control cabinet, **as directed**.

2. Duplex Specialty Gas Manifolds:
   a. Central Control Panel Unit: Weatherproof cabinet, supply and delivery pressure gages, electrical alarm system connections and transformer, indicator lights or devices, manifold connection, line-pressure regulator, shutoff valves, and safety valve.
   b. Manifold and Headers: Duplex, nonferrous-metal header for number of cylinders indicated, divided into two equal banks. Units include design for 2000-psig (13.8-MPa) minimum inlet pressure. Include cylinder bank headers with inlet (pigtail) connections complying with CGA V-1, individual inlet check valves, shutoff valve, pressure regulator, check valve, and pressure gage.
   c. Operation: Automatic, pressure-switch-activated changeover from one cylinder bank to the other when first bank becomes exhausted, without line-pressure fluctuation or resetting of regulators and without supply interruption by shutoff of either cylinder bank header.
   d. <**Insert specialty gas**> Manifold: For <**Insert number cylinders**> capacity at 55-psig (380-kPa) line pressure, with electric heater or orifice design that will prevent freezing during high demand.
   e. Specialty Gas Cylinders: Will be furnished by Owner **OR** Number and type of medical gas cylinders required for complete manifold systems, **as directed**.
   f. Label manifold control unit with permanent label identifying specialty gas type and system operating pressure.
   g. Mounting: Wall with mounting brackets for manifold control cabinet and headers **OR** Floor with support legs for manifold control cabinet, **as directed**.
3. Medical Gas Manifolds: Comply with NFPA 99, Ch. 5, for high-pressure medical gas cylinders.
   a. Central Control Panel Unit: Weatherproof cabinet, supply and delivery pressure gages, electrical alarm system connections and transformer, indicator lights or devices, manifold connection, pressure changeover switch, line-pressure regulator, shutoff valves, and safety valve.
   b. Manifold and Headers: Duplex, nonferrous-metal header for number of cylinders indicated, divided into two equal banks. Units include design for 2000-psig (13.8-MPa) minimum inlet pressure, except nitrous oxide manifolds may be designed for 800 psig (5520 kPa) and carbon dioxide manifolds may be designed for 1500 psig (10.35 MPa). Include cylinder bank headers with inlet (pigtail) connections complying with CGA V-1, individual inlet check valves, shutoff valve, pressure regulator, check valve, and pressure gage.
   c. Operation: Automatic, pressure-switch-activated changeover from one cylinder bank to the other when first bank becomes exhausted, without line-pressure fluctuation or resetting of regulators and without supply interruption by shutoff of either cylinder bank header.
   d. Medical Carbon Dioxide Manifolds: For 2 cylinders and 250-cfh (1.97-L/s) **OR** 4 cylinders and 500-cfh (3.94-L/s), **as directed**, capacity at 55-psig (380-kPa) line pressure.
   e. Medical Helium Manifolds: For 2 cylinders and 250-cfh (1.97-L/s) **OR** 4 cylinders and 500-cfh (3.94-L/s), **as directed**, capacity at 55-psig (380-kPa) line pressure.
   f. Medical Nitrous Oxide Manifolds: For 8 cylinders and 1333-cfh (10.5-L/s) **OR** 12 cylinders and 2000-cfh (15.7-L/s), **as directed**, capacity at 55-psig (380-kPa) line pressure, with electric heater or orifice design that will prevent freezing during high demand.
   g. Medical Nitrogen Manifolds: For 8 cylinders and 2000-cfh (15.7-L/s) **OR** 12 cylinders and 3000-cfh (23.6-L/s), **as directed**, capacity at 180-psig (1240-kPa) **OR** higher than 200-psig (1380-kPa), **as directed**, line pressure.
   h. Medical Oxygen Manifolds: For 12 cylinders and 1500-cfh (11.8-L/s) **OR** 20 cylinders 2500-cfh (19.7-L/s), **as directed**, capacity at 55-psig (380-kPa), **as directed**, line pressure.
   i. Medical Gas Cylinders: Will be furnished by Owner **OR** Number and type of medical gas cylinders required for complete manifold systems, **as directed**.
   j. Label manifold control unit with permanent label identifying medical gas type and system operating pressure.

k. Mounting: Wall with mounting brackets for manifold control cabinet and headers **OR** Floor with support legs for manifold control cabinet, **as directed**.

K. Bulk Gas Storage Tanks
1. Bulk Specialty Gas Storage Tanks:
2. Bulk Medical Gas Storage Tanks:
   a. Bulk Medical Gas Storage Tank Systems: Bulk storage tank with connections for alarm system, continuous supply, and reserve supply that will operate only during emergencies, complying with NFPA 99, "Health Care Facilities."
   b. Controls: Include actuating switch for alarm system connection and means for automatic actuating of reserve supply.
   c. Bulk Medical Gas Storage Tanks: Vertical mounting, double-wall construction with inner vessel fabricated according to ASME Boiler and Pressure Vessel Code for unfired pressure vessels and suitable for medical gas service. Include insulation and vacuum seal between walls. Fabricate outer shell from carbon steel with factory-applied manufacturer's standard protective paint finish suitable for exterior installation. Include the following features, specialties, and components:
      1) Safety Valves: ASME construction with pressure setting to correspond to tank working pressure and as required for component or system being protected.
      2) Pressure Gages: For tank pressure and facility service line pressure.
      3) Contents Gage: High- and low-level indicator with electric signal circuit connection.
      4) Drain Valves: For piping, inner vessel, and outer shell.
      5) Fill Assembly: Fill connection, piping, valves, relief devices, and controls.
      6) Facility Service Assembly: Piping, valves, relief devices, vaporizer, shutoff valve, pressure regulator, line shutoff valve or check valve, and reserve supply connection for connection to building service piping.
      7) Include permanent label showing medical gas type, storage tank capacity, tank pressure rating, vaporizer capacity, and operating instructions.
      8) Liquid Oxygen Storage Tank: Nickel-steel or stainless-steel inner vessel with 250-psig (1725-kPa) minimum working pressure. Include electric **OR** steam **OR** ambient vaporizer, **as directed**.
      9) Liquid Nitrous Oxide Storage Tank: Steel-alloy inner vessel with 300-psig (2070-kPa) minimum working pressure. Include electric **OR** steam, **as directed**, vaporizer.
   d. Oxygen Reserve Supply: Manifold header for high-pressure cylinders, fabricated from copper-tube or brass pipe and fittings and suitable for pressures up to 4000 psig (27.6 MPa). Include header inlet connections complying with CGA V-1, with individual inlet check valves, header shutoff valve, header pressure regulator, line shutoff valve or check valve, pressure gage, and inlet connections for number of cylinders indicated.
   e. Nitrous Oxide Reserve Supply: Manifold header for high-pressure cylinders, fabricated from copper-tube or brass pipe and fittings and suitable for pressures up to 4000 psig (27.6 MPa). Include header inlet connections complying with CGA V-1, with individual inlet check valves, header shutoff valve, header pressure regulator, line shutoff valve or check valve, pressure gage, inlet connections for number of cylinders indicated, and electric heater.

L. Medical Gas Piping Alarm Systems
1. Panels for medical gas piping systems may be combined in single panels with medical compressed-air and medical vacuum piping systems.
2. Components: Designed for continuous service and to operate on power supplied from 120 **OR** 240 **OR** 277, **as directed**,-V ac power source to alarm panels and with connections for low-voltage wiring to remote sensing devices. Include step-down transformers if required.
3. Pressure Switches or Pressure Transducer Sensors: Continuous line monitoring with electrical connections for alarm system.
   a. Low-Pressure Operating Range: 0- to 100-psig (0- to 690-kPa).
   b. High-Pressure Operating Range: Up to 250-psig (1725-kPa).

4. General Requirements for Medical Gas Alarm Panels: Factory wired with audible and color-coded visible signals to indicate specified functions.
   a. Mounting: Exposed, surface **OR** Recessed, **as directed**, installation.
   b. Enclosures: Fabricated from minimum 0.047-inch- (1.2-mm-) thick steel or minimum 0.05-inch- (1.27-mm-) thick aluminum, with knockouts for electrical and piping connections.
5. Master Alarm Panels: With separate trouble alarm signals, pressure gages, and indicators for medical gas piping systems.
   a. Include alarm signals when the following conditions exist:
      1) Medical Carbon Dioxide: Pressure drops below 40 psig (275 kPa) or rises above 60 psig (415 kPa) and changeover is made to alternate bank.
      2) Medical Helium: Pressure drops below 40 psig (275 kPa) or rises above 60 psig (415 kPa) and changeover is made to alternate bank.
      3) Medical Nitrogen: Pressure drops below 145 psig (1000 kPa) or rises above 200 psig (1380 kPa) and changeover is made to alternate bank.
      4) Medical Nitrous Oxide (for bulk oxygen storage tank system with cylinder reserve): Liquid level is low, pressure downstream from main shutoff valve drops below 40 psig (275 kPa) or rises above 60 psig (415 kPa), changeover is made to reserve, reserve is in use, and reserve level is low.
      5) Medical Nitrous Oxide (for nitrous oxide manifold system): Pressure drops below 40 psig (275 kPa) or rises above 60 psig (415 kPa) and changeover is made to alternate bank.
      6) Medical Oxygen (for bulk oxygen storage tank system with cylinder reserve): Liquid level is low, pressure downstream from main shutoff valve drops below 40 psig (275 kPa) or rises above 60 psig (415 kPa), changeover is made to reserve, reserve is in use, reserve level is low, and reserve pressure is low.
      7) Medical Oxygen (for oxygen manifold system): Pressure downstream from main shutoff valve drops below 40 psig (275 kPa) or rises above 60 psig (415 kPa) and changeover is made to alternate bank.
6. Anesthetizing-Area Alarm Panels: Separate trouble alarm signals; pressure gages; and indicators for medical gas piping systems.
   a. Include alarm signals when the following conditions exist:
      1) Medical Carbon Dioxide: Pressure drops below 40 psig (275 kPa) or rises above 60 psig (415 kPa).
      2) Medical Helium: Pressure drops below 40 psig (275 kPa) or rises above 60 psig (415 kPa).
      3) Medical Nitrous Oxide: Pressure drops below 40 psig (275 kPa) or rises above 60 psig (415 kPa).
      4) Medical Nitrogen: Pressure drops below 145 psig (1000 kPa) or rises above 200 psig (1380 kPa).
      5) Medical Oxygen: Pressure drops below 40 psig (275 kPa) or rises above 60 psig (415 kPa).
7. Area Alarm Panels: Separate trouble alarm signals; pressure and vacuum gages; and indicators for medical gas piping systems.
   a. Include alarm signals when the following conditions exist:
      1) Oxygen: Pressure drops below 40 psig (275 kPa) or rises above 60 psig (415 kPa).
8. Dental Area Alarm Panels: Separate trouble alarm signals; pressure and vacuum gages; and indicators for medical gas piping systems.
   a. Include alarm signals when the following conditions exist:
      1) Medical Nitrogen: Pressure drops below 145 psig (1000 kPa) or rises above 200 psig (1380 kPa) and changeover is made to alternate bank.
      2) Medical Nitrous Oxide (for bulk nitrous oxide storage tank system with cylinder reserve): Liquid level is low, pressure downstream from main shutoff valve drops below 40 psig (275 kPa) or rises above 60 psig (415 kPa), changeover is made to reserve, reserve is in use, and reserve level is low.

3) Medical Nitrous Oxide (for nitrous oxide manifold system): Pressure drops below 40 psig (275 kPa) or rises above 60 psig (415 kPa) and changeover is made to alternate bank.
4) Medical Oxygen (for bulk oxygen storage tank system with cylinder reserve): Liquid level is low, pressure downstream from main shutoff valve drops below 40 psig (275 kPa) or rises above 60 psig (415 kPa), changeover is made to reserve, reserve is in use, reserve level is low, and reserve pressure is low.
5) Medical Oxygen (for nitrous oxide manifold system): Pressure downstream from main shutoff valve drops below 40 psig (275 kPa) or rises above 60 psig (415 kPa) and changeover is made to alternate bank.

9. Medical Laboratory Area Alarm Panels: Separate trouble alarm signals; pressure and vacuum gages; and indicators for medical gas piping systems.
   a. Include alarm signals when the following conditions exist:
      1) Medical Carbon Dioxide: Pressure drops below 40 psig (275 kPa) or rises above 60 psig (415 kPa).
      2) Medical Helium: Pressure drops below 40 psig (275 kPa) or rises above 60 psig (415 kPa).
      3) Medical Oxygen: Pressure drops below 40 psig (275 kPa) or rises above 60 psig (415 kPa).

M. Computer Interface Cabinet
1. Description: Wall-mounting, welded-steel, control cabinet with gasketed door, mounting brackets, grounding device, and white-enamel finish for connection of medical gas system alarms to facility computer. Include factory-installed signal circuit boards, power transformer, circuit breaker, wiring terminal board, and internal wiring capable of interfacing 20, **as directed**, alarm signals.

N. Gas Cylinder Storage Racks
1. Wall Storage Racks: Fabricate racks with chain restraints for upright cylinders as indicated or provide equivalent manufactured wall racks.
2. Freestanding Storage Racks: Fabricate racks as indicated or provide equivalent manufactured storage racks.

O. Sleeves
1. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
2. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
   a. Underdeck Clamp: Clamping ring with set screws.

P. Escutcheons
1. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to closely fit around pipe and tube and OD that completely covers opening.
2. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with polished chrome-plated finish.
3. One-Piece, Cast-Brass Escutcheons: With set screw.
   a. Finish: Polished chrome-plated **OR** Rough brass, **as directed**.
4. Split-Casting, Cast-Brass Escutcheons: With concealed hinge and set screw.
   a. Finish: Polished chrome-plated **OR** Rough brass, **as directed**.
5. One-Piece, Stamped-Steel Escutcheons: With set screw **OR** spring clips, **as directed**, and chrome-plated finish.
6. Split-Plate, Stamped-Steel Escutcheons: With concealed **OR** exposed-rivet, **as directed**, hinge, set screw **OR** spring clips, **as directed**, and chrome-plated finish.
7. One-Piece, Floor-Plate Escutcheons: Cast iron.
8. Split-Casting, Floor-Plate Escutcheons: Cast brass with concealed hinge and set screw.

Q. Grout

1. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   a. Characteristics: Post-hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
   b. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
   c. Packaging: Premixed and factory packaged.

R. Nitrogen
1. Description: Comply with USP 28 - NF 23 for oil-free dry nitrogen.

1.3 EXECUTION

A. Earthwork
1. Comply with requirements in Division 02 Section "Earthwork" for excavating, trenching, and backfilling and for underground warning tapes.

B. Piping Applications
1. Nonhealthcare, Specialty Gas Piping: Type L, copper medical gas tube; wrought-copper fittings; and brazed **OR** press-type fittings and pressure-sealed, **as directed**, joints.
2. Nonhealthcare, Specialty Gas Piping NPS 2-1/2 (DN 65) and Smaller: Type K **OR** Type L, **as directed**, copper medical gas tube; wrought-copper fittings; and brazed **OR** press-type fittings and pressure-sealed, **as directed**, joints.
3. Nonhealthcare, Specialty Gas Piping NPS 3 (DN 80) and Larger: Type K, copper tube; wrought-copper fittings; and brazed **OR** press-type fittings and pressure-sealed, **as directed**, joints.
4. Medical Gas Piping: Use Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.
5. Medical Gas Piping Except Nitrogen: Use Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.
6. Medical Nitrogen Piping: Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.
7. Medical Nitrogen Piping NPS 2-1/2 (DN 65) and Smaller: Type K **OR** Type L, **as directed**, copper medical gas tube; wrought-copper fittings; and brazed joints.
8. Medical Nitrogen Piping NPS 3 (DN 80) and Larger: Type K, copper tube; wrought-copper fittings; and brazed joints.
9. Protective Conduit: Use PVC pipe, PVC fittings, and solvent-cemented joints.

C. Piping Installation
1. Drawing plans, schematics, and diagrams indicate general location and arrangement of gas piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
2. Comply with ASSE Standard #6010 for installation of medical gas piping.
3. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
4. 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.
5. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.
6. Install piping adjacent to equipment and specialties to allow service and maintenance.
7. Install nipples, unions, and special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications below unless otherwise indicated.
8. Install piping to permit valve servicing.
9. Install piping free of sags and bends.
10. Install fittings for changes in direction and branch connections.

