

- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage, vent and storm drain piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
  - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
  - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  - 6. Prepare reports for tests and required corrective action.

### 3.8 CLEANING

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

END OF SECTION 15150



## SECTION 15194 - FUEL GAS PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes fuel gas piping, specialties, and accessories within the building.

#### 1.3 PROJECT CONDITIONS

- A. Design values of fuel gas supplied for these systems are as follows:

1. Nominal Heating Value: 1000 Btu/cu. ft..
2. Nominal Specific Gravity: 0.6.

#### 1.4 QUALITY ASSURANCE

- A. Electrical Components and Devices: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ANSI Standard: Comply with ANSI Z223.1, "National Fuel Gas Code."
- C. UL Standard: Provide components listed in UL's "Gas and Oil Equipment Directory" if specified to be UL listed.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Gas Valves, NPS 2 and Smaller:
    - a. BMI Canada, Inc.
    - b. Crane Valves.
    - c. Dungs: Karl Dungs, Inc.

- d. Flow Control Equipment, Inc.
  - e. Grinnell Corp.
  - f. Honeywell, Inc.
  - g. Jomar International, Ltd.
  - h. Kitz Corp. of America.
  - i. Legend Valve and Fitting, Inc.
  - j. Lyall: R. W. Lyall & Co., Inc.
  - k. McDonald: A. Y. McDonald Mfg. Co.
  - l. Milwaukee Valve Co., Inc.
  - m. Mueller Co.; Mueller Gas Products Div.
  - n. Nibco, Inc.
  - o. Red-White Valve Corp.
  - p. Velan Valve Corp.
  - q. Watts Industries, Inc.; Water Products Div.
2. Plug Valves, NPS 2-1/2 and Larger:
- a. Flow Control Equipment, Inc.
  - b. Milliken Valve Co., Inc.
  - c. Nordstrom Valves, Inc.
  - d. Olson Technologies, Inc.; Homestead Valve Div.
  - e. Walworth Co.
3. [UL-Listed Earthquake Valves:
- a. Energy Pacific.
  - b. Safe T Quake Corp.
  - c. Seismic Safety Products, Inc.
  - d. Seismic Valve Co., Inc.
  - e. Trembler-Tech, Inc.
  - f. Westcoast Seismic Protection Co., Ltd.]
4. Service Pressure Regulators:
- a. American Meter Co.
  - b. Equimeter, Inc.
  - c. Fisher Controls International, Inc.
  - d. National Meter.
  - e. Richards Industries, Inc.; Jordan Valve Div.
  - f. Schlumberger Industries; Gas Div.
5. Line Pressure Regulators:
- a. American Meter Co.
  - b. Donkin: Bryan Donkin RMG Canada, Ltd.
  - c. Eclipse Combustion, Inc.
  - d. Equimeter, Inc.
  - e. Fisher Controls International, Inc.
  - f. Maxitrol Co.
  - g. National Meter.
  - h. Richards Industries, Inc.; Jordan Valve Div.

- i. Schlumberger Industries; Gas Div.

## 2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

## 2.3 PIPES, TUBES, FITTINGS, AND JOINING MATERIALS

- A. Steel Pipe: ASTM A 53; Type E or S; Grade B; Schedule 40; black.
  - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern, with threaded ends according to ASME B1.20.1.
  - 2. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends according to ASME B1.20.1.
  - 3. Cast-Iron Flanges and Flanged Fittings: ASME B16.1, Class 125.
  - 4. Steel Welding Fittings: ASME B16.9, wrought steel or ASME B16.11, forged steel.
  - 5. Steel Threaded Fittings: ASME B16.11, forged steel with threaded ends according to ASME B1.20.1.
  - 6. Joint Compound and Tape: Suitable for natural gas.
  - 7. Steel Flanges and Flanged Fittings: ASME B16.5.
  - 8. Gasket Material: Thickness, material, and type suitable for natural gas.

## 2.4 PIPING SPECIALTIES

- A. Flexible Connectors: ANSI Z21.24, copper alloy.
- B. Quick-Disconnect Devices: ANSI Z21.41, convenience outlets and matching plug connector.

## 2.5 SPECIALTY VALVES

- A. Valves, NPS 2 and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.
- B. Valves, NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
- C. Gas Stops: Bronze body with AGA stamp, plug type with bronze plug and flat or square head, ball type with chrome-plated brass ball and lever handle, or butterfly valve with stainless-steel disc and fluorocarbon elastomer seal and lever handle; 2-psig minimum pressure rating.
- D. Gas Valves, NPS 2 and Smaller: ASME B16.33 and IAS-listed bronze body and 125-psig pressure rating.
  - 1. Tamperproof Feature: Include design for locking.

- E. Plug Valves, NPS 2-1/2 and Larger: ASME B16.38 and MSS SP-78 cast-iron, lubricated plug valves, with 125-psig pressure rating.

- 1. Tamperproof Feature: Include design for locking.

- F. [Earthquake Valves: FM approved or listed in IAS Directory as complying with ANSI Z21.70 and UL listed. Include mechanical operator.]

## 2.6 SERVICE METERS

- A. Service Meters: Positive-displacement type suitable for fuel gas service. Include metal case, temperature compensation, corrosion-resistant internal components, and flow registered in cubic feet per hour.

- 1. NPS 2 and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.
  - 2. NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
  - 3. Type: ANSI B109.3, rotary.

## 2.7 PRESSURE REGULATORS

- A. Description: Single stage and suitable for fuel gas service. Include steel jacket and corrosion-resistant components, elevation compensator, and atmospheric vent.

- 1. NPS 2 and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.
  - 2. Appliance Pressure Regulators: ANSI Z21.18. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.

- B. Pressure Regulator Vents: Factory- or field-installed, corrosion-resistant screen in opening if not connected to vent piping.

## PART 3 - EXECUTION

### 3.1 SERVICE ENTRANCE PIPING

- A. Extend fuel gas piping and connect to fuel gas distribution for service entrance to building.

- 1. Exterior fuel gas distribution system piping, service pressure regulator, and service meter will be provided by gas utility.

- B. Install dielectric fitting downstream from and adjacent to each service meter unless meter is supported from service-meter bar with integral dielectric fitting. Install shutoff valve downstream from and adjacent to dielectric fitting.

### 3.2 PIPING APPLICATIONS

- A. Flanges, unions, transition, and special fittings with pressure ratings same as or higher than system pressure rating may be used in applications below, unless otherwise indicated.
- B. Fuel Gas Piping, 0.5 psig or Less: Use the following:
  - 1. NPS 1/2 and Smaller: NPS 3/4 steel pipe, malleable-iron threaded fittings, and threaded joints.
  - 2. NPS 3/4 and NPS 1: Steel pipe, malleable-iron threaded fittings, and threaded joints.
  - 3. NPS 1-1/4 to NPS 2: Steel pipe, malleable-iron threaded fittings, and threaded joints.
  - 4. NPS 2-1/2 to NPS 4: Steel pipe, steel welding fittings, and welded joints.
  - 5. Larger Than NPS 4: Steel pipe, steel welding fittings, and welded joints.
- C. Fuel Gas Piping 2 to 5 psig: Use the following:
  - 1. NPS 2 and Smaller: Steel pipe, steel welding fittings, and welded joints.
  - 2. NPS 2-1/2 to NPS 4: Steel pipe, steel welding fittings, and welded joints.
  - 3. Larger Than NPS 4: Steel pipe, steel welding fittings, and welded joints.
- D. Underground Fuel Gas Piping: Steel pipe, steel welding fittings, and welded joints. Encase in containment conduit.
- E. Gas Service Piping at Meters and Regulators, Above 5 psig: Steel pipe, steel welding fittings, and welded joints.

### 3.3 VALVE APPLICATIONS

- A. Appliance Shutoff Valves for Pressure 0.5 psig or Less: Appliance connector valve or gas stop.
- B. Appliance Shutoff Valves for Pressure 0.5 to 2 psig: Gas stop or gas valve.
- C. Appliance Shutoff Valves for Pressure 2 to 5 psig: Gas valve.
- D. Piping Line Valves, NPS 2 and Smaller: Gas valve.
- E. Piping Line Valves, NPS 2-1/2 and Larger: Plug valve or general-duty valve.

### 3.4 PIPING INSTALLATION

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation requirements.
- B. Concealed Locations: Except as specified below, install concealed gas piping in airtight conduit constructed of Schedule 40, seamless, black steel pipe with welded joints. Vent conduit to outside and terminate with screened vent cap.

1. Above-Ceiling Locations: All welded gas piping may be installed in accessible spaces, subject to approval of authorities having jurisdiction, whether or not such spaces are used as plenums. Do not locate valves above ceilings.
  2. In Walls: Gas piping with welded joints and protective wrapping specified in "Protective Coating" Article in Part 2 may be installed in masonry walls, subject to approval of authorities having jurisdiction.
  3. Prohibited Locations: Do not install gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
    - a. Exception: Accessible above-ceiling space specified above.
- C. Drips and Sediment Traps: Install drips at points where condensate may collect. Include outlets of service meters. Locate where readily accessible for cleaning and emptying. Do not install where condensate would be subject to freezing.
1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use minimum-length nipple of 3 pipe diameters, but not less than 3 inches long, and same size as connected pipe. Install with space between bottom of drip and floor for removal of plug or cap.
- D. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels, unless indicated to be exposed to view.
- E. Install fuel gas piping at uniform grade of 0.1 percent slope upward toward risers.
- F. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- G. Connect branch piping from top or side of horizontal piping.
- H. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.
- I. Install strainer on inlet of each line pressure regulator and automatic and electrically operated valve.
- J. Install flanges on valves, specialties, and equipment having NPS 2-1/2 and larger connections.
- K. Install vent piping for gas pressure regulators and gas trains, extend outside building, and vent to atmosphere. Terminate vents with turned-down, reducing-elbow fittings with corrosion-resistant insect screens in large end.
- 3.5 HANGER AND SUPPORT INSTALLATION
- A. Refer to Division 15 Section "Hangers and Supports" for pipe hanger and support devices.



- B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
  2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
  3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
  4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
  5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

### 3.6 CONNECTIONS

- A. Connect piping to appliances using gas with shutoff valves and unions. Install valve upstream from and within 72 inches of each appliance. Install union downstream from valve.
- B. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance using gas.
- C. Ground equipment.
1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
  2. Do not use gas pipe as grounding electrode.

### 3.7 FIELD QUALITY CONTROL

- A. Inspect, test, and purge piping according to ANSI Z223.1, Part 4 "Inspection, Testing, and Purging," and requirements of authorities having jurisdiction.

END OF SECTION 15194



## SECTION 15410 - PLUMBING FIXTURES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes plumbing fixtures and related components.

#### 1.3 DEFINITIONS

- A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Fitting: Device that controls flow of water into or out of plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
  - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; about plumbing fixtures for people with disabilities.
- C. Regulatory Requirements: Comply with requirements in U.S. Architectural & Transportation Barriers Compliance Board's "Uniform Federal Accessibility Standards (UFAS), 1985-494-187" about plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
  - 1. Hand Sinks: NSF 2 construction.
  - 2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
  - 3. Stainless-Steel Fixtures Other Than Service Sinks: ASME A112.19.3M.
  - 4. Vitreous-China Fixtures: ASME A112.19.2M.
  - 5. Water-Closet, Flushometer Tank Trim: ASSE 1037.
- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
  - 1. Hose-Connection Vacuum Breakers: ASSE 1011.
  - 2. Hose-Coupling Threads: ASME B1.20.7.
  - 3. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
  - 4. Pipe Threads: ASME B1.20.1.
  - 5. Supply and Drain Fittings: ASME A112.18.1M.

## 1.5 COORDINATION

- A. Coordinate roughing-in and final plumbing fixture locations, and verify that fixtures can be installed to comply with original design and referenced standards.

## PART 2 - PRODUCTS

### 2.1 FIXTURES AND TRIM

- A. Refer to plumbing drawing P-1.2 for plumbing fixture schedule.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in for water soil and for waste piping systems and supports to verify actual locations and sizes of piping connections and that locations and types of supports match those indicated, before plumbing fixture installation. Use manufacturer's roughing-in data if roughing-in data are not indicated.
- B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 FIXTURE INSTALLATION

- A. Assemble fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. For wall-hanging fixtures, install off-floor supports affixed to building substrate.
  - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
  - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
  - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-hanging fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-hanging fixtures with tubular waste piping attached to supports.
- F. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.
- G. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
  - 1. Exception: Use ball, gate, or globe valve if stops are not specified with fixture. Refer to Division 15 Section "Valves" for general-duty valves.
- H. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- I. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- J. Install toilet seats on water closets.
- K. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- L. Install water-supply, flow-control fittings with specified flow rates in fixture supplies at stop valves.
- M. Install traps on fixture outlets.
- N. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for escutcheons.