11. Install medical gas piping to medical gas service connections specified in this Section, to medical gas service connections in equipment specified in this Section, and to equipment specified in other Sections requiring medical gas service.
12. Install exterior, buried medical gas piping in protective conduit fabricated with PVC pipe and fittings. Do not extend conduit through foundation wall.
13. Install seismic restraints on gas piping. Seismic-restraint devices are specified in Division 15 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment".
14. Install medical gas service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.
15. Connect gas piping to gas sources and to gas outlets and equipment requiring gas service.
16. Install unions, in copper tubing adjacent to each valve and at final connection to each piece of equipment and specialty.

D. Valve Installation
1. Install shutoff valve at each connection to gas laboratory and healthcare equipment and specialties.
2. Install check valves to maintain correct direction of gas flow from laboratory and healthcare gas supplies.
3. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.
4. Install zone valves and gages in valve boxes. Rotate valves to angle that prevents closure of cover when valve is in closed position.
5. Install pressure regulators on gas piping where reduced pressure is required.
6. Install emergency oxygen connection with pressure relief valve and full-size discharge piping to outside, with check valve downstream from pressure relief valve and with ball valve and check valve in supply main from bulk oxygen storage tank.

E. Joint Construction
1. Ream ends of PVC pipes and remove burrs.
2. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.
3. Threaded Joints: Apply appropriate tape to external pipe threads.
4. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter. Continuously purge joint with oil-free, dry nitrogen during brazing.
5. Pressure-Sealed Joints: Join copper tube and press-type fittings with tools recommended by fitting manufacturer.
6. Memory-Metal Coupling Joints: Join new copper tube to existing tube according to procedures developed by fitting manufacturer for installation of memory-metal coupling joints.
7. Solvent-Cemented Joints: Clean and dry joining surfaces. Join PVC pipe and fittings according to the following:
   a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   b. Apply primer and join according to ASME B31.9 for solvent-cemented joints and to ASTM D 2672.

F. Gas Service Component Installation
1. Assemble patient service console with service connections. Install with supplies concealed, in walls. Attach console box or mounting bracket to substrate.
2. Install nitrogen pressure-control panels in walls. Attach to substrate.
3. Assemble ceiling columns and install anchored to substrate. Provide structural steel, hanger rods, anchors, and fasteners in addition to components furnished with specialties necessary to fabricate supports.
4. Assemble ceiling assemblies and install anchored to substrate. Provide structural steel, hanger rods, anchors, and fasteners in addition to components furnished with specialties necessary to fabricate supports.
5. Install gas manifolds on concrete base, **as directed**, anchored to substrate.
6. Install gas cylinders and connect to manifold piping.

7. Install gas manifolds with seismic restraints as indicated.
8. Install bulk gas storage tanks and reserve supply tanks level on concrete bases. Set tanks and connect gas piping to tanks according to applicable requirements in NFPA 50 for bulk oxygen storage systems, **as directed**. Install tanks level and plumb, firmly anchored to concrete bases; maintain NFPA 50 and tank manufacturer's recommended clearances. Orient tanks so controls and devices are accessible for servicing.
9. Install bulk gas storage tanks and reserve supply tanks with seismic restraints.

G. Medical Gas Piping Alarm System Installation
1. Install medical gas alarm system components in locations required by and according to NFPA 99.
2. Install medical gas area and master alarm panels where indicated.
3. Install computer interface cabinet with connection to medical gas piping alarm system and facility computer.

H. Sleeve Installation
1. Sleeves are not required for core-drilled holes.
2. Permanent sleeves are not required for holes formed by removable PE sleeves.
3. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs using galvanized-steel pipe **OR** galvanized-steel sheet **OR** stack sleeve fittings **OR** PVC pipe, **as directed**.
   a. Wall Penetrations: Cut sleeves to length for mounting flush with both surfaces.
   b. Floor Penetrations: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

   OR

   Install sleeves in new walls and slabs as new walls and slabs are constructed.
4. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
   a. PVC **OR** Steel, **as directed**, 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 (50 mm) above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing And Trim" for flashing.
      1) Seal space outside of sleeve fittings with grout.
5. 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 "Through-penetration Firestop Systems".

I. Escutcheon Installation
1. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
   a. 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 **OR** stamped steel with set screw **OR** stamped steel with set screw or spring clips **OR** stamped steel with spring clips, **as directed**.
      3) Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish **OR** One piece or split casting, cast brass with polished chrome-plated finish **OR** Split casting, cast brass with polished chrome-plated finish **OR** One piece, stamped steel with set screw **OR** One piece or split plate, stamped steel with set screw **OR** Split plate, stamped steel with set screw, **as directed**.

4) Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish **OR** cast brass with rough-brass finish **OR** stamped steel with set screw **OR** stamped steel with spring clips **OR** stamped steel with set screw or spring clips, **as directed**.
5) Bare Piping in Equipment Rooms: One piece, cast brass **OR** stamped steel with set screw **OR** stamped steel with spring clips **OR** stamped steel with set screw or spring clips, **as directed**.
6) Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

b. Existing Piping:
1) Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.
2) Insulated Piping: Split plate, stamped steel with concealed **OR** exposed-rivet, **as directed**, hinge and spring clips.
3) Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish **OR** plate, stamped steel with concealed hinge and spring clips, **as directed**.
4) Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish **OR** plate, stamped steel with concealed hinge and set screw, **as directed**.
5) Bare Piping in Unfinished Service Spaces: Split casting, cast brass with polished chrome-plated finish **OR** casting, cast brass with rough-brass finish **OR** plate, stamped steel with concealed hinge and set screw or spring clips **OR** plate, stamped steel with concealed or exposed-rivet hinge and set screw or spring clips **OR** plate, stamped steel with exposed-rivet hinge and set screw or spring clips, **as directed**.
6) Bare Piping in Equipment Rooms: Split casting, cast brass **OR** plate, stamped steel with set screw or spring clips, **as directed**.
7) Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.

J. Hanger And Support Installation
1. Comply with requirements in Division 15 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment" for seismic-restraint devices.
2. Comply with requirements in Division 15 Section "Hangers And Supports For Plumbing Piping And Equipment" for pipe hanger and support devices.
3. Vertical Piping: MSS Type 8 or 42, clamps.
4. Individual, Straight, Horizontal Piping Runs:
a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel, clevis hangers.
b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable, roller hangers.
5. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Division 15 Section "Hangers And Supports For Plumbing Piping And Equipment" for trapeze hangers.
6. Base of Vertical Piping: MSS Type 52, spring hangers.
7. Support horizontal piping within 12 inches (300 mm) of each fitting and coupling.
8. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
9. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
a. NPS 1/4 (DN 8): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
b. NPS 3/8 and NPS 1/2 (DN 10 and DN 15): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
c. NPS 3/4 (DN 20): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
d. NPS 1 (DN 25): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
e. NPS 1-1/4 (DN 32): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
f. NPS 1-1/2 (DN 40): 10 feet (3 m) with 3/8-inch (10-mm) rod.
g. NPS 2 (DN 50): 11 feet (3.4 m) with 3/8-inch (10-mm) rod.
h. NPS 2-1/2 (DN 65): 13 feet (4 m) with 1/2-inch (13-mm) rod.
i. NPS 3 (DN 80): 14 feet (4.3 m) with 1/2-inch (13-mm) rod.
j. NPS 3-1/2 (DN 90): 15 feet (4.6 m) with 1/2-inch (13-mm) rod.

k. NPS 4 (DN 100): 16 feet (4.9 m) with 1/2-inch (13-mm) rod.
l. NPS 5 (DN 125): 18 feet (5.5 m) with 1/2-inch (13-mm) rod.
m. NPS 6 (DN 150): 20 feet (6 m) with 5/8-inch (16-mm) rod.
n. NPS 8 (DN 200): 23 feet (7 m) with 3/4-inch (19-mm) rod.

10. Install supports for vertical copper tubing every 10 feet (3 m).

K. Labeling And Identification

1. Install identifying labels and devices for specialty gas piping, valves, and specialties. Comply with requirements in Division 15 Section "Identification For Plumbing Piping And Equipment".
2. Install identifying labels and devices for healthcare medical gas piping systems according to NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:
   a. Carbon Dioxide: Black or white letters on gray background.
   b. Helium: White letters on brown background.
   c. Nitrogen: White letters on black background.
   d. Nitrous Oxide: White letters on blue background.
   e. Oxygen: White letters on green background or green letters on white background.

L. Field Quality Control For Laboratory Facility Specialty Gas

1. Perform field tests and inspections of specialty gas piping for nonhealthcare laboratory facilities and prepare test reports.
2. Tests and Inspections:
   a. Piping Leak Tests for Specialty Gas Piping: Test new and modified parts of existing piping. Cap and fill specialty gas piping with oil-free, dry nitrogen to pressure of 50 psig (345 kPa) above system operating pressure, but not less than 150 psig (1035 kPa). Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
   b. Repair leaks and retest until no leaks exist.
   c. Inspect specialty gas regulators for proper operation.

M. Field Quality Control For Healthcare Facility Medical Gas

1. Perform tests and inspections of medical gas piping systems in healthcare facilities and prepare test reports.
2. Tests and Inspections:
   a. Medical Gas Piping Testing Coordination: Perform tests, inspections, verifications, and certification of medical gas piping systems concurrently with tests, inspections, and certification of medical compressed-air piping and medical vacuum piping systems.
   b. Preparation: Perform the following Installer tests according to requirements in NFPA 99 and ASSE Standard #6010:
      1) Initial blow down.
      2) Initial pressure test.
      3) Cross-connection test.
      4) Piping purge test.
      5) Standing pressure test for positive pressure medical gas piping.
      6) Standing pressure test for vacuum systems.
      7) Repair leaks and retest until no leaks exist.
   c. System Verification: Comply with requirements in NFPA 99, ASSE Standard #6020, and ASSE Standard #6030 for verification of medical gas piping systems and perform the following tests and inspections:
      1) Standing pressure test.
      2) Individual-pressurization **OR** Pressure-differential, **as directed**, cross-connection test.
      3) Valve test.
      4) Master and area alarm tests.
      5) Piping purge test.

6) Piping particulate test.
7) Piping purity test.
8) Final tie-in test.
9) Operational pressure test.
10) Medical gas concentration test.
11) Medical air purity test.
12) Verify correct labeling of equipment and components.
13) Verify the following source equipment:
    a) Medical gas supply sources.

d. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:
    1) Inspections performed.
    2) Procedures, materials, and gases used.
    3) Test methods used.
    4) Results of tests.

3. Remove and replace components that do not pass tests and inspections and retest as specified above.

END OF SECTION 15063b

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Task	Specification	Specification Description
15063	02441a	Common Work Results for Fire Suppression
15063	02441b	Common Work Results for Plumbing
15063	02441c	Common Work Results for HVAC
15063	15061	Domestic Water Piping
15063	15061a	Sanitary Waste And Vent Piping
15063	15061b	Storm Drainage Piping
15063	15061c	Hydronic Piping
15063	15061e	Refrigerant Piping
15063	15061g	General-Service Compressed-Air Piping

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SECTION 15064 - RADIANT HEATING PIPING

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for radiant heating piping. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. This Section includes radiant heating piping, including pipes, fittings, and piping specialties.

C. Definitions
1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. PEX: Crosslinked polyethylene.
3. PEX/AL/PEX: Crosslinked polyethylene/aluminum/crosslinked polyethylene.

D. Submittals
1. Product Data: For each type of radiant heating pipe, fitting, manifold, specialty, and control.
   a. For radiant heating piping and manifolds, include pressure and temperature rating, oxygen-barrier performance, fire-performance characteristics, and water flow and pressure drop characteristics.
2. Shop Drawings: Show piping layout and details drawn to scale, including valves, manifolds, controls, and support assemblies, and their attachments to building structure.
3. Operation and Maintenance Data.

1.2 PRODUCTS

A. PEX Pipe And Fittings
1. Pipe Material: PEX plastic according to ASTM F 876.
2. Oxygen Barrier: Limit oxygen diffusion through the tube to maximum 0.10 mg per cu. m/day at 104 deg F (40 deg C) according to DIN 4726.
3. Fittings: ASTM F 1807, metal insert and copper crimp rings.
4. Pressure/Temperature Rating: Minimum 100 psig (690 kPa) and 180 deg F (82 deg C).

B. PEX/AL/PEX Pipe And Fittings
1. Pipe Material: PEX plastic bonded to the inside and outside of a welded aluminum tube according to ASTM F 1281.
2. Oxygen Barrier: Limit oxygen diffusion through the pipe to maximum 0.10 mg per cu. m/day at 104 deg F (40 deg C) according to DIN 4726.
3. Fittings: ASTM F 1974, metal insert fittings with split ring and compression nut (compression joint) or metal insert fittings with copper crimp rings (crimp joint).
4. Flame-Spread and Smoke-Developed Indexes: 25 and 50 or less, respectively, tested according to ASTM E 84.
5. Pressure/Temperature Rating: Minimum 100 psig (690 kPa) and 210 deg F (99 deg C).

C. EPDM Pipe And Fittings
1. Pipe Material: Crosslinked EPDM inner and outer tubes.
2. Wall Thickness: Minimum 0.125 inch (3.2 mm).
3. Oxygen Barrier: Ductile aluminum foil layer applied to the inner tube to limit oxygen diffusion through the pipe to maximum 0.10 mg per cu. m/day at 104 deg F (40 deg C) according to DIN 4726.

4. Reinforcing Braid: Braided-aluminum wire between the inner and outer tube.
5. Fittings: ASTM F 1807, copper with stainless-steel crimps or clamps.
6. Pressure/Temperature Rating: Minimum 100 psig (690 kPa) and 210 deg F (99 deg C).