- O. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Refer to Division 7 Section "Joint Sealants" for sealant and installation requirements.

### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect water supplies from water distribution piping to fixtures.
- C. Connect drain piping from fixtures to drainage piping.
- D. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures. Connect to plumbing piping.
- E. Supply and Waste Connections to Fixtures and Equipment Specified in Other Sections: Connect fixtures and equipment with water supplies, stops, risers, traps, and waste piping specified. Use size fittings required to match fixtures and equipment. Connect to plumbing piping.
- F. Ground equipment.
  - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.4 FIELD QUALITY CONTROL

- A. Verify that installed fixtures are categories and types specified for locations where installed.
- B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

### 3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow and stream.

- C. Replace washers and seals of leaking and dripping faucets and stops.

### 3.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
  1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
  2. Remove sediment and debris from drains.

### 3.7 PROTECTION

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

END OF SECTION 15410





## SECTION 15430 - PLUMBING SPECIALTIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following plumbing specialties:
  - 1. Backflow preventers.
  - 2. Cleanouts.
  - 3. Floor drains.
  - 4. Pharmacy water purification system.

#### 1.3 NATIONAL ACCOUNT

- A. CVS/Pharmacy has entered into a national account agreement with Innovative Medical Services for furnishing the Pharmacy water purification system specified in this section. Complete installation shall be by the Contractor. For pricing quotations, placing orders, and further information, please call Innovative Medical Services at (619) 596-9900 x102.

#### 1.4 DEFINITIONS

- A. The following are industry abbreviations for plastic piping materials:
  - 1. PVC: Polyvinyl chloride plastic.

#### 1.5 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:
  - 1. Domestic Water Piping: 125 psig.
  - 2. Sanitary Waste and Vent Piping: 10-foot head of water.

#### 1.6 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of plumbing specialties and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- B. Plumbing specialties shall bear label, stamp, or other markings of specified testing agency.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for piping materials and installation.
- E. NSF Compliance:
  - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components. Include marking "NSF-pw" on plastic potable-water piping and "NSF-dwv" on plastic drain, waste, and vent piping.
  - 2. Comply with NSF 61, "Drinking Water System Components--Health Effects, Sections 1 through 9," for potable domestic water plumbing specialties.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

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

### 2.2 BACKFLOW PREVENTERS

- A. Manufacturers:
  - 1. Ames Co., Inc.
  - 2. B & K Industries, Inc.
  - 3. Cla-Val Co.
  - 4. CMB Industries, Inc.; Febco Backflow Preventers.
  - 5. Conbraco Industries, Inc.
  - 6. FLOMATIC Corp.
  - 7. IMI Cash Valve.
  - 8. Mueller Co.; Hersey Meters Div.
  - 9. Sparco, Inc.
  - 10. Watts Industries, Inc.; Water Products Div.
  - 11. Zurn Industries, Inc.; Wilkins Div.

- B. General: ASSE standard, backflow preventers.
1. NPS 2 and Smaller: Bronze body with threaded ends.
  2. NPS 2-1/2 and Larger: Bronze, cast-iron, steel, or stainless-steel body with flanged ends.
    - a. Interior Lining: AWWA C550 or FDA-approved, epoxy coating for backflow preventers having cast-iron or steel body.
  3. Interior Components: Corrosion-resistant materials.
  4. Exterior Finish: Polished chrome plate if used in chrome-plated piping system.
  5. Strainer: On inlet, if indicated.
- C. Pipe-Applied, Atmospheric-Type Vacuum Breakers: ASSE 1001, with floating disc and atmospheric vent.
- D. Hose-Connection Vacuum Breakers: ASSE 1011, nickel plated, with nonremovable and manual drain features, and ASME B1.20.7, garden-hose threads on outlet. Units attached to rough-bronze-finish hose connections may be rough bronze.
- E. Intermediate Atmospheric-Vent Backflow Preventers: ASSE 1012, suitable for continuous pressure application. Include inlet screen and two independent check valves with intermediate atmospheric vent.
- F. Reduced-Pressure-Principle Backflow Preventers: ASSE 1013, suitable for continuous pressure application. Include outside screw and yoke gate valves on inlet and outlet, and strainer on inlet; test cocks; and pressure-differential relief valve with ASME A112.1.2 air-gap fitting located between two positive-seating check valves.
1. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
- G. Double-Check Backflow Prevention Assemblies: ASSE 1015, suitable for continuous pressure application. Include shutoff valves on inlet and outlet, and strainer on inlet; test cocks; and two positive-seating check valves.
1. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
- H. Antisiphon-Pressure-Type Vacuum Breakers: ASSE 1020, suitable for continuous pressure application. Include shutoff valves, spring-loaded check valve, spring-loaded floating disc, test cocks, and atmospheric vent.
1. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
- I. Dual-Check-Valve-Type Backflow Preventers: ASSE 1024, suitable for continuous pressure application. Include union inlet and two independent check valves.
- J. Dual-Check-Valve-Type Backflow Preventers: ASSE 1032, suitable for continuous pressure application for carbonated beverage dispensers. Include stainless-steel body; primary and secondary checks; ball check; intermediate atmospheric-vent port for relieving carbon dioxide; and threaded ends, NPS 3/8.

- K. Hose-Connection Backflow Preventers: ASSE 1052, suitable for at least 3-gpm flow and applications with up to 10-foot head of water back pressure. Include two check valves; intermediate atmospheric vent; and nonremovable, ASME B1.20.7, garden-hose threads on outlet.

### 2.3 MISCELLANEOUS PIPING SPECIALTIES

- A. Water Hammer Arresters: ASSE 1010 or PDI-WH 201, piston type with pressurized metal-tube cushioning chamber. Sizes indicated are based on ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.
  - 1. Manufacturers:
    - a. Amtrol, Inc.
    - b. Josam Co.
    - c. Precision Plumbing Products, Inc.
    - d. Sioux Chief Manufacturing Co., Inc.
    - e. Watts Industries, Inc.; Drainage Products Div.
    - f. Watts Industries, Inc.; Water Products Div.
    - g. Zurn Industries, Inc.; Wilkins Div.
- B. Hose Bibbs: Refer to plumbing drawing P-1.2 – Plumbing Fixture Schedule.
- C. Deep-Seal Traps: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap seal primer valve connection.
  - 1. NPS 2: 4-inch- minimum water seal.
  - 2. NPS 2-1/2 and Larger: 5-inch- minimum water seal.
- D. Floor-Drain Inlet Fittings: Cast iron, with threaded inlet and threaded or spigot outlet, and trap seal primer valve connection.
- E. Fixed Air-Gap Fittings: Manufactured cast-iron or bronze drainage fitting with semiopen top with threads or device to secure drainage inlet piping in top and bottom spigot or threaded outlet larger than top inlet. Include design complying with ASME A112.1.2 that will provide fixed air gap between installed inlet and outlet piping.
- F. Stack Flashing Fittings: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
- G. Vent Caps: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and set-screws to secure to vent pipe.
- H. Vent Terminals: Commercially manufactured, shop- or field-fabricated, frost-proof assembly constructed of galvanized steel, copper, or lead-coated copper. Size to provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

- I. Expansion Joints: ASME A112.21.2M, assembly with cast-iron body with bronze sleeve, packing gland, and packing; of size and end types corresponding to connected piping.
- 2.4 CLEANOUTS
- A. Refer to plumbing drawing P-1.2 – Plumbing Fixture Schedule.
- 2.5 FLOOR DRAINS
- A. Refer to plumbing drawing P-1.2 – Plumbing Fixture Schedule.
- 2.6 PHARMACY WATER PURIFICATION SYSTEM
- A. Manufacturer: Innovative Medical Services (IMS), El Cajon, California (no substitutes).
  - B. Description: "Fillmaster Pharmapure" water purification system including the "Scanmaster 1000e" fully programmed digital dispenser, filtration system, water storage tank, air-gap faucet, drain adapter, tubing, installation cabinet and all necessary hardware.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
  1. Locate backflow preventers in same room as connected equipment or system.
  2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
  3. Do not install bypass piping around backflow preventers.
- C. Install pressure regulators with inlet and outlet shutoff valves and balance valve bypass. Install pressure gages on inlet and outlet.
- D. Install strainers on supply side of each control valve, pressure regulator, and solenoid valve.
- E. Install expansion joints on vertical risers, stacks, and conductors if indicated.

- F. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
  - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
  - 2. Locate at each change in direction of piping greater than 45 degrees.
  - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
  - 4. Locate at base of each vertical soil and waste stack.
- G. Install cleanout deck plates with top flush with finished floor, for floor cleanouts for piping below floors.
- H. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.
- I. Install flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.
- J. Install vent flashing sleeves on stacks passing through roof. Secure over stack flashing according to manufacturer's written instructions.
- K. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- L. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
  - 1. Position floor drains for easy access and maintenance.
  - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
    - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
    - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
    - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
  - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
  - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- M. Install pharmacy water purification system as shown on the Drawings and in accordance with manufacturer's instructions.

### 3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Connect plumbing specialties to piping specified in other Division 15 Sections.
- D. Ground equipment.
- E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- F. Connect plumbing specialties and devices that require power according to Division 16 Sections.

### 3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
  - 1. Lead Sheets: Burn joints of lead sheets 6-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4-lb/sq. ft., 0.0625-inch thickness or thinner.
  - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
  - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
  - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
  - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 7 Section "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled and their installation, including piping and electrical connections. Report results in writing.
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. 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.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

### 3.5 PROTECTION

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

END OF SECTION 15430



## SECTION 15485 - ELECTRIC, DOMESTIC WATER HEATERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following for domestic water systems:
  - 1. Tankless, electric water heaters.
  - 2. Commercial, electric water heaters.
  - 3. Compression tanks.
  - 4. Accessories.

#### 1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain same type of water heaters through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of water heaters and are based on specific units indicated. Other manufacturers' products complying with requirements may be considered. Refer to Division 1 Section "Substitutions."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. ASME Compliance: Fabricate and label water heater, hot-water storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.
- E. ASHRAE Standards: Comply with performance efficiencies prescribed for the following:
  - 1. ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings," for commercial water heaters.

#### 1.4 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

- B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of water heaters that fail in materials or workmanship within specified warranty period.
  - 1. Failures include heating elements and storage tanks.
  - 2. Warranty Period: From date of Substantial Completion:
    - a. Heating Elements: 1 year.
    - b. Storage Tanks: 6 years.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Point-of-Use, Tankless, Electric Water Heaters:
    - a. Chronomite Laboratories, Inc.
    - b. Eemax, Inc.
    - c. PVI Industries, Inc.
  - 2. Commercial, Point-of-Use, Small-Capacity, Electric Water Heaters:
    - a. Lochinvar Corp.
    - b. Rheem Manufacturing Co.; Ruud Water Heater Div.
    - c. Smith: A. O. Smith Water Products Co.
    - d. State Industries.
  - 3. Water Heater Stand and Drain Pan Units:
    - a. Safety: W. H. Safety Products, Inc.
  - 4. Compression Tanks:
    - a. Amtrol, Inc.
    - b. Armstrong Pumps, Inc.
    - c. Myers: F. E. Myers.
    - d. Smith: A. O. Smith; Aqua-Air Div.
    - e. State Industries.
    - f. Taco, Inc.
    - g. Wessels Co.
    - h. Zurn Industries, Inc.; Wilkins Div.

### 2.2 POINT-OF-USE, STORAGE, ELECTRIC WATER HEATERS

- A. Description: Automatic, electric vertical storage type with capacity, recovery rates, and electrical characteristics as scheduled with 100 degrees F temperature rise, 150 psig maximum working pressure.
- B. Storage Tank Construction: non-ASME code steel with 150-psig (1035-kPa) working-pressure rating.
  - 1. Tappings: Factory fabricated of materials compatible with tank for piping connections, relief valve, drain, anode rod, and controls as required. Attach tappings to tank before testing and labeling. Include ASME B1.20.1, pipe thread.
  - 2. Interior Finish: Materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
  - 3. Insulation: Comply with ASHRAE 90.1. Surround entire storage tank except connections and controls.
  - 4. Jacket: Steel, with enameled finish.
- C. Heating Elements: Two, unless otherwise indicated; electric, screw-in, immersion type.
  - 1. Temperature Control: Adjustable thermostat.
- D. Anode Rod: Factory installed, magnesium.
- E. Drain Valve: ASSE 1005, corrosion-resistant metal, factory installed.
- F. Special Requirement: NSF 5 construction.