D. Distribution Manifolds
1. Manifold: Minimum NPS 1 (DN 25), brass **OR** copper **OR** modular plastic **OR** stainless steel, **as directed**.
2. Main Shutoff Valves:
   a. Factory installed on supply and return connections.
   b. Two **OR** Three, **as directed**,-piece body.
   c. Body: Brass or bronze.
   d. Ball: Chrome-plated bronze.
   e. Seals: PTFE.
   f. CWP Rating: 150 psig (1035 kPa).
   g. Maximum Operating Temperature: 225 deg F (107 deg C).
3. Manual Air Vents:
   a. Body: Bronze.
   b. Internal Parts: Nonferrous.
   c. Operator: Key furnished with valve, or screwdriver bit.
   d. Inlet Connection: NPS 1/2 (DN 15).
   e. Discharge Connection: NPS 1/8 (DN 6).
   f. CWP Rating: 150 psig (1035 kPa).
   g. Maximum Operating Temperature: 225 deg F (107 deg C).
4. Balancing Valves:
   a. Body: Plastic or bronze, ball or plug, or globe cartridge type.
   b. Ball or Plug: Brass or stainless steel.
   c. Globe Cartridge and Washer: Brass with EPDM composition washer.
   d. Seat: PTFE.
   e. Visual Flow Indicator: Flowmeter with visible indication in a clear plastic cap at top of valve.
      OR
      Differential Pressure Gage Connections: Integral seals for portable meter to measure loss across calibrated orifice.
   f. Handle Style: Lever or knob, with memory stop to retain set position if used for shutoff.
   g. CWP Rating: Minimum 125 psig (860 kPa).
   h. Maximum Operating Temperature: 250 deg F (121 deg C).
5. Zone Control Valves:
   a. Body: Plastic or bronze, ball or plug, or globe cartridge type.
   b. Ball or Plug: Brass or stainless steel.
   c. Globe Cartridge and Washer: Brass with EPDM composition washer.
   d. Seat: PTFE.
   e. Actuator: Replaceable electric motor.
   f. CWP Rating: Minimum 125 psig (860 kPa).
   g. Maximum Operating Temperature: 250 deg F (121 deg C).
6. Thermometers:
   a. Mount on supply and return connections.
   b. Case: Dry type, metal or plastic, 2-inch (50-mm) diameter.
   c. Element: Bourdon tube or other type of pressure element.
   d. Movement: Mechanical, connecting element and pointer.
   e. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
   f. Pointer: Black metal.
   g. Window: Plastic.
   h. Connector: Rigid, back type.
   i. Thermal System: Liquid- or mercury-filled bulb in copper-plated steel, aluminum, or brass stem.

j. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

7. Mounting Brackets: Copper, or plastic or copper-clad steel, where in contact with manifold.

E. Piping Specialties

1. Cable Ties:
   a. Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
   b. Minimum Width: 1/8 inch (3 mm).
   c. Tensile Strength: 20 lb (9 kg), minimum.
   d. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
2. Floor-Mounting Staples:
   a. Steel, with corrosion-resistant coating and smooth finish without sharp edges.
   b. Minimum Thickness: 3/32 inch (2.4 mm).
   c. Width: Minimum, wider than tubing.
3. Floor-Mounting Clamps:
   a. Two bolt, steel, with corrosion-resistant coating and smooth finish without sharp edges.
   b. Minimum Thickness: 3/32 inch (2.4 mm).
   c. Width: Minimum, wider than tubing.
4. Floor Mounting Tracks:
   a. Aluminum or plastic channel track with smooth finish, no sharp edges.
   b. Minimum Thickness: 1/16 inch (1.6 mm).
   c. Slot Width: Snap fit to hold tubing.
   d. Slot Spacing: 2-inch (50-mm) **OR** 3-inch (75-mm), **as directed**, intervals.
5. Channeled Subfloor:
   a. Plywood, APA-rated subfloor panel, composed of premium, tongue-and-groove, 7-layer, Douglas fir structural subfloor panels.
   b. Particleboard manufactured to meet Federal Housing Authority standards of less than 0.3-ppm formaldehyde.
   c. Clad panel with minimum 0.025-inch- (0.635-mm-) thick aluminum recessed in the grooves sized to maintain contact with radiant piping.
6. Modular Interlocking Blocks:
   a. Polypropylene snap-together blocks with grooves to support piping.
   b. Galvanized sheet metal or aluminum emission plates.
   c. Natural mineralboard cover panel.
7. Heat-Emission Plates:
   a. Formed aluminum suitable for radiant heating piping.
   b. Minimum Thickness: 1/16 inch (1.6 mm).
   c. Slot Width: Snap fit to maintain pressure fit on tubing.

F. Controls

1. Temperature-control devices and sequence of operations are specified in Division 15 Section(s) "Hvac Instrumentation And Controls" AND "Sequence Of Operation".
2. Wall-Mounting Thermostat:
   a. Minimum temperature range from 50 to 90 deg F (10 to 32 deg C).
   b. Manually operated with on-off switch.
   c. Day and night setback and clock program with minimum four periods per day.
   d. Operate pumps or open zone control valves if room temperature falls below the thermostat setting, and stop pumps or close zone control valves when room temperature rises above the thermostat setting.
3. Heated-Panel Thermostat:
   a. Remote bulb unit with adjustable temperature range from 50 to 90 deg F (10 to 32 deg C).
   b. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected pump or zone control valve.
   c. Remote bulb on capillary tube, resistance temperature device, or thermistor for directly sensing radiant panel temperature.
   d. Stop pump or close zone control valves if heated-panel thermostat setting is exceeded.

e. Corrosion-resistant, waterproof control enclosure.

4. Heated-Panel Thermostat with Outdoor Temperature Reset:
   a. Remote bulb unit with adjustable temperature range from 50 to 90 deg F (10 to 32 deg C).
   b. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected pump and zone control valve.
   c. Remote bulb on capillary tube, resistance temperature device, or thermistor for directly sensing radiant panel temperature.
   d. Remote bulb on capillary tube, resistance temperature device, or thermistor for directly sensing outdoor-air temperature.
   e. Operate zone control valves to reset supply-water temperature inversely with outdoor-air temperature as follows:
      1) Low outdoor-air temperature, zero deg F (minus 18 deg C) with high supply-water temperature 110 deg F (43 deg C).
      2) High outdoor-air temperature, 60 deg F (16 deg C) with low supply-water temperature 70 deg F (21 deg C).
   f. Corrosion-resistant, waterproof control enclosure.
5. Precipitation and Temperature Sensor:
   a. Microprocessor-based **OR** Automatic, **as directed**, control with manual on, automatic, and standby/reset switch.
   b. Precipitation and temperature sensors shall sense the surface conditions of pavement and shall be programmed to operate pump and zone control valves as follows:
      1) Temperature Span: 34 to 44 deg F (1 to 7 deg C).
      2) Adjustable Delay Off Span: 30 to 90 minutes.
      3) Start Pump or Open Zone Control Valves: Following two-minute delay if ambient temperature is below set point and precipitation is detected.
      4) Stop Pump or Close Zone Control Valves: On detection of a dry surface plus time delay.
   c. Corrosion-proof and waterproof enclosure suitable for outdoor mounting, for controls and precipitation and temperature sensors.
   d. Minimum 30-A contactor to start pump and open valves.
   e. Precipitation sensor shall be mounted in pavement.
   f. Provide relay with contacts to indicate operational status, on or off, for interface with central HVAC control system workstation.

1.3 EXECUTION

A. Applications
1. Install the following types of radiant heating piping for the applications described:
   a. Piping in Exterior Pavement: EPDM **OR** PEX **OR** PEX/AL/PEX, **as directed**.
   b. Piping in Interior Reinforced-Concrete Floors: EPDM **OR** PEX **OR** PEX/AL/PEX, **as directed**.
   c. Piping in Level Fill Concrete Floors (Not Reinforced): EPDM **OR** PEX **OR** PEX/AL/PEX, **as directed**.
   d. Piping in Ceilings: EPDM **OR** PEX **OR** PEX/AL/PEX, **as directed**.
   e. Piping in Subfloors: EPDM **OR** PEX **OR** PEX/AL/PEX, **as directed**.
   f. Piping below Wood Floors: EPDM **OR** PEX **OR** PEX/AL/PEX, **as directed**.

B. Installation
1. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such 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 Shop or Coordination Drawings.
2. Install radiant heating piping continuous from the manifold through the heated panel and back to the manifold without piping joints in heated panels.

3. Connect radiant piping to manifold in a reverse-return arrangement.
4. Do not bend pipes in radii smaller than manufacturer's minimum bend radius dimensions.
5. Install manifolds in accessible locations, or install access panels to provide maintenance access as required in Division 08 Section "Access Doors And Frames".
6. Refer to Division 15 Section "Hydronic Piping" for pipes and connections to hydronic systems and for glycol-solution fill requirements.
7. Fire- and Smoke-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials according to Division 07 Section "Through-penetration Firestop Systems".
8. Piping in Exterior Pavement:
   a. Secure piping in concrete floors by attaching pipes to reinforcement using cable ties.
   b. Space cable ties a maximum of 18 inches (457 mm) o.c., and at center of turns or bends.
   c. Maintain 3-inch (75-mm) minimum cover.
   d. Install a sleeve of 3/8-inch- (9.5-mm-) thick, foam-type insulation or PE pipe around tubing and extending for a minimum of 10 inches (250 mm) on each side of slab joints to protect the tubing passing through expansion or control joints. Anchor sleeve to slab form at control joints to provide maximum clearance for saw cut.
   e. Maintain minimum 40-psig (275-kPa) pressure in piping during concrete placement and continue for 24 hours after placement.
9. Piping in Interior Reinforced-Concrete Floors:
   a. Secure piping in concrete floors by attaching pipes to reinforcement using cable ties.
   b. Space cable ties a maximum of 18 inches (457 mm) o.c., and at center of turns or bends.
   c. Maintain 2-inch (50-mm) minimum cover.
   d. Install a sleeve of 3/8-inch- (9.5-mm-) thick, foam-type insulation or PE pipe around tubing and extending for a minimum of 10 inches (250 mm) on each side of slab joints to protect the tubing passing through expansion or control joints. Anchor sleeve to slab form at control joints to provide maximum clearance for saw cut.
   e. Maintain minimum 40-psig (275-kPa) pressure in piping during concrete placement and continue for 24 hours after placement.
10. Piping in Level Fill Concrete Floors (Not Reinforced):
    a. Secure piping in concrete floors by attaching pipes to subfloor using tracks, clamps, or staples.
    b. Space tracks, clamps, or staples a maximum of 18 inches (457 mm) o.c., and at center of turns or bends.
    c. Maintain 3/4-inch (19-mm) minimum cover.
    d. Install a sleeve of 3/8-inch- (9.5-mm-) thick, foam-type insulation or PE pipe around tubing and extending for a minimum of 10 inches (250 mm) on each side of slab joints to protect the tubing passing through expansion or control joints. Anchor sleeve to slab form at control joints to provide maximum clearance for saw cut.
    e. Maintain minimum 40-psig (275-kPa) pressure in piping during the concrete pour and continue for 24 hours during curing.
11. Piping in Ceiling:
    a. Secure piping by attaching pipes to ceiling substrate using clamps or staples.
    b. Space clamps or staples a maximum of 18 inches (457 mm) o.c., and at center of turns or bends.
    c. Maintain 1-1/2-inch (38-mm) minimum plaster cover.
    d. Maintain minimum 40-psig (275-kPa) pressure in piping during the plaster application and continue for 24 hours during curing.
12. Piping in Subfloor:
    a. Secure piping by laying piping in subfloor channels or modular interlocking blocks.
    b. Use straight channel panels or blocks in the center, and curved channel panels or blocks at the ends.
    c. Finish floor with mineralboard panel cover or finished floor surface.
13. Piping below Wood Floor:
    a. Secure piping by attaching pipes to subfloor using heat-emission plates, clamps, or staples.

b. Space heat-emission plates, clamps, or staples a maximum of 4 inches (100 mm) o.c., and at center of turns or bends.
c. Install heat-emission plates on underside of wood subfloor with maximum space between plates, as noted above, to maintain pipe contact with floor.

14. Revise locations and elevations from those indicated as required to suit field conditions and ensure integrity of piping and as approved.
15. After system balancing has been completed, mark balancing valves to permanently indicate final position.
16. Perform the following adjustments before operating the system:
    a. Open valves to fully open position.
    b. Check operation of automatic valves.
    c. Set temperature controls so all zones call for full flow.
    d. Purge air from piping.
17. After the concrete or plaster heating panel has cured as recommended by concrete or plaster supplier, operate radiant heating system as follows:
    a. Start system heating at a maximum of 10 deg F (6 deg C) above the ambient radiant panel temperature, and increase 10 deg F (6 deg C) each following day until design temperature is achieved.
    b. For freeze protection, operate at a maximum of 60 deg F (16 deg C) supply-water temperature.

C. Field Quality Control
1. Prepare radiant heating piping for testing as follows:
    a. Open all isolation valves and close bypass valves.
    b. Open and verify operation of zone control valves.
    c. Flush with clean water, and clean strainers.
2. Tests and Inspections:
    a. Leak Test: After installation, charge system and test for leaks. Subject piping to hydrostatic test pressure that is not less than 1.5 times the design pressure but not more than 100 psig (690 kPa). Repair leaks and retest until no leaks exist.
    b. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Remove and replace malfunctioning radiant heating piping components that do not pass tests, and retest as specified above.
4. Prepare a written report of testing.

END OF SECTION 15064

Task	Specification	Specification Description
15064	02242	Piped Utilities Basic Materials And Methods
15064	02531	Relief Wells
15064	02455	Water Distribution
15064	02464a	Monitoring Wells
15064	02456	Water Supply Wells
15064	02455a	Sanitary Sewerage
15064	02441a	Common Work Results for Fire Suppression
15064	02441b	Common Work Results for Plumbing
15064	02441c	Common Work Results for HVAC
15064	15061	Domestic Water Piping
15064	15061a	Sanitary Waste And Vent Piping
15064	15061b	Storm Drainage Piping
15064	15061c	Hydronic Piping
15064	15063	Compressed-Air Piping For Laboratory And Healthcare Facilities
15064	15063a	Vacuum Piping For Laboratory And Healthcare Facilities
15064	15063b	Gas Piping For Laboratory And Healthcare Facilities
15066	02242	Piped Utilities Basic Materials And Methods
15066	02531	Relief Wells
15066	02464a	Monitoring Wells
15066	02456	Water Supply Wells
15066	02455a	Sanitary Sewerage
15066	02441a	Common Work Results for Fire Suppression
15066	02441b	Common Work Results for Plumbing
15066	02441c	Common Work Results for HVAC
15072	02531	Relief Wells
15072	02464a	Monitoring Wells
15072	02456	Water Supply Wells
15072	02455a	Sanitary Sewerage
15072	02441a	Common Work Results for Fire Suppression
15072	02441b	Common Work Results for Plumbing
15072	02441c	Common Work Results for HVAC
15072	02551	Facility Natural-Gas Piping
15072	02551a	Facility Liquefied-Petroleum Gas Piping
15075	02242	Piped Utilities Basic Materials And Methods
15075	02441a	Common Work Results for Fire Suppression
15075	02441b	Common Work Results for Plumbing
15075	02441c	Common Work Results for HVAC
15075	15061a	Sanitary Waste And Vent Piping

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SECTION 15080 - METERS AND GAGES FOR PLUMBING PIPING

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for meters and gages for plumbing piping. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section Includes:
   a. Bimetallic-actuated thermometers.
   b. Filled-system thermometers.
   c. Liquid-in-glass thermometers.
   d. Light-activated thermometers.
   e. Thermowells.
   f. Dial-type pressure gages.
   g. Gage attachments.
   h. Test plugs.
   i. Test-plug kits.
   j. Sight flow indicators.

C. Submittals
1. Product Data: For each type of product indicated.
2. Product Certificates: For each type of meter and gage, from manufacturer.
3. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

1.2 PRODUCTS

A. Bimetallic-Actuated Thermometers
1. Standard: ASME B40.200.
2. Case: Liquid-filled and sealed type(s); stainless steel with 3-inch (76-mm) **OR** 5-inch (127-mm), **as directed**, nominal diameter.
3. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F (deg C) **OR** deg F and deg C, **as directed**.
4. Connector Type(s): Union joint, adjustable angle **OR** rigid, back **OR** rigid, bottom, **as directed**, with unified-inch screw threads.
5. Connector Size: 1/2 inch (13 mm), with ASME B1.1 screw threads.
6. Stem: 0.25 or 0.375 inch (6.4 or 9.4 mm) in diameter; stainless steel.
7. Window: Plain glass or plastic.
8. Ring: Stainless steel.
9. Element: Bimetal coil.
10. Pointer: Dark-colored metal.
11. Accuracy: Plus or minus 1 **OR** 1.5, **as directed**, percent of scale range.

B. Filled-System Thermometers
1. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:
   a. Standard: ASME B40.200.
   b. Case: Sealed type, cast aluminum or drawn steel; 4-1/2-inch (114-mm) **OR** 5-inch (127-mm) **OR** 6-inch (152-mm), **as directed**, nominal diameter.
   c. Element: Bourdon tube or other type of pressure element.

d. Movement: Mechanical, dampening type, **as directed**, with link to pressure element and connection to pointer.
e. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C) **OR** deg F and deg C, **as directed**.
f. Pointer: Dark-colored metal.
g. Window: Glass or plastic.
h. Ring: Metal **OR** Stainless steel, **as directed**.
i. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device **OR** rigid, back **OR** rigid, bottom, **as directed**; with ASME B1.1 screw threads.
j. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
   1) Design for Thermowell Installation: Bare stem.
k. Accuracy: Plus or minus 1 percent of scale range.

2. Direct-Mounted, Plastic-Case, Vapor-Actuated Thermometers:
   a. Standard: ASME B40.200.
   b. Case: Sealed type, plastic; 4-1/2-inch (114-mm) **OR** 5-inch (127-mm) **OR** 6-inch (152-mm), **as directed**, nominal diameter.
   c. Element: Bourdon tube or other type of pressure element.
   d. Movement: Mechanical, with link to pressure element and connection to pointer.
   e. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C) **OR** deg F and deg C, **as directed**.
   f. Pointer: Dark-colored metal.
   g. Window: Glass or plastic.
   h. Ring: Metal or plastic.
   i. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device **OR** rigid, back **OR** rigid, bottom, **as directed**; with ASME B1.1 screw threads.
   j. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
      1) Design for Thermowell Installation: Bare stem.
   k. Accuracy: Plus or minus 1 percent of scale range.