### 2.3 POINT-OF-USE, INSTANTANEOUS, ELECTRICAL WATER HEATERS

- A. Tankless point of use water heater for instantaneous/unlimited hot water demand with electrical characteristics as scheduled, and 150 psig maximum working pressure.
- B. Cast aluminum alloy casing, plastic element assembly with stainless steel heating coils.
- C. Differential pressure flow activated switch and integral high temperature cut-off at 190 degrees F.

### 2.4 COMPRESSION TANKS

- A. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
- B. Construction: 150-psig (1035-kpa) working-pressure rating.
- C. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1, pipe thread.
- D. Tank Interior Finish: Materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
- E. Tank Exterior Finish: Manufacturer's standard, unless finish is indicated.
- F. Air-Charging Valve: Factory installed.

## 2.5 WATER HEATER ACCESSORIES

- A. Combination Temperature and Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into tank.
  - 1. Option: Separate temperature and pressure relief valves are acceptable instead of combination relief valve.
  - 2. Exception: Omit combination temperature and pressure relief valve for tankless water heater, and furnish pressure relief valve for installation in piping.
- B. Vacuum Relief Valves: Comply with ASME PTC 25.3. Furnish for installation in piping.
  - 1. Exception: Omit if water heater has integral vacuum-relieving device.
- C. Water Heater Stand and Drain Pan Units: High-density-polyethylene-plastic, 18-inch- (457-mm-) high, enclosed-base stand complying with IAPMO PS 103 and IAS No. 2. Include integral or separate drain pan with raised edge and NPS 1 (DN25) drain outlet with ASME B1.20.1, pipe thread.
- D. Water Heater Stands: Water heater manufacturer's factory-fabricated, steel stand for floor mounting and capable of supporting water heater and water. Include dimension that will support bottom of water heater a minimum of 18 inches (457 mm) above the floor.
- E. Water Heater Mounting Brackets: Water heater manufacturer's factory-fabricated, steel bracket for wall mounting and capable of supporting water heater and water.
- F. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of water heater and include drain outlet not less than NPS 3/4 (DN20).

## PART 3 - EXECUTION

## 3.1 WATER HEATER INSTALLATION

- A. Install water heaters on concrete bases.
  - 1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
- B. Install water heaters, 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.
- C. Anchor water heaters to substrate.
- D. **[Install seismic restraints for water heaters when specified by local codes.] [Anchor to substrate.]**
- E. Install temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend relief valve outlet with water piping in continuous downward pitch and discharge onto closest floor drain.

- F. Install vacuum relief valves in cold-water-inlet piping.
- G. Install water heater drain piping as indirect waste to spill into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 15 Section "Plumbing Specialties" for drain valves.
- H. Install thermometers on water heater inlet and outlet piping.
- I. Fill water heaters with water.
- J. Charge compression tanks with air.
- K. Install instantaneous water heaters in accordance *with* manufacturer's instructions.

### 3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Make connections with dielectric fittings where piping is made of dissimilar metal.
- D. Electrical Connections: Power wiring and disconnect switches are specified in Division 16 Sections. Arrange wiring to allow unit service.
- E. Ground equipment.
  - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.3 FIELD QUALITY CONTROL

- A. Engage a factory-authorized service representative to perform startup service.
- B. In addition to manufacturer's written installation and startup checks, perform the following:
  - 1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 2. Verify that piping system tests are complete.
  - 3. Check for piping connection leaks.
  - 4. Check for clear relief valve inlets, outlets, and drain piping.
  - 5. Test operation of safety controls, relief valves, and devices.
  - 6. Energize electric circuits.
  - 7. Adjust operating controls.
  - 8. Adjust hot-water-outlet temperature settings. Do not set above 140 deg F (60 deg C) unless piping system application requires higher temperature.

END OF SECTION 15485



## SECTION 15543 - FUEL-FIRED UNIT HEATERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes gas-fired unit heaters.

#### 1.2 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

#### 1.3 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace heat exchanger of fuel-fired unit heater that fail in materials and workmanship within five years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

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

#### 2.2 GAS-FIRED UNIT HEATERS

- A. Manufacturers:

- 1. Modine Manufacturing Company, provided by York International Corporation.
    - a. Model Number: HD 75AS011.

- B. Description: Factory assembled, piped, and wired, and complying with AGA Z83.8, "Gas Unit Heaters."

- 1. AGA Approval: Designed and certified by and bearing label of American Gas Association.

2. Type of Gas: Designed and built to burn natural gas with characteristics same as those of gas available at Project site.
- C. Venting: Gravity.
- D. Housing: Steel, with integral draft hood and inserts for suspension mounting rods.
- E. Heat Exchanger: Aluminized.
- F. Burners: Stainless steel.
- G. Unit Fan: Propeller fan with aluminum blades dynamically balanced and resiliently mounted.
  1. Steel fan-blade guard.
  2. Motors: Totally enclosed with internal thermal-overload protection and complying with Division 15 Section "Motors."
- H. Controls: Regulated redundant 24-V ac gas valve containing pilot solenoid valve, electric gas valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff all in one body.
  1. Gas Control Valve: Single stage.
  2. Ignition: Electronically controlled electric spark with flame sensor.
  3. Fan Thermal Switch: Operates fan on heat-exchanger temperature.
  4. Vent Flow Verification: Differential pressure switch to verify open vent.
  5. Control Transformer: 24 V ac.
  6. High Limit: Thermal switch or fuse to stop burner.
  7. Sensors, components, and wiring are specified in Division 15 Section "HVAC Instrumentation and Controls."
  8. Thermostat: Single-stage, 24-V ac, wall-mounting type with 50 to 90 deg F operating range and fan on switch.
- I. Discharge Louvers: Independently adjustable horizontal blades.
  1. Unit-mounted thermostat bracket.

## 2.3 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested, fuel-fired unit heater before shipping.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install unit heaters level and plumb.



- B. Suspended Units: Suspend from substrate using threaded rods, spring hangers, and building attachments. Secure rods to unit hanger attachments. Adjust hangers so unit is level and plumb.
- C. Substrate-Mounted Units: Provide supports connected to substrate. Secure units to supports.
- D. Spring hangers are specified in Division 15 Section "Mechanical Vibration and Seismic Controls."

### 3.2 CONNECTIONS

- A. Install piping adjacent to machine to allow service and maintenance.
- B. Gas Piping: Comply with applicable requirements in Division 15 Section "Fuel Gas Piping." Connect gas piping to gas train inlet; provide union with enough clearance for burner removal and service. Provide AGA-approved flexible units.
- C. Connect vents according to Division 15 Section "Breechings, Chimneys, and Stacks."
- D. Electrical: Comply with applicable requirements in Division 16 Sections.
  - 1. Install electrical devices furnished with heaters but not specified to be factory mounted.
- E. Ground equipment according to Division 16 Section "Grounding and Bonding."

### 3.3 FIELD QUALITY CONTROL

- A. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

### 3.4 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Adjust burner and other unit components for optimum heating performance and efficiency.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fuel-fired unit heaters. Refer to Division 1 Section "Demonstration and Training".

END OF SECTION 15543  
CVS 12/99



## SECTION 15782 - ROOFTOP UNITS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes rooftop heating and cooling units.

#### 1.3 NATIONAL ACCOUNT

- A. CVS/Pharmacy has entered into a national account agreement with York for furnishing the HVAC roof top units specified in this section. Complete installation shall be by the Contractor. For pricing quotations, placing orders, and further information, call York at (800) 775-9675 ext. 6084.

#### 1.4 QUALITY ASSURANCE

- A. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."
- B. Energy Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- C. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- D. Listing and Labeling: Provide electrically operated components specified in this Section that are listed and labeled.
  - 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
- E. Comply with AGA Z223.1 for gas-fired furnace section.
- F. Comply with NFPA 70.

#### 1.5 COORDINATION

- A. Coordinate installation of roof curbs, equipment supports, and roof penetrations with roof construction.

## 1.6 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: A written warranty, executed by the manufacturer and signed by the Contractor, agreeing to replace components that fail in materials or workmanship, within the specified warranty period, provided manufacturer's written instructions for installation, operation, and maintenance have been followed.
  - 1. Warranty Period, Compressors: Manufacturers standard, but not less than 5 years after date of Substantial Completion.
  - 2. Warranty Period, Heat Exchangers: Manufacturers standard, but not less than 10 years after date of Substantial Completion.

## 1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
  - 1. Fan Belts: One set for each belt-drive fan.
  - 2. Filters: One set of filters for each unit.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide rooftop A/C units manufactured by York.

### 2.2 ROOFTOP UNITS

- A. Description: Factory assembled and tested; single package air to air DX cooling and heating system; down-flow configuration; designed for roof installation; and consisting of compressors, condensers, evaporator coils, condenser and evaporator fans, refrigeration and temperature controls, filters, and dampers.
- B. Casing: Manufacturer's standard construction with enamel paint exterior finish, removable panels or access doors with neoprene gaskets for inspection and access to internal parts, minimum 1/2-inch-thick thermal insulation, knockouts for electrical and piping connections, exterior condensate drain connection, and lifting lugs.

- C. Evaporator Fans: Forward curved, centrifugal, belt driven with adjustable sheaves or direct-drive fans; and with permanently lubricated motor bearings.
- D. Power Exhaust Fans (only where indicated): Forward-curved, centrifugal or propeller type, directly driven with permanently lubricated motor bearings.
- E. Condenser Fans: Propeller type, directly driven with permanently lubricated motor bearings.
- F. Refrigerant Coils: Aluminum-plate fin and seamless copper tube in galvanized steel casing with equalizing-type vertical distributor.
- G. Compressors: Serviceable, semihermetic, or fully hermetic compressors with integral vibration isolators and crankcase heaters.
  - 1. Safety Controls: Manual-reset type for low pressure, high pressure, and compressor motor overload protection.
  - 2. Timed-Off Control: Automatic-reset control shuts compressor off after 5 minutes.
- H. Heat Exchangers: Manufacturer's standard construction for induced draft gas-fired heat exchangers and burners with the following controls:
  - 1. Redundant, dual gas valves (3-6 tons: single stage; 7 ½ ton and larger 2-stage).
  - 2. Electronic-spark ignition system.
  - 3. High-limit cutout.
  - 4. Forced-draft proving switch.
- I. Economizer: Factory installed, return- and outside-air low leakage dampers, outside-air hood with filter, fully modulating electronic-control system with adjustable mixed-air thermostat (55°F set point) and automatic changeover through adjustable differential enthalpy-control device, and adjustable outdoor air minimum positioner; designed for 100% outside-air.
- J. Low Ambient Control: Head-pressure control, designed to operate at temperatures as low as 0 deg F.
- K. Sensor/ Thermostat: Provide temporary thermostat Honeywell Model T874D-1165 with sub-base model Q674A1019 or equal at all sensor locations. All thermostats will be removed and discarded by Energy Management System contractor.
- L. Smoke Detectors: Photoelectric detector to de-energize unit.
- M. Coastal Requirements: There are two different options to be specified in coastal area.
  - 1. Project located within five (5) miles of a body of salt water: The condenser coil and evaporator coil shall be coated using Technicoat 10-1 processes.
  - 2. Project located between five (5) and fifteen (15) miles from a body of salt water: The condenser coil shall be coated using Technicoat 10-1 processes.

## 2.3 ROOF CURBS

- A. Manufacturer's standard, insulated with corrosion-protection coating, gasketing, factory-installed wood nailer, according to NRCA standards.
  - 1. Curb Height: Minimum 14 inches.
  - 2. Burglar Bars: Furnished by rooftop A/C unit manufacturer for field installation. Designed to install in the supply and return air openings of the roof curb.

## 2.4 CONDENSATE PIPING

- A. Hard Copper Tube: ASTM B 88, Type M, water tube, drawn temper.
  - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
  - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
  - 3. Copper Unions: MSS SP-123, cast-copper alloy, hexagonal-stock body, with ball-and-socket, metal-to metal seating surfaces and solder-joint or threaded ends.
  - 4. Copper, Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.
    - a. Copper-Tubing, Keyed Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for hot water, and bolts and nuts.

## 2.5 MOTORS

- A. Motor Construction: NEMA MG 1, general purpose, continuous duty, Design B.
- B. Enclosure Type: Open, dripproof.