3. Remote-Mounted, Metal-Case, Vapor-Actuated Thermometers:
   a. Standard: ASME B40.200.
   b. Case: Sealed type, cast aluminum or drawn steel; 4-1/2-inch (114-mm) **OR** 6-inch (152-mm), **as directed**, nominal diameter with back **OR** front, **as directed**, flange and holes for panel mounting.
   c. Element: Bourdon tube or other type of pressure element.
   d. Movement: Mechanical, with link to pressure element and connection to pointer.
   e. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C) **OR** deg F and deg C, **as directed**.
   f. Pointer: Dark-colored metal.
   g. Window: Glass or plastic.
   h. Ring: Metal **OR** Stainless steel, **as directed**.
   i. Connector Type(s): Union joint, back **OR** bottom, **as directed**; with ASME B1.1 screw threads.
   j. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
      1) Design for Thermowell Installation: Bare stem.
   k. Accuracy: Plus or minus 1 percent of scale range.

4. Remote-Mounted, Plastic-Case, Vapor-Actuated Thermometers:
   a. Standard: ASME B40.200.
   b. Case: Sealed type, plastic; 4-1/2-inch (114-mm) **OR** 6-inch (152-mm), **as directed**, nominal diameter with back **OR** front, **as directed**, flange and holes for panel mounting.
   c. Element: Bourdon tube or other type of pressure element.

d. Movement: Mechanical, with link to pressure element and connection to pointer.
e. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C) **OR** deg F and deg C, **as directed**.
f. Pointer: Dark-colored metal.
g. Window: Glass or plastic.
h. Ring: Metal or plastic.
i. Connector Type(s): Union joint, threaded, back **OR** bottom, **as directed**; with ASME B1.1 screw threads.
j. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
   1) Design for Thermowell Installation: Bare stem.
k. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

C. Liquid-In-Glass Thermometers
1. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:
   a. Standard: ASME B40.200.
   b. Case: Cast aluminum; 6-inch (152-mm) nominal size.
   c. Case Form: Back angle **OR** Straight, **as directed**, unless otherwise indicated.
   d. Tube: Glass with magnifying lens and blue or red organic liquid.
   e. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C) **OR** deg F and deg C, **as directed**.
   f. Window: Glass or plastic.
   g. Stem: Aluminum or brass and of length to suit installation.
      1) Design for Thermowell Installation: Bare stem.
   h. Connector: 3/4 inch (19 mm), with ASME B1.1 screw threads.
   i. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.
2. Plastic-Case, Compact-Style, Liquid-in-Glass Thermometers:
   a. Standard: ASME B40.200.
   b. Case: Plastic; 6-inch (152-mm) nominal size.
   c. Case Form: Back angle **OR** Straight, **as directed**, unless otherwise indicated.
   d. Tube: Glass with magnifying lens and blue or red organic liquid.
   e. Tube Background: Nonreflective with permanently etched scale markings graduated in deg F (deg C) **OR** deg F and deg C, **as directed**.
   f. Window: Glass or plastic.
   g. Stem: Aluminum or brass and of length to suit installation.
      1) Design for Thermowell Installation: Bare stem.
   h. Connector: 3/4 inch (19 mm), with ASME B1.1 screw threads.
   i. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.
3. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
   a. Standard: ASME B40.200.
   b. Case: Cast aluminum; 7-inch (178-mm) **OR** 9-inch (229-mm), **as directed**, nominal size unless otherwise indicated.
   c. Case Form: Adjustable angle **OR** Back angle **OR** Straight, **as directed**, unless otherwise indicated.
   d. Tube: Glass with magnifying lens and blue or red organic liquid.
   e. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C) **OR** deg F and deg C, **as directed**.
   f. Window: Glass or plastic.
   g. Stem: Aluminum and of length to suit installation.
      1) Design for Thermowell Installation: Bare stem.
   h. Connector: 1-1/4 inches (32 mm), with ASME B1.1 screw threads.
   i. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

4. Plastic-Case, Industrial-Style, Liquid-in-Glass Thermometers:
   a. Standard: ASME B40.200.
   b. Case: Plastic; 7-inch (178-mm) **OR** 9-inch (229-mm), **as directed**, nominal size unless otherwise indicated.
   c. Case Form: Adjustable angle **OR** Back angle **OR** Straight, **as directed**, unless otherwise indicated.
   d. Tube: Glass with magnifying lens and blue or red organic liquid.
   e. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C) **OR** deg F and deg C, **as directed**.
   f. Window: Glass or plastic.
   g. Stem: Aluminum **OR** Brass **OR** Stainless steel **OR** Aluminum, brass, or stainless steel, **as directed**, and of length to suit installation.
      1) Design for Thermowell Installation: Bare stem.
   h. Connector: 1-1/4 inches (32 mm), with ASME B1.1 screw threads.
   i. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

D. Light-Activated Thermometers
1. Direct-Mounted, Light-Activated Thermometers:
   a. Case: Plastic **OR** Metal, **as directed**; 7-inch (178-mm) **OR** 9-inch (229-mm), **as directed**, nominal size unless otherwise indicated.
   b. Scale(s): Deg F (Deg C) **OR** Deg F and deg C, **as directed**.
   c. Case Form: Adjustable angle.
   d. Connector: 1-1/4 inches (32 mm), with ASME B1.1 screw threads.
   e. Stem: Aluminum and of length to suit installation.
      1) Design for Thermowell Installation: Bare stem.
   f. Display: Digital.
   g. Accuracy: Plus or minus 2 deg F (1 deg C).
2. Remote-Mounted, Light-Activated Thermometers:
   a. Case: Plastic, for wall mounting.
   b. Scale(s): Deg F (Deg C) **OR** Deg F and deg C, **as directed**.
   c. Sensor: Bulb and thermister wire.
      1) Design for Thermowell Installation: Bare stem.
   d. Display: Digital.
   e. Accuracy: Plus or minus 2 deg F (1 deg C).

E. Thermowells
1. Thermowells:
   a. Standard: ASME B40.200.
   b. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
   c. Material for Use with Copper Tubing: CNR or CUNI.
   d. Material for Use with Steel Piping: CRES **OR** CSA, **as directed**.
   e. Type: Stepped shank unless straight or tapered shank is indicated.
   f. External Threads: NPS 1/2, NPS 3/4, or NPS 1, (DN 15, DN 20, or NPS 25,) ASME B1.20.1 pipe threads.
   g. Internal Threads: 1/2, 3/4, and 1 inch (13, 19, and 25 mm), with ASME B1.1 screw threads.
   h. Bore: Diameter required to match thermometer bulb or stem.
   i. Insertion Length: Length required to match thermometer bulb or stem.
   j. Lagging Extension: Include on thermowells for insulated piping and tubing.
   k. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
2. Heat-Transfer Medium: Mixture of graphite and glycerin.

F. Pressure Gages

1. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
   a. Standard: ASME B40.100.
   b. Case: Liquid-filled **OR** Sealed **OR** Open-front, pressure relief **OR** Solid-front, pressure relief, **as directed**, type(s); cast aluminum or drawn steel; 4-1/2-inch (114-mm) **OR** 6-inch (152-mm), **as directed**, nominal diameter.
   c. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
   d. Pressure Connection: Brass, with NPS 1/4 (DN 8) **OR** NPS 1/4 or NPS 1/2 (DN 8 or DN 15) **OR** NPS 1/2 (DN 15), **as directed**, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
   e. Movement: Mechanical, with link to pressure element and connection to pointer.
   f. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa) **OR** psi and kPa, **as directed**.
   g. Pointer: Dark-colored metal.
   h. Window: Glass or plastic.
   i. Ring: Metal **OR** Brass **OR** Stainless steel, **as directed**.
   j. Accuracy: Grade A, plus or minus 1 percent of middle half of **OR** Grade B, plus or minus 2 percent of middle half of **OR** Grade C, plus or minus 3 percent of middle half of **OR** Grade D, plus or minus 5 percent of whole, **as directed**, scale range.
2. Direct-Mounted, Plastic-Case, Dial-Type Pressure Gages:
   a. Standard: ASME B40.100.
   b. Case: Sealed type; plastic; 4-1/2-inch (114-mm) **OR** 6-inch (152-mm), **as directed**, nominal diameter.
   c. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
   d. Pressure Connection: Brass, with NPS 1/4 (DN 8) **OR** NPS 1/4 or NPS 1/2 (DN 8 or DN 15) **OR** NPS 1/2 (DN 15), **as directed**, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
   e. Movement: Mechanical, with link to pressure element and connection to pointer.
   f. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa) **OR** psi and kPa, **as directed**.
   g. Pointer: Dark-colored metal.
   h. Window: Glass or plastic.
   i. Accuracy: Grade A, plus or minus 1 percent of middle half of **OR** Grade B, plus or minus 2 percent of middle half of **OR** Grade C, plus or minus 3 percent of middle half of **OR** Grade D, plus or minus 5 percent of whole, **as directed**, scale range.
3. Remote-Mounted, Metal-Case, Dial-Type Pressure Gages:
   a. Standard: ASME B40.100.
   b. Case: Liquid-filled **OR** Sealed, **as directed**, type; cast aluminum or drawn steel **OR** metal, **as directed**; 4-1/2-inch (114-mm) **OR** 6-inch (152-mm), **as directed**, nominal diameter with back **OR** front, **as directed**, flange and holes for panel mounting.
   c. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
   d. Pressure Connection: Brass, with NPS 1/4 (DN 8) **OR** NPS 1/4 or NPS 1/2 (DN 8 or DN 15) **OR** NPS 1/2 (DN 15), **as directed**, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
   e. Movement: Mechanical, with link to pressure element and connection to pointer.
   f. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa) **OR** psi and kPa, **as directed**.
   g. Pointer: Dark-colored metal.
   h. Window: Glass or plastic.
   i. Ring: Metal **OR** Stainless steel, **as directed**.
   j. Accuracy: Grade A, plus or minus 1 percent of middle half of **OR** Grade B, plus or minus 2 percent of middle half of **OR** Grade C, plus or minus 3 percent of middle half of **OR** Grade D, plus or minus 5 percent of whole, **as directed**, scale range.
4. Remote-Mounted, Plastic-Case, Dial-Type Pressure Gages:
   a. Standard: ASME B40.100.
   b. Case: Sealed type; plastic; 4-1/2-inch (114-mm) **OR** 6-inch (152-mm), **as directed**, nominal diameter with back **OR** front, **as directed**, flange and holes for panel mounting.

c. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
d. Pressure Connection: Brass, with NPS 1/4 (DN 8) **OR** NPS 1/4 or NPS 1/2 (DN 8 or DN 15) **OR** NPS 1/2 (DN 15), **as directed**, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
e. Movement: Mechanical, with link to pressure element and connection to pointer.
f. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa) **OR** psi and kPa, **as directed**.
g. Pointer: Dark-colored metal.
h. Window: Glass or plastic.
i. Accuracy: Grade A, plus or minus 1 percent of middle half of **OR** Grade B, plus or minus 2 percent of middle half of **OR** Grade C, plus or minus 3 percent of middle half of **OR** Grade D, plus or minus 5 percent of whole, **as directed**, scale range.

G. Gage Attachments
1. Snubbers: ASME B40.100, brass; with NPS 1/4 (DN 8) **OR** NPS 1/4 or NPS 1/2 (DN 8 or DN 15) **OR** NPS 1/2 (DN 15), **as directed**, ASME B1.20.1 pipe threads and piston **OR** porous-metal, **as directed**,-type surge-dampening device. Include extension for use on insulated piping.
2. Valves: Brass ball **OR** Brass or stainless-steel needle, **as directed**, with NPS 1/4 (DN 8) **OR** NPS 1/4 or NPS 1/2 (DN 8 or DN 15) **OR** NPS 1/2 (DN 15), **as directed**, ASME B1.20.1 pipe threads.

H. Test Plugs
1. Description: Test-station fitting made for insertion into piping tee fitting.
2. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
3. Thread Size: NPS 1/4 (DN 8) or NPS 1/2 (DN 15), ASME B1.20.1 pipe thread.
4. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F (3450 kPa at 93 deg C).
5. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

I. Test-Plug Kits
1. Furnish one test-plug kit(s) containing one **OR** two, **as directed**, thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
2. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F (minus 4 to plus 52 deg C).
3. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F (minus 18 to plus 104 deg C).
4. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- (51- to 76-mm-) diameter dial and probe. Dial range shall be at least 0 to 200 psig (0 to 1380 kPa).
5. Carrying Case: Metal or plastic, with formed instrument padding.

J. Sight Flow Indicators
1. Description: Piping inline-installation device for visual verification of flow.
2. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.
3. Minimum Pressure Rating: 125 psig (860 kPa) **OR** 150 psig (1034 kPa), **as directed**.
4. Minimum Temperature Rating: 200 deg F (93 deg C).
5. End Connections for NPS 2 (DN 50) and Smaller: Threaded.
6. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged.

1.3 EXECUTION

A. Installation
1. Install thermowells with socket extending a minimum of 2 inches (51 mm) into fluid **OR** one-third of pipe diameter **OR** to center of pipe, **as directed**, and in vertical position in piping tees.
2. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
3. Install thermowells with extension on insulated piping.
4. Fill thermowells with heat-transfer medium.
5. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
6. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
7. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
8. Install remote-mounted pressure gages on panel.
9. Install valve and snubber in piping for each pressure gage for fluids.
10. Install test plugs in piping tees.
11. Install thermometers in the following locations:
    a. Inlet and outlet of each water heater.
    b. Inlets and outlets of each domestic water heat exchanger.
    c. Inlet and outlet of each domestic hot-water storage tank.
    d. Inlet and outlet of each remote domestic water chiller.
12. Install pressure gages in the following locations:
    a. Building water service entrance into building.
    b. Inlet and outlet of each pressure-reducing valve.
    c. Suction and discharge of each domestic water pump.

B. Connections
1. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

C. Adjusting
1. Adjust faces of meters and gages to proper angle for best visibility.

D. Thermometer Schedule
1. Thermometers at inlet and outlet of each domestic water heater shall be one of the following:
    a. Liquid-filled **OR** Sealed, **as directed**, bimetallic-actuated type.
    b. Direct **OR** Remote, **as directed**,-mounted, metal **OR** plastic, **as directed**,-case, vapor-actuated type.
    c. Compact **OR** Industrial, **as directed**,-style, liquid-in-glass type.
    d. Direct **OR** Remote, **as directed**,-mounted, light-activated type.
    e. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.
2. Thermometers at inlets and outlets of each domestic water heat exchanger shall be one of the following:
    a. Liquid-filled **OR** Sealed, **as directed**, bimetallic-actuated type.
    b. Direct **OR** Remote, **as directed**,-mounted, metal **OR** plastic, **as directed**,-case, vapor-actuated type.
    c. Compact **OR** Industrial, **as directed**,-style, liquid-in-glass type.
    d. Direct **OR** Remote, **as directed**,-mounted, light-activated type.
    e. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.
3. Thermometers at inlet and outlet of each domestic hot-water storage tank shall be one of the following:
    a. Liquid-filled **OR** Sealed, **as directed**, bimetallic-actuated type.

b. Direct **OR** Remote, **as directed**,-mounted, metal **OR** plastic, **as directed**,-case, vapor-actuated type.
c. Compact **OR** Industrial, **as directed**,-style, liquid-in-glass type.
d. Direct **OR** Remote, **as directed**,-mounted, light-activated type.
e. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.

4. Thermometers at inlet and outlet of each remote domestic water chiller shall be one of the following:
   a. Liquid-filled **OR** Sealed, **as directed**, bimetallic-actuated type.
   b. Direct **OR** Remote, **as directed**,-mounted, metal **OR** plastic, **as directed**,-case, vapor-actuated type.
   c. Compact **OR** Industrial, **as directed**,-style, liquid-in-glass type.
   d. Direct **OR** Remote, **as directed**,-mounted, light-activated type.
   e. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.
5. Thermometer stems shall be of length to match thermowell insertion length.