## 2.6 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate capacity according to ARI 210/240, "Unitary Air-Conditioning and Air Source Heat Pump Equipment" for units with capacity 135,000 BTUH or greater.
- B. Verification of Performance: Rate capacity according to ARI 360, "Commercial and Industrial Unitary Air-Conditioning Equipment."
  - 1. Sound Power Level Ratings: Comply with ARI 270, "Standard for Sound Rating of Outdoor Unitary Equipment."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roof for compliance with requirements for conditions affecting installation and performance of rooftop units. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install units according to manufacturer's written instructions.
- B. Install units level and plumb, maintaining manufacturer's recommended clearances.
- C. Curb Support: Install roof curb on roof structure, level, according to NRCA's written installation instructions. Install and secure rooftop units on curbs and coordinate roof penetrations and flashing with roof construction.
- D. Condensate Piping:
  - 1. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation.
  - 2. Install condensate piping at minimum 1% downward slope in direction of flow unless otherwise indicated.
  - 3. Refer to Division 15 Section "Pipe Insulation" for basic piping insulation requirements.
  - 4. Condensate drain: All sizes Type "M" Copper

### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
  - 1. Install piping to allow service and maintenance.
  - 2. Gas Piping: Conform to applicable requirements of Division 15 Section "Natural Gas Piping." Connect gas piping to burner, full size of gas train inlet, and provide union with sufficient clearance for burner removal and service.
- B. Duct installation requirements are specified in other Division 15 Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
  - 1. Install ducts to termination in roof mounting frames. Roof penetrations shall be no larger than the ductwork size plus 1-inch. Insulate space between roof and bottom of unit.
  - 2. Install burglar bars in both supply and return air openings of roof curb.
- C. Electrical: Conform to applicable requirements in Division 16 Sections.
- D. Ground equipment.

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

#### 3.4 TESTING

- A. Manufacturer shall perform an Equipment Performance Check (E.P.C.). The E.P.C. shall be conducted by a factory trained field service representative.
- B. Submit report to Owner for approval. Report shall include a list of items checked/verified and actual performance data under both heating and cooling operations.
- C. Schedule E.P.C. with manufacturer after complete installation and start-up of equipment. Give manufacturer a minimum of 2 weeks notice. System must be operational a minimum of 24 hours before E.P.C.

END OF SECTION 15782



## SECTION 15815 - METAL DUCTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes rectangular and round, metal ducts for heating, ventilating, and air-conditioning systems in pressure classes from minus 2- to plus 10-inch wg.

#### 1.3 SYSTEM DESCRIPTION

- A. Duct system design, as indicated, has been used to select and size air-moving and -distribution equipment and other components of air system. Changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

#### 1.4 QUALITY ASSURANCE

- A. Comply with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems," unless otherwise indicated.

### PART 2 - PRODUCTS

#### 2.1 SHEET METAL MATERIALS

- A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.
- B. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

## 2.2 DUCT LINER

- A. General: Comply with NFPA 90A or NFPA 90B and NAIMA's "Fibrous Glass Duct Liner Standard."
- B. Materials: ASTM C 1071 with coated surface exposed to airstream to prevent erosion of glass fibers.
  - 1. Thickness: 1 inch.
  - 2. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
  - 3. Fire-Hazard Classification: Maximum flame-spread rating of 25 and smoke-developed rating of 50, when tested according to ASTM C 411.
  - 4. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and ASTM C 916.
  - 5. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in duct.

## 2.3 SEALANT MATERIALS

- A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.
  - 1. Joint and Seam Tape: 2 inches wide; glass-fiber fabric reinforced.
  - 2. Tape Sealing System: Woven-fiber tape impregnated with a gypsum mineral compound and a modified acrylic/silicone activator to react exothermically with tape to form a hard, durable, airtight seal.

## 2.4 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for building materials.
  - 1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  - 2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- B. Hanger Materials: Galvanized, sheet steel or round, threaded steel rod.
  - 1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rod or galvanized rods with threads painted after installation.
  - 2. Straps and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for sheet steel width and thickness and for steel rod diameters.
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

- D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
  - 1. Supports for Galvanized-Steel Ducts: Galvanized steel shapes and plates.

## 2.5 DUCT FABRICATION

- A. General: Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction with galvanized, sheet steel, according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Comply with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
  - 1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.
  - 2. Materials: Free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.
- B. Static-Pressure Classifications: Unless otherwise indicated, construct ducts to the following:
  - 1. Supply Ducts: 1-inch wg.
  - 2. Return Ducts: 1-inch wg, negative pressure.
  - 3. Exhaust Ducts: 1-inch wg, negative pressure.

## PART 3 - EXECUTION

### 3.1 DUCT INSTALLATION, GENERAL

- A. Duct installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of ducts, fittings, and accessories.
- B. Install ducts, unless otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs.
- C. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- D. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same metal thickness as duct. Overlap opening on four sides by at least 1-1/2 inches.

### 3.2 SEAM AND JOINT SEALING

- A. General: Seal duct seams and joints according to the duct pressure class indicated and as described in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

- B. Pressure Classification Less Than 2-Inch wg: Transverse joints.
- C. Seal externally insulated ducts before insulation installation.

### 3.3 HANGING AND SUPPORTING

- A. Install rigid round and rectangular, metal duct with support systems indicated in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.
- C. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
- D. Install concrete inserts before placing concrete.
- E. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

### 3.4 CONNECTIONS

- A. Connect equipment with flexible connectors according to Division 15 Section "Duct Accessories."
- B. For branch, outlet and inlet, and terminal unit connections, comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

### 3.5 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect the system. Vacuum ducts before final acceptance to remove dust and debris.

END OF SECTION 15815

## SECTION 15820 - DUCT ACCESSORIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Backdraft dampers.
  - 2. Manual-volume dampers.
  - 3. Fire and smoke dampers.
  - 4. Zoning Dampers
  - 5. Turning vanes.
  - 6. Duct-mounted access doors and panels.
  - 7. Flexible ducts.
  - 8. Flexible connectors.
  - 9. Duct accessory hardware.

#### 1.3 QUALITY ASSURANCE

- A. NFPA Compliance: Comply with the following NFPA standards:
  - 1. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

### PART 2 - PRODUCTS

#### 2.1 SHEET METAL MATERIALS

- A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.

#### 2.2 BACKDRAFT DAMPERS

- A. Description: Suitable for horizontal or vertical installations.
- B. Frame: 0.052-inch- thick, galvanized, sheet steel, with welded corners and mounting flange.
- C. Blades: 0.025-inch- thick, roll-formed aluminum.