E. Thermometer Scale-Range Schedule
1. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F (Minus 20 to plus 50 deg C) **OR** 0 to 100 deg F and minus 20 to plus 50 deg C, **as directed**.
2. Scale Range for Domestic Cold-Water Piping: 0 to 150 deg F (Minus 20 to plus 70 deg C) **OR** 0 to 150 deg F and minus 20 to plus 70 deg C, **as directed**.
3. Scale Range for Domestic Cold-Water Piping: 30 to 240 deg F (0 to plus 115 deg C) **OR** 30 to 240 deg F and 0 to plus 115 deg C, **as directed**.
4. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F (0 to 150 deg C) **OR** 0 to 250 deg F and 0 to 150 deg C, **as directed**.
5. Scale Range for Domestic Hot-Water Piping: 20 to 240 deg F (0 to 150 deg C) **OR** 20 to 240 deg F and 0 to 150 deg C, **as directed**.
6. Scale Range for Domestic Hot-Water Piping: 30 to 240 deg F (0 to plus 115 deg C) **OR** 30 to 240 deg F and 0 to plus 115 deg C, **as directed**.
7. Scale Range for Domestic Cooled-Water Piping: 0 to 100 deg F (Minus 20 to plus 50 deg C) **OR** 0 to 100 deg F and minus 20 to plus 50 deg C, **as directed**.
8. Scale Range for Domestic Cooled-Water Piping: 0 to 150 deg F (Minus 20 to plus 70 deg C) **OR** 0 to 150 deg F and minus 20 to plus 70 deg C, **as directed**.

F. Pressure-Gage Schedule
1. Pressure gages at discharge of each water service into building shall be one of the following:
   a. Liquid-filled **OR** Sealed **OR** Open-front, pressure-relief **OR** Solid-front, pressure-relief, **as directed**, direct **OR** remote, **as directed**,-mounted, metal case.
   b. Sealed, direct **OR** remote, **as directed**,-mounted, plastic case.
   c. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.
2. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be one of the following:
   a. Liquid-filled **OR** Sealed **OR** Open-front, pressure-relief **OR** Solid-front, pressure-relief, **as directed**, direct **OR** remote, **as directed**,-mounted, metal case.
   b. Sealed, direct **OR** remote, **as directed**,-mounted, plastic case.
   c. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.
3. Pressure gages at suction and discharge of each domestic water pump shall be one of the following:
   a. Liquid-filled **OR** Sealed **OR** Open-front, pressure-relief **OR** Solid-front, pressure-relief, **as directed**, direct **OR** remote, **as directed**,-mounted, metal case.
   b. Sealed, direct **OR** remote, **as directed**,-mounted, plastic case.

c. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.

G. Pressure-Gage Scale-Range Schedule

1. Scale Range for Water Service Piping: 0 to 100 psi (0 to 600 kPa) **OR** 0 to 100 psi and 0 to 600 kPa, **as directed**.
2. Scale Range for Water Service Piping: 0 to 160 psi (0 to 1100 kPa) **OR** 0 to 160 psi and 0 to 1100 kPa, **as directed**.
3. Scale Range for Water Service Piping: 0 to 200 psi (0 to 1400 kPa) **OR** 0 to 200 psi and 0 to 1400 kPa, **as directed**.
4. Scale Range for Domestic Water Piping: 0 to 100 psi (0 to 600 kPa) **OR** 0 to 100 psi and 0 to 600 kPa, **as directed**.
5. Scale Range for Domestic Water Piping: 0 to 160 psi (0 to 1100 kPa) **OR** 0 to 160 psi and 0 to 1100 kPa, **as directed**.
6. Scale Range for Domestic Water Piping: 0 to 200 psi (0 to 1400 kPa) **OR** 0 to 200 psi and 0 to 1400 kPa, **as directed**.
7. Scale Range for Domestic Water Piping: 0 to 300 psi (0 to 2500 kPa) **OR** 0 to 300 psi and 0 to 2500 kPa, **as directed**.

END OF SECTION 15080

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SECTION 15080a - METERS AND GAGES FOR HVAC PIPING

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for meters and gages for HVAC piping. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section Includes:
a. Bimetallic-actuated thermometers.
b. Filled-system thermometers.
c. Liquid-in-glass thermometers.
d. Light-activated thermometers.
e. Thermowells.
f. Dial-type pressure gages.
g. Gage attachments.
h. Test plugs.
i. Test-plug kits.
j. Sight flow indicators.
k. Orifice flowmeters.
l. Pitot-tube flowmeters.
m. Turbine flowmeters.
n. Venturi flowmeters.
o. Vortex-shedding flowmeters.
p. Impeller-turbine, thermal-energy meters.
q. Ultrasonic, thermal-energy meters.

C. Submittals
1. Product Data: For each type of product indicated.
2. Wiring Diagrams: For power, signal, and control wiring.
3. Product Certificates: For each type of meter and gage, from manufacturer.
4. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

1.2 PRODUCTS

A. Bimetallic-Actuated Thermometers
1. Standard: ASME B40.200.
2. Case: Liquid-filled and sealed type(s); stainless steel with 3-inch (76-mm) **OR** 5-inch (127-mm), **as directed**, nominal diameter.
3. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F (deg C) **OR** deg F and deg C, **as directed**.
4. Connector Type(s): Union joint, adjustable angle **OR** rigid, back **OR** rigid, bottom, **as directed**, with unified-inch screw threads.
5. Connector Size: 1/2 inch (13 mm), with ASME B1.1 screw threads.
6. Stem: 0.25 or 0.375 inch (6.4 or 9.4 mm) in diameter; stainless steel.
7. Window: Plain glass or plastic.
8. Ring: Stainless steel.
9. Element: Bimetal coil.
10. Pointer: Dark-colored metal.

11. Accuracy: Plus or minus 1 **OR** 1.5, **as directed**, percent of scale range.

B. Filled-System Thermometers
1. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:
   a. Standard: ASME B40.200.
   b. Case: Sealed type, cast aluminum or drawn steel; 4-1/2-inch (114-mm) **OR** 5-inch (127-mm) **OR** 6-inch (152-mm), **as directed**, nominal diameter.
   c. Element: Bourdon tube or other type of pressure element.
   d. Movement: Mechanical, dampening type, **as directed**, with link to pressure element and connection to pointer.
   e. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C) **OR** deg F and deg C, **as directed**.
   f. Pointer: Dark-colored metal.
   g. Window: Glass or plastic.
   h. Ring: Metal **OR** Stainless steel.
   i. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device **OR** rigid, back **OR** rigid, bottom, **as directed**; with ASME B1.1 screw threads.
   j. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
      1) Design for Air-Duct Installation: With ventilated shroud.
      2) Design for Thermowell Installation: Bare stem.
   k. Accuracy: Plus or minus 1 percent of scale range.
2. Direct-Mounted, Plastic-Case, Vapor-Actuated Thermometers:
   a. Standard: ASME B40.200.
   b. Case: Sealed type, plastic; 4-1/2-inch (114-mm) **OR** 5-inch (127-mm) **OR** 6-inch (152-mm), **as directed**, nominal diameter.
   c. Element: Bourdon tube or other type of pressure element.
   d. Movement: Mechanical, with link to pressure element and connection to pointer.
   e. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C) **OR** deg F and deg C, **as directed**.
   f. Pointer: Dark-colored metal.
   g. Window: Glass or plastic.
   h. Ring: Metal or plastic.
   i. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device **OR** rigid, back **OR** rigid, bottom, **as directed**; with ASME B1.1 screw threads.
   j. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
      1) Design for Air-Duct Installation: With ventilated shroud.
      2) Design for Thermowell Installation: Bare stem.
   k. Accuracy: Plus or minus 1 percent of scale range.
3. Remote-Mounted, Metal-Case, Vapor-Actuated Thermometers:
   a. Standard: ASME B40.200.
   b. Case: Sealed type, cast aluminum or drawn steel; 4-1/2-inch (114-mm) **OR** 6-inch (152-mm), **as directed**, nominal diameter with back **OR** front, **as directed**, flange and holes for panel mounting.
   c. Element: Bourdon tube or other type of pressure element.
   d. Movement: Mechanical, with link to pressure element and connection to pointer.
   e. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C) **OR** deg F and deg C, **as directed**.
   f. Pointer: Dark-colored metal.
   g. Window: Glass or plastic.
   h. Ring: Metal **OR** Stainless steel, **as directed**.

i. Connector Type(s): Union joint, back **OR** bottom, **as directed**; with ASME B1.1 screw threads.
j. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
1) Design for Air-Duct Installation: With ventilated shroud.
2) Design for Thermowell Installation: Bare stem.
k. Accuracy: Plus or minus 1 percent of scale range.

4. Remote-Mounted, Plastic-Case, Vapor-Actuated Thermometers:
a. Standard: ASME B40.200.
b. Case: Sealed type, plastic; 4-1/2-inch (114-mm) **OR** 6-inch (152-mm), **as directed**, nominal diameter with back **OR** front, **as directed**, flange and holes for panel mounting.
c. Element: Bourdon tube or other type of pressure element.
d. Movement: Mechanical, with link to pressure element and connection to pointer.
e. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C) **OR** deg F and deg C, **as directed**.
f. Pointer: Dark-colored metal.
g. Window: Glass or plastic.
h. Ring: Metal or plastic.
i. Connector Type(s): Union joint, threaded, back **OR** bottom, **as directed**; with ASME B1.1 screw threads.
j. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
1) Design for Air-Duct Installation: With ventilated shroud.
2) Design for Thermowell Installation: Bare stem.
k. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

C. Liquid-In-Glass Thermometers
1. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:
a. Standard: ASME B40.200.
b. Case: Cast aluminum; 6-inch (152-mm) nominal size.
c. Case Form: Back angle **OR** Straight, **as directed**, unless otherwise indicated.
d. Tube: Glass with magnifying lens and blue or red, **as directed**, organic liquid.
e. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C) **OR** deg F and deg C, **as directed**.
f. Window: Glass or plastic.
g. Stem: Aluminum or brass and of length to suit installation.
1) Design for Air-Duct Installation: With ventilated shroud.
2) Design for Thermowell Installation: Bare stem.
h. Connector: 3/4 inch (19 mm), with ASME B1.1 screw threads.
i. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2. Plastic-Case, Compact-Style, Liquid-in-Glass Thermometers:
a. Standard: ASME B40.200.
b. Case: Plastic; 6-inch (152-mm) nominal size.
c. Case Form: Back angle **OR** Straight, **as directed**, unless otherwise indicated.
d. Tube: Glass with magnifying lens and blue or red, **as directed**, organic liquid.
e. Tube Background: Nonreflective with permanently etched scale markings graduated in deg F (deg C) **OR** deg F and deg C, **as directed**.
f. Window: Glass or plastic.
g. Stem: Aluminum or brass and of length to suit installation.
1) Design for Air-Duct Installation: With ventilated shroud.
2) Design for Thermowell Installation: Bare stem.
h. Connector: 3/4 inch (19 mm), with ASME B1.1 screw threads.
i. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

3. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
   a. Standard: ASME B40.200.
   b. Case: Cast aluminum; 7-inch (178-mm) **OR** 9-inch (229-mm), **as directed**, nominal size unless otherwise indicated.
   c. Case Form: Adjustable angle **OR** Back angle **OR** Straight, **as directed**, unless otherwise indicated.
   d. Tube: Glass with magnifying lens and blue or red, **as directed**, organic liquid.
   e. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C) **OR** deg F and deg C, **as directed**.
   f. Window: Glass or plastic.
   g. Stem: Aluminum and of length to suit installation.
      1) Design for Air-Duct Installation: With ventilated shroud.
      2) Design for Thermowell Installation: Bare stem.
   h. Connector: 1-1/4 inches (32 mm), with ASME B1.1 screw threads.
   i. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.
4. Plastic-Case, Industrial-Style, Liquid-in-Glass Thermometers:
   a. Standard: ASME B40.200.
   b. Case: Plastic; 7-inch (178-mm) **OR** 9-inch (229-mm), **as directed**, nominal size unless otherwise indicated.
   c. Case Form: Adjustable angle **OR** Back angle **OR** Straight, **as directed**, unless otherwise indicated.
   d. Tube: Glass with magnifying lens and blue or red, **as directed**, organic liquid.
   e. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C) **OR** deg F and deg C, **as directed**.
   f. Window: Glass or plastic.
   g. Stem: Aluminum **OR** Brass **OR** Stainless steel, **as directed**, and of length to suit installation.
      1) Design for Air-Duct Installation: With ventilated shroud.
      2) Design for Thermowell Installation: Bare stem.
   h. Connector: 1-1/4 inches (32 mm), with ASME B1.1 screw threads.
   i. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

D. Light-Activated Thermometers
1. Direct-Mounted, Light-Activated Thermometers:
   a. Case: Plastic **OR** Metal, **as directed**; 7-inch (178-mm) **OR** 9-inch (229-mm), **as directed**, nominal size unless otherwise indicated.
   b. Scale(s): Deg F (Deg C) **OR** Deg F and deg C, **as directed**.
   c. Case Form: Adjustable angle.
   d. Connector: 1-1/4 inches (32 mm), with ASME B1.1 screw threads.
   e. Stem: Aluminum and of length to suit installation.
      1) Design for Air-Duct Installation: With ventilated shroud.
      2) Design for Thermowell Installation: Bare stem.
   f. Display: Digital.
   g. Accuracy: Plus or minus 2 deg F (1 deg C).
2. Remote-Mounted, Light-Activated Thermometers:
   a. Case: Plastic, for wall mounting.
   b. Scale(s): Deg F (Deg C) **OR** Deg F and deg C, **as directed**.
   c. Sensor: Bulb and thermister wire.
      1) Design for Air-Duct Installation: With ventilated shroud.
      2) Design for Thermowell Installation: Bare stem.
   d. Display: Digital.
   e. Accuracy: Plus or minus 2 deg F (1 deg C).

E. Duct-Thermometer Mounting Brackets
1. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

F. Thermowells
1. Thermowells:
   a. Standard: ASME B40.200.
   b. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
   c. Material for Use with Copper Tubing: CNR **OR** CUNI, **as directed**.
   d. Material for Use with Steel Piping: CRES **OR** CSA, **as directed**.
   e. Type: Stepped shank unless straight or tapered shank is indicated.
   f. External Threads: NPS 1/2, NPS 3/4, or NPS 1, (DN 15, DN 20, or NPS 25,) ASME B1.20.1 pipe threads.
   g. Internal Threads: 1/2, 3/4, and 1 inch (13, 19, and 25 mm), with ASME B1.1 screw threads.
   h. Bore: Diameter required to match thermometer bulb or stem.
   i. Insertion Length: Length required to match thermometer bulb or stem.
   j. Lagging Extension: Include on thermowells for insulated piping and tubing.
   k. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
2. Heat-Transfer Medium: Mixture of graphite and glycerin.

G. Pressure Gages
1. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
   1) Standard: ASME B40.100.
   2) Case: Liquid-filled **OR** Sealed **OR** Open-front, pressure relief **OR** Solid-front, pressure relief, **as directed**, type(s); cast aluminum or drawn steel; 4-1/2-inch (114-mm) **OR** 6-inch (152-mm), **as directed**, nominal diameter.
   3) Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
   4) Pressure Connection: Brass, with NPS 1/4 (DN 8) **OR** NPS 1/2 (DN 15), **as directed**, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
   5) Movement: Mechanical, with link to pressure element and connection to pointer.
   6) Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa) **OR** psi and kPa, **as directed**.
   7) Pointer: Dark-colored metal.
   8) Window: Glass or plastic.
   9) Ring: Metal **OR** Brass **OR** Stainless steel, **as directed**.
   10) Accuracy: Grade A, plus or minus 1 percent of middle half of **OR** Grade B, plus or minus 2 percent of middle half of **OR** Grade C, plus or minus 3 percent of middle half of **OR** Grade D, plus or minus 5 percent of whole, **as directed**, scale range.
2. Direct-Mounted, Plastic-Case, Dial-Type Pressure Gages:
   a. Standard: ASME B40.100.
   b. Case: Sealed type; plastic; 4-1/2-inch (114-mm) **OR** 6-inch (152-mm), **as directed**, nominal diameter.
   c. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
   d. Pressure Connection: Brass, with NPS 1/4 (DN 8) **OR** NPS 1/2 (DN 15), **as directed**, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
   e. Movement: Mechanical, with link to pressure element and connection to pointer.
   f. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa) **OR** psi and kPa, **as directed**.
   g. Pointer: Dark-colored metal.
   h. Window: Glass or plastic.
   i. Accuracy: Grade A, plus or minus 1 percent of middle half of **OR** Grade B, plus or minus 2 percent of middle half of **OR** Grade C, plus or minus 3 percent of middle half of **OR** Grade D, plus or minus 5 percent of whole, **as directed**, scale range.

3. Remote-Mounted, Metal-Case, Dial-Type Pressure Gages:
   a. Standard: ASME B40.100.
   b. Case: Liquid-filled **OR** Sealed, **as directed**, type; cast aluminum or drawn steel **OR** metal, **as directed**; 4-1/2-inch (114-mm) **OR** 6-inch (152-mm), **as directed**, nominal diameter with back **OR** front, **as directed**, flange and holes for panel mounting.
   c. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
   d. Pressure Connection: Brass, with NPS 1/4 (DN 8) **OR** NPS 1/2 (DN 15), **as directed**, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
   e. Movement: Mechanical, with link to pressure element and connection to pointer.
   f. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa) **OR** psi and kPa, **as directed**.
   g. Pointer: Dark-colored metal.
   h. Window: Glass or plastic.
   i. Ring: Metal **OR** Stainless steel, **as directed**.
   j. Accuracy: Grade A, plus or minus 1 percent of middle half of **OR** Grade B, plus or minus 2 percent of middle half of **OR** Grade C, plus or minus 3 percent of middle half of **OR** Grade D, plus or minus 5 percent of whole, **as directed**, scale range.
4. Remote-Mounted, Plastic-Case, Dial-Type Pressure Gages:
   a. Standard: ASME B40.100.
   b. Case: Sealed type; plastic; 4-1/2-inch (114-mm) **OR** 6-inch (152-mm), **as directed**, nominal diameter with back **OR** front, **as directed**, flange and holes for panel mounting.
   c. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
   d. Pressure Connection: Brass, with NPS 1/4 (DN 8) **OR** NPS 1/2 (DN 15), **as directed**, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
   e. Movement: Mechanical, with link to pressure element and connection to pointer.
   f. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa) **OR** psi and kPa, **as directed**.
   g. Pointer: Dark-colored metal.
   h. Window: Glass or plastic.
   i. Accuracy: Grade A, plus or minus 1 percent of middle half of **OR** Grade B, plus or minus 2 percent of middle half of **OR** Grade C, plus or minus 3 percent of middle half of **OR** Grade D, plus or minus 5 percent of whole, **as directed**, scale range.

H. Gage Attachments
1. Snubbers: ASME B40.100, brass; with NPS 1/4 (DN 8) **OR** NPS 1/2 (DN 15), **as directed**, ASME B1.20.1 pipe threads and piston-type **OR** porous-metal-type, **as directed**, surge-dampening device. Include extension for use on insulated piping.
2. Siphons: Loop-shaped section of brass **OR** stainless-steel **OR** steel, **as directed**, pipe with NPS 1/4 (DN 8) **OR** NPS 1/2 (DN 15), **as directed**, pipe threads.
3. Valves: Brass ball **OR** Brass or stainless-steel needle, **as directed**, with NPS 1/4 (DN 8) **OR** NPS 1/2 (DN 15), **as directed**, ASME B1.20.1 pipe threads.

I. Test Plugs
1. Description: Test-station fitting made for insertion into piping tee fitting.
2. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
3. Thread Size: NPS 1/4 (DN 8) **OR** NPS 1/2 (DN 15), **as directed**, ASME B1.20.1 pipe thread.
4. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F (3450 kPa at 93 deg C).
5. Core Inserts: Chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber.

J. Test-Plug Kits
1. Furnish one test-plug kit(s) containing one **OR** two, **as directed**, thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

2. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F (minus 4 to plus 52 deg C).
3. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F (minus 18 to plus 104 deg C).
4. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- (51- to 76-mm-) diameter dial and probe. Dial range shall be at least 0 to 200 psig (0 to 1380 kPa).
5. Carrying Case: Metal or plastic, with formed instrument padding.

K. Sight Flow Indicators
1. Description: Piping inline-installation device for visual verification of flow.
2. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.
3. Minimum Pressure Rating: 125 psig (860 kPa) **OR** 150 psig (1034 kPa), **as directed**.
4. Minimum Temperature Rating: 200 deg F (93 deg C).
5. End Connections for NPS 2 (DN 50) and Smaller: Threaded.
6. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged.

L. Flowmeters
1. Orifice Flowmeters:
   a. Description: Flowmeter with sensor, hoses or tubing, fittings, valves, indicator, and conversion chart.
   b. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
   c. Sensor: Wafer-orifice-type, calibrated, flow-measuring element; for installation between pipe flanges.
      1) Design: Differential-pressure-type measurement for gas **OR** oil **OR** steam **OR** water, **as directed**.
      2) Construction: Cast-iron body, brass valves with integral check valves and caps, and calibrated nameplate.
      3) Minimum Pressure Rating: 300 psig (2070 kPa).
      4) Minimum Temperature Rating: 250 deg F (121 deg C).
   d. Permanent Indicators: Meter suitable for wall or bracket mounting, calibrated for connected sensor and having 6-inch- (152-mm-) diameter, or equivalent, dial with fittings and copper tubing for connecting to sensor.
      1) Scale: Gallons per minute (Liters per second).
      2) Accuracy: Plus or minus 1 percent between 20 and 80 percent of scale range.
   e. Portable Indicators: Hand-held, differential-pressure type, calibrated for connected sensor and having two 12-foot (3.7-m) hoses, with carrying case.
      1) Scale: Gallons per minute (Liters per second).
      2) Accuracy: Plus or minus 2 percent between 20 and 80 percent of scale range.
   f. Display: Shows rate of flow, with register to indicate total volume in gallons (liters).
   g. Conversion Chart: Flow rate data compatible with sensor and indicator.
   h. Operating Instructions: Include complete instructions with each flowmeter.
2. Pitot-Tube Flowmeters:
   a. Description: Flowmeter with sensor and indicator.
   b. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
   c. Sensor: Insertion type; for inserting probe into piping and measuring flow directly in gallons per minute (liters per second).
      1) Design: Differential-pressure-type measurement for oil **OR** water, **as directed**.
      2) Construction: Stainless-steel probe of length to span inside of pipe, with integral transmitter and direct-reading scale.
      3) Minimum Pressure Rating: 150 psig (1035 kPa).
      4) Minimum Temperature Rating: 250 deg F (121 deg C).

d. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
e. Integral Transformer: For low-voltage power connection.
f. Accuracy: Plus or minus 3 percent.
g. Display: Shows rate of flow, with register to indicate total volume in gallons (liters).
h. Operating Instructions: Include complete instructions with each flowmeter.

3. Turbine Flowmeters:
   a. Description: Flowmeter with sensor and indicator.
   b. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
   c. Sensor: Impeller turbine; for inserting into pipe fitting or for installing in piping and measuring flow directly in gallons per minute (liters per second).
      1) Design: Device or pipe fitting with inline turbine and integral direct-reading scale for gas **OR** oil **OR** steam **OR** water, **as directed**.
      2) Construction: Bronze or stainless-steel body, with plastic turbine or impeller.
      3) Minimum Pressure Rating: 150 psig (1035 kPa).
      4) Minimum Temperature Rating: 180 deg F (82 deg C).
   d. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
   e. Accuracy: Plus or minus 1-1/2 percent.
   f. Display: Shows rate of flow, with register to indicate total volume in gallons (liters).
   g. Operating Instructions: Include complete instructions with each flowmeter.
4. Venturi Flowmeters:
   a. Description: Flowmeter with calibrated flow-measuring element, hoses or tubing, fittings, valves, indicator, and conversion chart.
   b. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
   c. Sensor: Venturi-type, calibrated, flow-measuring element; for installation in piping.
      1) Design: Differential-pressure-type measurement for gas **OR** oil **OR** steam **OR** water, **as directed**.
      2) Construction: Bronze, brass, or factory-primed steel, with brass fittings and attached tag with flow conversion data.
      3) Minimum Pressure Rating: 250 psig (1725 kPa).
      4) Minimum Temperature Rating: 250 deg F (121 deg C).
      5) End Connections for NPS 2 (DN 50) and Smaller: Threaded.
      6) End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged or welded.
      7) Flow Range: Flow-measuring element and flowmeter shall cover operating range of equipment or system served.
   d. Permanent Indicators: Meter suitable for wall or bracket mounting, calibrated for connected flowmeter element, and having 6-inch- (152-mm-) diameter, or equivalent, dial with fittings and copper tubing for connecting to flowmeter element.
      1) Scale: Gallons per minute (Liters per second).
      2) Accuracy: Plus or minus 1 percent between 20 and 80 percent of scale range.
   e. Portable Indicators: Hand-held, differential-pressure type, calibrated for connected flowmeter element and having two 12-foot (3.7-m) hoses, with carrying case.
      1) Scale: Gallons per minute (Liters per second).
      2) Accuracy: Plus or minus 2 percent between 20 and 80 percent of scale range.
   f. Display: Shows rate of flow, with register to indicate total volume in gallons (liters).
   g. Conversion Chart: Flow rate data compatible with sensor.
   h. Operating Instructions: Include complete instructions with each flowmeter.
5. Vortex-Shedding Flowmeters:
   a. Description: Flowmeter with sensor and indicator.
   b. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
   c. Sensor: Inline type; for installing between pipe flanges and measuring flow directly in gallons per minute (liters per second).

1) Design: Flow obstruction device, vortex-measurement type for gas **OR** steam **OR** liquids, **as directed**.
2) Construction: Stainless-steel body, with integral transmitter and direct-reading scale.
3) Minimum Pressure Rating: 1000 psig (6900 kPa).
4) Minimum Temperature Rating: 500 deg F (260 deg C).
5) Integral Transformer: For low-voltage power operation.

d. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
e. Accuracy: Plus or minus 0.25 percent for liquids and 0.75 percent for gases.
f. Display: Shows rate of flow, with register to indicate total volume in gallons (liters).
g. Operating Instructions: Include complete instructions with each flowmeter.

M. Thermal-Energy Meters

1. Impeller-Turbine, Thermal-Energy Meters:
   a. Description: System with strainer, **as directed**, flow sensor, temperature sensors, transmitter, indicator, and connecting wiring.
   b. Flow Sensor: Impeller turbine with corrosion-resistant-metal body and transmitter; for installing in piping.
      1) Design: Total thermal-energy measurement.
      2) Minimum Pressure Rating: 150 psig (1035 kPa).
      3) Minimum Temperature Range: 40 to 250 deg F (5 to 121 deg C).
   c. Temperature Sensors: Insertion-type transducer.
   d. Indicator: Solid-state, integrating-type meter with integral battery pack, **as directed**; for wall mounting.
      1) Data Output: Six-digit electromechanical counter with readout in kilowatts per hour or British thermal units (joules).
      2) Battery Pack: Five-year lithium battery.
   e. Accuracy: Plus or minus 1 percent.
   f. Display: Visually indicates total fluid volume in gallons (liters) and thermal-energy flow in kilowatts per hour or British thermal units (joules).
   g. Strainer: Full size of main line piping.
   h. Operating Instructions: Include complete instructions with each thermal-energy meter system.
2. Ultrasonic, Thermal-Energy Meters:
   a. Description: Meter with flow sensor, temperature sensors, transmitter, indicator, and connecting wiring.
   b. Flow Sensor: Transit-time ultrasonic type with transmitter.
   c. Temperature Sensors: Insertion-type or strap-on transducer.
   d. Indicator: Solid-state, integrating-type meter with integral battery pack, **as directed**.
      1) Data Output: Six-digit electromechanical counter with readout in kilowatts per hour or British thermal units (joules).
      2) Battery Pack: Five-year lithium battery.
   e. Accuracy: Plus or minus 1 percent.
   f. Display: Visually indicates total fluid volume in gallons (liters) and thermal-energy flow in kilowatts per hour or British thermal units (joules).
   g. Operating Instructions: Include complete instructions with each thermal-energy meter system.

1.3 EXECUTION

A. Installation

1. Install thermowells with socket extending a minimum of 2 inches (51 mm) into fluid **OR** one-third of pipe diameter **OR** to center of pipe, **as directed**, and in vertical position in piping tees.
2. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

3. Install thermowells with extension on insulated piping.
4. Fill thermowells with heat-transfer medium.
5. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
6. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
7. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.
8. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
9. Install remote-mounted pressure gages on panel.
10. Install valve and snubber in piping for each pressure gage for fluids (except steam).
11. Install valve and syphon fitting in piping for each pressure gage for steam.
12. Install test plugs in piping tees.
13. Install flow indicators in piping systems in accessible positions for easy viewing.
14. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.
15. Install flowmeter elements in accessible positions in piping systems.
16. Install wafer-orifice flowmeter elements between pipe flanges.
17. Install differential-pressure-type flowmeter elements, with at least minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.
18. Install permanent indicators on walls or brackets in accessible and readable positions.
19. Install connection fittings in accessible locations for attachment to portable indicators.
20. Mount thermal-energy meters on wall if accessible; if not, provide brackets to support meters.
21. Install thermometers in the following locations:
    a. Inlet and outlet of each hydronic zone.
    b. Inlet and outlet of each hydronic boiler.
    c. Two inlets and two outlets of each chiller.
    d. Inlet and outlet of each hydronic coil in air-handling units.
    e. Two inlets and two outlets of each hydronic heat exchanger.
    f. Inlet and outlet of each thermal-storage tank.
    g. Outside-, return-, supply-, and mixed-air ducts.
22. Install pressure gages in the following locations:
    a. Discharge of each pressure-reducing valve.
    b. Inlet and outlet of each chiller chilled-water and condenser-water connection.
    c. Suction and discharge of each pump.

B. Connections
1. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.
2. Connect flowmeter-system elements to meters.
3. Connect flowmeter transmitters to meters.
4. Connect thermal-energy meter transmitters to meters.

C. Adjusting
1. After installation, calibrate meters according to manufacturer's written instructions.
2. Adjust faces of meters and gages to proper angle for best visibility.

D. Thermometer Schedule
1. Thermometers at inlet and outlet of each hydronic zone shall be one of the following:
    a. Liquid-filled **OR** Sealed, **as directed**, bimetallic-actuated type.
    b. Direct-mounted **OR** Remote-mounted, **as directed**, metal-case **OR** plastic-case, **as directed**, vapor-actuated type.
    c. Compact-style **OR** Industrial-style, **as directed**, liquid-in-glass type.
    d. Direct-mounted **OR** Remote-mounted, **as directed**, light-activated type.
    e. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.

2. Thermometers at inlet and outlet of each hydronic boiler shall be one of the following:
   a. Liquid-filled **OR** Sealed, **as directed**, bimetallic-actuated type.
   b. Direct-mounted **OR** Remote-mounted, **as directed**, metal-case **OR** plastic-case, **as directed**, vapor-actuated type.
   c. Compact-style **OR** Industrial-style, **as directed**, liquid-in-glass type.
   d. Direct-mounted **OR** Remote-mounted, **as directed**, light-activated type.
   e. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.
3. Thermometers at inlets and outlets of each chiller shall be one of the following:
   a. Liquid-filled **OR** Sealed, **as directed**, bimetallic-actuated type.
   b. Direct-mounted **OR** Remote-mounted, **as directed**, metal-case **OR** plastic-case, **as directed**, vapor-actuated type.
   c. Compact-style **OR** Industrial-style, **as directed**, liquid-in-glass type.
   d. Direct-mounted **OR** Remote-mounted, **as directed**, light-activated type.
   e. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.
4. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems shall be one of the following:
   a. Liquid-filled **OR** Sealed, **as directed**, bimetallic-actuated type.
   b. Direct-mounted **OR** Remote-mounted, **as directed**, metal-case **OR** plastic-case, **as directed**, vapor-actuated type.
   c. Compact-style **OR** Industrial-style, **as directed**, liquid-in-glass type.
   d. Direct-mounted **OR** Remote-mounted, **as directed**, light-activated type.
   e. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.
5. Thermometers at inlets and outlets of each hydronic heat exchanger shall be one of the following:
   a. Liquid-filled **OR** Sealed, **as directed**, bimetallic-actuated type.
   b. Direct-mounted **OR** Remote-mounted, **as directed**, metal-case **OR** plastic-case, **as directed**, vapor-actuated type.
   c. Compact-style **OR** Industrial-style, **as directed**, liquid-in-glass type.
   d. Direct-mounted **OR** Remote-mounted, **as directed**, light-activated type.
   e. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.
6. Thermometers at inlet and outlet of each hydronic heat-recovery unit shall be one of the following:
   a. Liquid-filled **OR** Sealed, **as directed**, bimetallic-actuated type.
   b. Direct-mounted **OR** Remote-mounted, **as directed**, metal-case **OR** plastic-case, **as directed**, vapor-actuated type.
   c. Compact-style **OR** Industrial-style, **as directed**, liquid-in-glass type.
   d. Direct-mounted **OR** Remote-mounted, **as directed**, light-activated type.
   e. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.
7. Thermometers at inlet and outlet of each thermal-storage tank shall be one of the following:
   a. Liquid-filled **OR** Sealed, **as directed**, bimetallic-actuated type.
   b. Direct-mounted **OR** Remote-mounted, **as directed**, metal-case **OR** plastic-case, **as directed**, vapor-actuated type.
   c. Compact-style **OR** Industrial-style, **as directed**, liquid-in-glass type.
   d. Direct-mounted **OR** Remote-mounted, **as directed**, light-activated type.
   e. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.
8. Thermometers at outside-, return-, supply-, and mixed-air ducts shall be one of the following:
   a. Liquid-filled **OR** Sealed, **as directed**, bimetallic-actuated type.
   b. Direct-mounted **OR** Remote-mounted, **as directed**, metal-case **OR** plastic-case, **as directed**, vapor-actuated type.
   c. Compact-style **OR** Industrial-style, **as directed**, liquid-in-glass type.
   d. Direct-mounted **OR** Remote-mounted, **as directed**, light-activated type.
9. Thermometer stems shall be of length to match thermowell insertion length.

E. Thermometer Scale-Range Schedule

1. Scale Range for Chilled-Water Piping: Minus 40 to plus 160 deg F (Minus 40 to plus 100 deg C) **OR** Minus 40 to plus 160 deg F and minus 40 to plus 100 deg C, **as directed**.
2. Scale Range for Chilled-Water Piping: 0 to 100 deg F (Minus 20 to plus 50 deg C) **OR** 0 to 100 deg F and minus 20 to plus 50 deg C, **as directed**.
3. Scale Range for Chilled-Water Piping: 0 to 150 deg F (Minus 20 to plus 70 deg C) **OR** 0 to 150 deg F and minus 20 to plus 70 deg C, **as directed**.
4. Scale Range for Chilled-Water Piping: 0 to 250 deg F (0 to 150 deg C) **OR** 0 to 250 deg F and 0 to 150 deg C, **as directed**.
5. Scale Range for Condenser-Water Piping: 0 to 100 deg F (Minus 20 to plus 50 deg C) **OR** 0 to 100 deg F and minus 20 to plus 50 deg C, **as directed**.
6. Scale Range for Condenser-Water Piping: 0 to 150 deg F (Minus 20 to plus 70 deg C) **OR** 0 to 150 deg F and minus 20 to plus 70 deg C, **as directed**.
7. Scale Range for Condenser-Water Piping: 0 to 250 deg F (0 to 150 deg C) **OR** 0 to 250 deg F and 0 to 150 deg C, **as directed**.
8. Scale Range for Condenser-Water Piping: 20 to 240 deg F (0 to 150 deg C) **OR** 20 to 240 deg F and 0 to 150 deg C, **as directed**.
9. Scale Range for Condenser-Water Piping: 30 to 240 deg F (0 to plus 115 deg C) **OR** 30 to 240 deg F and 0 to plus 115 deg C, **as directed**.
10. Scale Range for Heating, Hot-Water Piping: 0 to 250 deg F (0 to 150 deg C) **OR** 0 to 250 deg F and 0 to 150 deg C, **as directed**.
11. Scale Range for Heating, Hot-Water Piping: 20 to 240 deg F (0 to 150 deg C) **OR** 20 to 240 deg F and 0 to 150 deg C, **as directed**.
12. Scale Range for Heating, Hot-Water Piping: 30 to 240 deg F (0 to plus 115 deg C) **OR** 30 to 240 deg F and 0 to plus 115 deg C, **as directed**.
13. Scale Range for Heating, Hot-Water Piping: 50 to 400 deg F (0 to 200 deg C) **OR** 50 to 400 deg F and 0 to 200 deg C, **as directed**.
14. Scale Range for Heating, Hot-Water Piping: 50 to 550 deg F (10 to 300 deg C) **OR** 50 to 550 deg F and 10 to 300 deg C, **as directed**.
15. Scale Range for Steam and Steam-Condensate Piping: 0 to 250 deg F (0 to 150 deg C) **OR** 0 to 250 deg F and 0 to 150 deg C, **as directed**.
16. Scale Range for Steam and Steam-Condensate Piping: 20 to 240 deg F (0 to 150 deg C) **OR** 20 to 240 deg F and 0 to 150 deg C, **as directed**.
17. Scale Range for Steam and Steam-Condensate Piping: 30 to 240 deg F (0 to plus 115 deg C) **OR** 30 to 240 deg F and 0 to plus 115 deg C, **as directed**.
18. Scale Range for Steam and Steam-Condensate Piping: 50 to 400 deg F (0 to 200 deg C) **OR** 50 to 400 deg F and 0 to 200 deg C, **as directed**.
19. Scale Range for Air Ducts: Minus 40 to plus 110 deg F (Minus 40 to plus 45 deg C) **OR** Minus 40 to plus 110 deg F and minus 40 to plus 45 deg C, **as directed**.
20. Scale Range for Air Ducts: Minus 40 to plus 160 deg F (Minus 40 to plus 100 deg C) **OR** Minus 40 to plus 160 deg F and minus 40 to plus 100 deg C, **as directed**.
21. Scale Range for Air Ducts: 0 to 100 deg F (Minus 20 to plus 50 deg C) **OR** 0 to 100 deg F and minus 20 to plus 50 deg C, **as directed**.
22. Scale Range for Air Ducts: 0 to 150 deg F (Minus 20 to plus 70 deg C) **OR** 0 to 150 deg F and minus 20 to plus 70 deg C, **as directed**.
23. Scale Range for Air Ducts: 0 to 250 deg F (0 to 150 deg C) **OR** 0 to 250 deg F and 0 to 150 deg C, **as directed**.
24. Scale Range for Air Ducts: 20 to 240 deg F (0 to 150 deg C) **OR** 20 to 240 deg F and 0 to 150 deg C, **as directed**.
25. Scale Range for Air Ducts: 30 to 240 deg F (0 to plus 115 deg C) **OR** 30 to 240 deg F and 0 to plus 115 deg C, **as directed.**
26. Scale Range for Air Ducts: 50 to 400 deg F (0 to 200 deg C) **OR** 50 to 400 deg F and 0 to 200 deg C, **as directed**.

F. Pressure-Gage Schedule

1. Pressure gages at discharge of each pressure-reducing valve shall be one of the following:
   a. Liquid-filled **OR** Sealed **OR** Open-front, pressure-relief **OR** Solid-front, pressure-relief, **as directed**, direct-mounted **OR** remote-mounted, **as directed**, metal case.
   b. Sealed, direct-mounted **OR** remote-mounted, **as directed**, plastic case.
   c. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.
2. Pressure gages at inlet and outlet of each chiller chilled-water and condenser-water connection shall be one of the following:
   a. Liquid-filled **OR** Sealed **OR** Open-front, pressure-relief **OR** Solid-front, pressure-relief, **as directed**, direct-mounted **OR** remote-mounted, **as directed**, metal case.
   b. Sealed, direct-mounted **OR** remote-mounted, **as directed**, plastic case.
   c. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.
3. Pressure gages at suction and discharge of each pump shall be one of the following:
   a. Liquid-filled **OR** Sealed **OR** Open-front, pressure-relief **OR** Solid-front, pressure-relief, **as directed**, direct-mounted **OR** remote-mounted, **as directed**, metal case.
   b. Sealed, direct-mounted **OR** remote-mounted, **as directed**, plastic case.
   c. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.

G. Pressure-Gage Scale-Range Schedule
1. Scale Range for Chilled-Water Piping: 30 in. Hg to 15 psi (minus 100 to 0 kPa) **OR** 30 in. Hg to 15 psi and minus 100 to 0 kP, **as directed**.
2. Scale Range for Chilled-Water Piping: 0 to 30 psi (0 to 240 kPa) **OR** 0 to 30 psi and 0 to 240 kP, **as directed**.
3. Scale Range for Chilled-Water Piping: 0 to 100 psi (0 to 600 kPa) **OR** 0 to 100 psi and 0 to 600 kP, **as directed**.
4. Scale Range for Chilled-Water Piping: 0 to 160 psi (0 to 1100 kPa) **OR** 0 to 160 psi and 0 to 1100 kP, **as directed**.
5. Scale Range for Chilled-Water Piping: 0 to 200 psi (0 to 1400 kPa) **OR** 0 to 200 psi and 0 to 1400 kPa, **as directed**.
6. Scale Range for Chilled-Water Piping: 0 to 300 psi (0 to 2500 kPa) **OR** 0 to 300 psi and 0 to 2500 kPa, **as directed**.
7. Scale Range for Chilled-Water Piping: 0 to 600 psi (0 to 4000 kPa) **OR** 0 to 600 psi and 0 to 4000 kPa, **as directed**.
8. Scale Range for Condenser-Water Piping: 30 in. Hg to 15 psi (minus 100 to 0 kPa) **OR** 30 in. Hg to 15 psi and minus 100 to 0 kPa, **as directed**.
9. Scale Range for Condenser-Water Piping: 0 to 30 psi (0 to 240 kPa) **OR** 0 to 30 psi and 0 to 240 kPa, **as directed**.
10. Scale Range for Condenser-Water Piping: 0 to 100 psi (0 to 600 kPa) **OR** 0 to 100 psi and 0 to 600 kPa, **as directed**.
11. Scale Range for Condenser-Water Piping: 0 to 160 psi (0 to 1100 kPa) **OR** 0 to 160 psi and 0 to 1100 kPa, **as directed**.
12. Scale Range for Condenser-Water Piping: 0 to 200 psi (0 to 1400 kPa) **OR** 0 to 200 psi and 0 to 1400 kPa, **as directed**.
13. Scale Range for Condenser-Water Piping: 0 to 300 psi (0 to 2500 kPa) **OR** 0 to 300 psi and 0 to 2500 kPa, **as directed**.
14. Scale Range for Condenser-Water Piping: 0 to 600 psi (0 to 4000 kPa) **OR** 0 to 600 psi and 0 to 4000 kPa, **as directed**.
15. Scale Range for Heating, Hot-Water Piping: 30 in. Hg to 15 psi (minus 100 to 0 kPa) **OR** 30 in. Hg to 15 psi and minus 100 to 0 kPa, **as directed**.
16. Scale Range for Heating, Hot-Water Piping: 0 to 30 psi (0 to 240 kPa) **OR** 0 to 30 psi and 0 to 240 kPa, **as directed**.
17. Scale Range for Heating, Hot-Water Piping: 0 to 100 psi (0 to 600 kPa) **OR** 0 to 100 psi and 0 to 600 kPa, **as directed**.

18. Scale Range for Heating, Hot-Water Piping: 0 to 160 psi (0 to 1100 kPa) **OR** 0 to 160 psi and 0 to 1100 kPa, **as directed**.
19. Scale Range for Heating, Hot-Water Piping: 0 to 200 psi (0 to 1400 kPa) **OR** 0 to 200 psi and 0 to 1400 kPa, **as directed**.
20. Scale Range for Heating, Hot-Water Piping: 0 to 300 psi (0 to 2500 kPa) **OR** 0 to 300 psi and 0 to 2500 kPa, **as directed**.
21. Scale Range for Heating, Hot-Water Piping: 0 to 600 psi (0 to 4000 kPa) **OR** 0 to 600 psi and 0 to 4000 kPa, **as directed**.
22. Scale Range for Steam Piping: 30 in. Hg to 15 psi (minus 100 to 0 kPa) **OR** 30 in. Hg to 15 psi and minus 100 to 0 kPa, **as directed**.
23. Scale Range for Steam Piping: 0 to 30 psi (0 to 240 kPa) **OR** 0 to 30 psi and 0 to 240 kPa, **as directed**.
24. Scale Range for Steam Piping: 0 to 100 psi (0 to 600 kPa) **OR** 0 to 100 psi and 0 to 600 kPa, **as directed**.
25. Scale Range for Steam Piping: 0 to 160 psi (0 to 1100 kPa) **OR** 0 to 160 psi and 0 to 1100 kPa, **as directed**.
26. Scale Range for Steam Piping: 0 to 200 psi (0 to 1400 kPa) **OR** 0 to 200 psi and 0 to 1400 kPa, **as directed**.
27. Scale Range for Steam Piping: 0 to 300 psi (0 to 2500 kPa) **OR** 0 to 300 psi and 0 to 2500 kPa, **as directed**.
28. Scale Range for Steam Piping: 0 to 600 psi (0 to 4000 kPa) **OR** 0 to 600 psi and 0 to 4000 kPa, **as directed**.

H. Flowmeter Schedule
1. Flowmeters for Chilled-Water Piping: Orifice **OR** Pitot-tube **OR** Turbine **OR** Venturi **OR** Vortex-shedding, **as directed,** type.
2. Flowmeters for Condenser-Water Piping: Orifice **OR** Pitot-tube **OR** Turbine **OR** Venturi **OR** Vortex-shedding, **as directed,** type.
3. Flowmeters for Heating, Hot-Water Piping: Orifice **OR** Pitot-tube **OR** Turbine **OR** Venturi **OR** Vortex-shedding, **as directed,** type.
4. Flowmeters for Steam and Steam-Condensate Piping: Orifice **OR** Turbine **OR** Venturi **OR** Vortex-shedding, **as directed,** type.

I. Thermal-Energy Meter Schedule
1. Thermal-Energy Meters for Chilled-Water Piping: Impeller-turbine **OR** Ultrasonic, **as directed,** type.
2. Thermal-Energy Meters for Condenser-Water Piping: Impeller-turbine **OR** Ultrasonic, **as directed,** type.
3. Thermal-Energy Meters for Heating, Hot-Water Piping: Impeller-turbine **OR** Ultrasonic, **as directed,** type.
4. Thermal-Energy Meters for Steam and Steam-Condensate Piping: Impeller-turbine **OR** Ultrasonic, **as directed,** type.

END OF SECTION 15080a

Task	Specification	Specification Description
15080	02242	Piped Utilities Basic Materials And Methods
15080	02455	Water Distribution
15080	02441a	Common Work Results for Fire Suppression
15080	02441b	Common Work Results for Plumbing
15080	02441c	Common Work Results for HVAC
15080	15061c	Hydronic Piping
15080	15061d	Steam And Condensate Piping

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SECTION 15083 - HYDRONIC PUMPS

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for hydronic pumps. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. This Section includes the following:
a. Close-coupled, in-line centrifugal pumps.
b. Close-coupled, end-suction centrifugal pumps.
c. Separately coupled, horizontal, in-line centrifugal pumps.
d. Separately coupled, vertical, in-line centrifugal pumps.
e. Separately coupled, base-mounted, end-suction centrifugal pumps.
f. Separately coupled, base-mounted, double-suction centrifugal pumps.
g. Separately coupled, vertical-mounted, double-suction centrifugal pumps.
h. Separately coupled, vertical-mounted, turbine centrifugal pumps.
i. Automatic condensate pump units.

C. Definitions
1. Buna-N: Nitrile rubber.
2. EPT: Ethylene propylene terpolymer.

D. Submittals
1. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.
2. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
a. Wiring Diagrams: Power, signal, and control wiring.
3. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

E. Quality Assurance
1. 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.
2. UL Compliance: Comply with UL 778 for motor-operated water pumps.

F. Delivery, Storage, And Handling
1. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.
2. Store pumps in dry location.
3. Retain protective covers for flanges and protective coatings during storage.
4. Protect bearings and couplings against damage from sand, grit, and other foreign matter.
5. Comply with pump manufacturer's written rigging instructions.

1.2 PRODUCTS

A. Close-Coupled, In-Line Centrifugal Pumps
1. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically. Rate pump for 125-psig (860-kPa) **OR** 175-psig (1204-kPa) **OR** 250-psig (1720-kPa), **as directed**, minimum working pressure and a continuous water temperature of 200 deg F (93 deg C) **OR** 225 deg F (107 deg C) **OR** 250 deg F (121 deg C), **as directed**.
2. Pump Construction:
a. Casing: Radially split, cast iron, with replaceable bronze wear rings, **as directed**, threaded gage tappings at inlet and outlet, and threaded companion-flange **OR** union end, **as directed**, connections.
b. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
c. Pump Shaft: Steel, with copper-alloy shaft sleeve **OR** Stainless steel**, as directed**.
d. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N **OR** EPT, **as directed**, bellows and gasket. Include water slinger on shaft between motor and seal.
e. Packing Seal: Stuffing box, with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
f. Pump Bearings: Permanently lubricated ball bearings **OR** Oil lubricated; bronze-journal or thrust type, **as directed**.
3. Motor: Single speed, with permanently lubricated **OR** grease-lubricated, **as directed**, ball bearings, unless otherwise indicated; and rigidly mounted to pump casing. Comply with requirements in Division 15 Section "Common Motor Requirements For Hvac Equipment".

B. Close-Coupled, End-Suction Centrifugal Pumps
1. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally. Rate pump for 125-psig (860-kPa) **OR** 175-psig (1204-kPa), **as directed**, minimum working pressure and a continuous water temperature of 225 deg F (107 deg C) **OR** 250 deg F (121 deg C), **as directed**.
2. Pump Construction:
a. Casing: Radially split, cast iron, with replaceable bronze wear rings, **as directed**, drain plug at bottom and air vent at top of volute, threaded gage tappings at inlet and outlet, and threaded companion-flange **OR** flanged, **as directed**, connections.
b. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
c. Pump Shaft: Steel, with copper-alloy shaft sleeve **OR** Stainless steel, **as directed**.
d. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N **OR** EPT, **as directed**, bellows and gasket. Include water slinger on shaft between motor and seal.
e. Pump Bearings: Permanently lubricated ball bearings **OR** Oil lubricated; bronze-journal or thrust type, **as directed**.
f. Motor: Single speed, with permanently lubricated **OR** grease-lubricated, **as directed**, ball bearings, unless otherwise indicated; rigidly mounted to pump casing with integral pump support. Comply with requirements in Division 15 Section "Common Motor Requirements For Hvac Equipment".

C. Separately Coupled, Horizontal, In-Line Centrifugal Pumps
1. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally. Rate pump for 125-psig (860-kPa) **OR** 175-psig (1204-kPa), **as**

directed, minimum working pressure and a continuous water temperature of 225 deg F (107 deg C) **OR** 250 deg F (121 deg C), **as directed**.

2. Pump Construction:
   a. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, and threaded companion-flange **OR** union end, **as directed**, connections.
   b. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, and keyed to shaft. Trim impeller to match specified performance.
   c. Pump Shaft: Steel, with copper-alloy shaft sleeve **OR** Stainless steel, **as directed**.
   d. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N **OR** EPT, **as directed**, bellows and gasket. Include water slinger on shaft between motor and seal.
   e. Pump Bearings: Permanently lubricated ball bearings **OR** Oil lubricated; bronze-journal or thrust type, **as directed**.
3. Shaft Coupling: Molded rubber insert with interlocking spider **OR** Interlocking frame with interconnecting springs, **as directed**, capable of absorbing vibration.
4. Motor: Single speed, with permanently lubricated ball **OR** oil-lubricated sleeve, **as directed**, bearings, unless otherwise indicated; and resiliently **OR** rigidly, **as directed**, mounted to pump casing. Comply with requirements in Division 15 Section "Common Motor Requirements For Hvac Equipment".

D. Separately Coupled, Vertical, In-Line Centrifugal Pumps
1. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted vertically. Rate pump for 125-psig (860-kPa) **OR** 175-psig (1204-kPa) **OR** 250-psig (1720-kPa), **as directed**, minimum working pressure and a continuous water temperature of 200 deg F (93 deg C) **OR** 225 deg F (107 deg C) **OR** 250 deg F (121 deg C), **as directed**.
2. Pump Construction:
   a. Casing: Radially split, cast iron, with replaceable bronze wear rings, **as directed**, threaded gage tappings at inlet and outlet, and threaded companion-flange **OR** union end, **as directed**, connections.
   b. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
   c. Pump Shaft: Steel, with copper-alloy shaft sleeve **OR** Stainless steel, **as directed**.
   d. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N **OR** EPT, **as directed**, bellows and gasket. Include water slinger on shaft between motor and seal.
   e. Packing Seal: Stuffing box, with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
   f. Pump Bearings: Permanently lubricated ball bearings **OR** Oil lubricated; bronze-journal or thrust type, **as directed**.
3. Shaft Coupling: Axially split spacer coupling.
4. Motor: Single speed, with permanently lubricated **OR** grease-lubricated, **as directed**, ball bearings, unless otherwise indicated; rigidly mounted to pump casing with lifting eye and supporting lugs in motor enclosure. Comply with requirements in Division 15 Section "Common Motor Requirements For Hvac Equipment".

E. Separately Coupled, Base-Mounted, End-Suction Centrifugal Pumps
1. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal. Rate pump for 125-psig (860-kPa) **OR** 175-psig (1204-kPa) **OR** 250-psig (1720-kPa), **as directed**, minimum working pressure and a continuous water temperature of 200 deg F (93 deg C) **OR** 225 deg F (107 deg C) **OR** 250 deg F (121 deg C), **as directed**.
2. Pump Construction:
   a. Casing: Radially split, cast iron, with replaceable bronze wear rings, **as directed**, threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and threaded companion-flange **OR** flanged, **as directed**, connections. Provide integral mount

on volute to support the casing, and attached piping to allow removal and replacement of impeller without disconnecting piping or requiring the realignment of pump and motor shaft, **as directed**.

b. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.

c. Pump Shaft: Steel, with copper-alloy shaft sleeve **OR** Stainless steel, **as directed**.

d. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N **OR** EPT, **as directed**, bellows and gasket.

e. Packing Seal: Stuffing box, with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.

f. Pump Bearings: Grease-lubricated ball bearings contained in cast-iron housing with grease fittings.

3. Shaft Coupling: Molded rubber insert and interlocking spider capable of absorbing vibration. Couplings shall be drop-out type to allow disassembly and removal without removing pump shaft or motor **OR** EPDM coupling sleeve for variable-speed applications, **as directed**.

4. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.

5. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.

6. Motor: Single speed, with permanently lubricated **OR** grease-lubricated, **as directed**, ball bearings, unless otherwise indicated; secured to mounting frame, with adjustable alignment. Comply with requirements in Division 15 Section "Common Motor Requirements For Hvac Equipment".

F. Separately Coupled, Base-Mounted, Double-Suction Centrifugal Pumps

1. Description: Factory-assembled and -tested, centrifugal, impeller-between-bearings, separately coupled, double-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal. Rate pump for 125-psig (860-kPa) **OR** 175-psig (1204-kPa) **OR** 250-psig (1720-kPa), **as directed**, minimum working pressure and a continuous water temperature of 200 deg F (93 deg C) **OR** 225 deg F (107 deg C) **OR** 250 deg F (121 deg C), **as directed**.

2. Pump Construction:

a. Casing: Radially **OR** Horizontally, **as directed**, split, cast iron, with replaceable bronze wear rings, **as directed**, threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and ASME B16.1, Class 125 **OR** 250, **as directed**, flanges. Casing supports shall allow removal and replacement of impeller without disconnecting piping, **as directed**.

b. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, and keyed to shaft. Trim impeller to match specified performance.

c. Pump Shaft: Stainless steel.

d. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N **OR** EPT, **as directed**, bellows and gasket.

e. Packing Seal: Stuffing box, with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.

f. Pump Bearings: Grease-lubricated ball bearings contained in cast-iron housing with grease fittings.

3. Shaft Coupling: Molded rubber insert and interlocking spider capable of absorbing vibration. Couplings shall be drop-out type to allow disassembly and removal without removing pump shaft or motor **OR** EPDM coupling sleeve for variable-speed applications, **as directed**.

4. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.

5. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.

6. Motor: Single speed, with grease-lubricated ball bearings, unless otherwise indicated; secured to mounting frame, with adjustable alignment. Comply with requirements in Division 15 Section "Common Motor Requirements For Hvac Equipment".

G. Separately Coupled, Vertical-Mounted, Double-Suction Centrifugal Pumps
1. Description: Factory-assembled and -tested, centrifugal, impeller-between-bearings, separately coupled, double-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted vertically. Rate pump for 125-psig (860-kPa) **OR** 175-psig (1204-kPa) **OR** 250-psig (1720-kPa), **as directed**, minimum working pressure and a continuous water temperature of 200 deg F (93 deg C) **OR** 225 deg F (107 deg C) **OR** 250 deg F (121 deg C), **as directed**.
2. Pump Construction:
   a. Casing: Radially split, cast iron, with replaceable bronze wear rings, **as directed**, threaded gage tappings at inlet and outlet, drain plug at bottom of volute, mounting support, and ASME B16.1, Class 125 **OR** 250, **as directed**, flanges.
   b. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, and keyed to shaft. Trim impeller to match specified performance.
   c. Pump Shaft: Stainless steel.
   d. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N **OR** EPT, **as directed**, bellows and gasket.
   e. Packing Seal: Stuffing box, with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
   f. Pump Bearings: Grease-lubricated ball bearings contained in cast-iron housing with grease fittings.
3. Shaft Coupling: Molded rubber insert and interlocking spider capable of absorbing vibration.
4. Motor: Single speed, with grease-lubricated ball bearings, unless otherwise indicated; secured to casing. Comply with requirements in Division 15 Section "Common Motor Requirements For Hvac Equipment".

H. Separately Coupled, Vertical-Mounted, Turbine Centrifugal Pumps
1. Description: Factory-assembled and -tested, single-stage **OR** multistage, **as directed**, centrifugal, impeller-between-bearings, end-suction pump as defined in HI 2.1-2.2 and HI 2.3; designed for installation with pump and motor shafts mounted vertically and projecting into a sump. Rate pump for 125-psig (860-kPa) **OR** 175-psig (1204-kPa), **as directed**, minimum working pressure and a continuous water temperature of 200 deg F (93 deg C).
2. Pump Construction:
   a. Pump Bowl: Cast iron, with replaceable bronze wear ring, **as directed**, cone **OR** basket, **as directed**, strainer, and suction bell. Water passages of intermediate bowls shall be coated with porcelain enamel, **as directed**.
   b. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, and keyed to shaft. Trim impeller to match specified performance.
   c. Pump Shaft: Carbon **OR** Stainless, **as directed**, steel sized per AWWA E-101.
   d. Pump Bearings: Water-lubricated bronze and rubber sleeve bearings contained in cast-iron housing.
   e. Pump Column: ASTM A 53/A 53M, Grade B steel pipe.
   f. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Seal shall be replaceable without removing the motor or disturbing the piping.
   g. Packing Seal: Stuffing box, with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
3. Shaft Coupling: Keyed with locking collets.
4. Discharge Head: ASME B16.1, Class 125 **OR** 250, **as directed**, discharge flange with threaded gage tapping. Top of discharge head shall have a registered fit to accurately locate the driver.
5. Drive Ratchet: Nonreversing ratchet.

6. Hollow Shaft Motor: Single speed, with grease-lubricated ball bearings, unless otherwise indicated; secured to discharge head. Comply with requirements in Division 15 Section "Common Motor Requirements For Hvac Equipment".

I. Automatic Condensate Pump Units
1. Description: Packaged units with corrosion-resistant pump, plastic tank with cover, and automatic controls. Include factory- or field-installed check valve and a 72-inch- (1800-mm-) minimum, electrical power cord with plug.

J. Pump Specialty Fittings
1. Suction Diffuser: Angle pattern, 175-psig (1204-kPa) **OR** 300-psig (2060-kPa), **as directed**, pressure rating, cast **OR** ductile, **as directed**,-iron body and end cap, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; bronze or stainless-steel straightening vanes; drain plug; and factory-fabricated support.
2. Triple-Duty Valve: Angle or straight pattern, 175-psig (1204-kPa) **OR** 300-psig (2060-kPa), **as directed**, pressure rating, cast **OR** ductile, **as directed**,-iron body, pump-discharge fitting; with drain plug and bronze-fitted shutoff, balancing, and check valve features. Brass gage ports with integral check valve, and orifice for flow measurement.

1.3 EXECUTION

A. Concrete Bases
1. Install concrete bases of dimensions indicated for pumps and controllers. Refer to Division 15 Section "Common Work Results For Hvac"
   a. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
   b. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   c. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   d. Install anchor bolts to elevations required for proper attachment to supported equipment.
2. Cast-in-place concrete materials and placement requirements are specified in Division 02.

B. Pump Installation
1. Comply with HI 1.4 **OR** HI 2.4, **as directed**.
2. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.
3. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
4. Install continuous-thread hanger rods and elastomeric hangers **OR** spring hangers **OR** spring hangers with vertical-limit stop, **as directed**, of sufficient size to support pump weight. Vibration isolation devices are specified in Division 15 Section "Vibration And Seismic Controls For Hvac Piping And Equipment". Fabricate brackets or supports as required. Hanger and support materials are specified in Division 15 Section "Hangers And Supports For Hvac Piping And Equipment".
5. Suspend vertically mounted, in-line centrifugal pumps independent of piping. Install pumps with motor and pump shafts vertical. Use continuous-thread hanger rods and elastomeric hangers **OR** spring hangers **OR** spring hangers with vertical-limit stop, **as directed**, of sufficient size to support pump weight. Vibration isolation devices are specified in Division 15 Section(s) "Vibration And Seismic Controls For Fire-suppression Piping And Equipment" AND "Vibration And Seismic Controls For Hvac Piping And Equipment". Hanger and support materials are specified in Division 15 Section(s) "Hangers And Supports For Plumbing Piping And Equipment" AND "Hangers And Supports For Hvac Piping And Equipment".

6. Set base-mounted pumps on concrete foundation. Disconnect coupling before setting. Do not reconnect couplings until alignment procedure is complete.
   a. Support pump baseplate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1-1/2 inches (19 to 38 mm) between pump base and foundation for grouting.
   b. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.
7. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.

C. Alignment
1. Align pump and motor shafts and piping connections after setting on foundation, grout has been set and foundation bolts have been tightened, and piping connections have been made.
2. Comply with pump and coupling manufacturers' written instructions.
3. Adjust pump and motor shafts for angular and offset alignment by methods specified in HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation" **OR** HI 2.1-2.5, "Vertical Pumps for Nomenclature, Definitions, Application and Operation",**as directed**.
4. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

D. Connections
1. Piping installation requirements are specified in other Division 15. Drawings indicate general arrangement of piping, fittings, and specialties.
2. Install piping adjacent to machine to allow service and maintenance.
3. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
4. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
5. Install check valve and throttling **OR** triple-duty, **as directed**, valve on discharge side of pumps.
6. Install Y-type strainer **OR** suction diffuser, **as directed**, and shutoff valve on suction side of pumps.
7. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.
8. Install pressure gages on pump suction and discharge, at integral pressure-gage tapping, or install single gage with multiple input selector valve.
9. Install check valve and gate or ball valve on each condensate pump unit discharge.
10. Install electrical connections for power, controls, and devices.
11. Ground equipment according to Division 16 Section "Grounding And Bonding".
12. Connect wiring according to Division 16 Section "Conductors And Cables".

END OF SECTION 15083