- D. Blade Seals: Neoprene.
- E. Tie Bars and Brackets: Aluminum.
- F. Return Spring: Adjustable tension.

## 2.3 MANUAL-VOLUME DAMPERS

- A. General: Factory fabricated with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
  - 1. Pressure Classifications of 3-Inch wg or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.
- B. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
  - 1. Steel Frames: Hat-shaped, galvanized, sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
  - 2. Roll-Formed Steel Blades: 0.064-inch- thick, galvanized, sheet steel.
  - 3. Blade Axles: Nonferrous.
  - 4. Tie Bars and Brackets: Galvanized steel.

## 2.4 FIRE DAMPERS

- A. General: Labeled to UL 555.
- B. Fire Rating: One and one-half hours.
- C. Frame: SMACNA Type B with blades out of airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- D. Mounting Sleeve: Factory- or field-installed galvanized, sheet steel.
  - 1. Minimum Thickness: 0.052 inch or 0.138 inch thick as indicated, and length to suit application.
  - 2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.
- E. Mounting Orientation: Vertical or horizontal as indicated.

- B. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 to 18 inches to suit duct size.
- C. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install duct accessories according to applicable details shown in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and NAIMA's "Fibrous Glass Duct Construction Standards" for fibrous-glass ducts.
- B. Install volume dampers in lined duct; avoid damage to and erosion of duct liner.
- C. Provide test holes at fan inlet and outlet and elsewhere as indicated.
- D. Install fire dampers, smoke dampers, and zoning dampers according to manufacturer's UL-approved written instructions.
  - 1. Install fusible links in fire dampers.
- E. Install duct access panels downstream from volume dampers, fire dampers, turning vanes, and equipment.
  - 1. Install duct access panels to allow access to interior of ducts for cleaning, inspecting, adjusting, and maintaining accessories and terminal units.
  - 2. Install access panels on side of duct where adequate clearance is available.
- F. Label access doors according to Division 15 Section "Mechanical Identification."

#### 3.2 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust fire dampers, smoke dampers, and zoning dampers for proper action.
- C. Final positioning of manual-volume dampers is specified in Division 15 Section "Testing, Adjusting, and Balancing."

END OF SECTION 15820





## SECTION 15838 - POWER VENTILATORS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Ceiling-mounting ventilators.

#### 1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Listing: U.L. listed.

#### 1.4 COORDINATION

- A. Coordinate size and location of structural-steel support members.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ceiling-Mounting Ventilators:
    - a. Breidert Air Products, Inc.
    - b. Broan Mfg. Co., Inc.
    - c. Cook, Loren Company.
    - d. Dayton Electric Manufacturing Co.
    - e. NuTone Inc.
    - f. Penn Ventilation Companies, Inc.

## 2.2 CEILING-MOUNTING VENTILATORS

- A. Description: Centrifugal fans designed for installing in ceiling
- B. Housing: Steel, lined with acoustical insulation.
- C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
- D. Grille: Plastic, louvered grille with flange on intake.
- E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.
- F. Accessories:
  - 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 percent to less than 50 percent.
  - 2. Isolation: Rubber-in-shear vibration isolators.
  - 3. Manufacturer's standard roof jack or wall cap, and transition fittings.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install power ventilators level and plumb in accordance with manufacturer's instructions.
- B. Support suspended units from structure using threaded steel rods and rubber-in-shear isolators.
- C. Install units with clearances for service and maintenance.

### 3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 15 Section "Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment.

END OF SECTION 15838

## SECTION 15855 - DIFFUSERS, REGISTERS, AND GRILLES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

#### 1.3 DEFINITIONS

- A. Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.
- B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.
- C. Register: A combination grille and damper assembly over an air opening.

#### 1.4 QUALITY ASSURANCE

- A. Product Options: Drawings and schedules indicate specific requirements of diffusers, registers, and grilles and are based on the specific requirements of the systems indicated. Other manufacturers' products with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURED UNITS

- A. Diffusers, registers, and grilles are scheduled on Drawings.

#### 2.2 SOURCE QUALITY CONTROL

- A. Testing: Test performance according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

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

#### 3.3 ADJUSTING

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

#### 3.4 CLEANING

- A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION 15855

SECTION 15940 - SEQUENCE OF OPERATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes control sequences for HVAC systems, subsystems, and equipment.

1.3 SINGLE-ZONE, SINGLE-DUCT, CONSTANT-VOLUME, AIR-HANDLING UNIT CONTROL SEQUENCES

- A. Fan Control: Thermostat starts fan to run continuously during occupied periods. Thermostat cycles fan during unoccupied periods.
- B. Smoke Detector: Smoke detector, located in supply air, signals alarm, stops fan, and closes smoke dampers when products of combustion are detected in air stream. Interlock manual firemen start/stop switch and fire alarm control panel to override smoke detector and provide manual override operation of RTU in accordance with local and state building codes.
- C. Mixed-Air Control: During occupied periods, when fan is running, economizer controller modulates outside-air, return-air, and relief-air dampers to maintain supply-air temperature.
  - 1. During occupied periods, when fan is running, open outside-air dampers to minimum position.
  - 2. During heating sequence, set outside-air dampers to minimum position.
  - 3. When outside-air enthalpy exceeds return-air enthalpy, set outside-air dampers to minimum position.
  - 4. During unoccupied periods, position outside-air and relief-air dampers closed and return-air dampers open.
- D. Filters: During occupied periods, when fan is running, differential air-pressure transmitter signals alarm when low- and high-pressure conditions exist.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 15940



## SECTION 15990 - TESTING, ADJUSTING, AND BALANCING

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:
  - 1. Balancing airflow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
  - 2. Adjusting total HVAC systems to provide indicated quantities.
  - 3. Measuring electrical performance of HVAC equipment.
  - 4. Setting quantitative performance of HVAC equipment.
  - 5. Verifying that automatic control devices are functioning properly.
  - 6. Reporting results of the activities and procedures specified in this Section.

## 1.3 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.
- C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- E. Report Forms: Test data sheets for recording test data in logical order.
- F. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- G. Test: A procedure to determine quantitative performance of a system or equipment.
- H. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.

- I. AABC: Associated Air Balance Council.
- J. AMCA: Air Movement and Control Association.
- K. NEBB: National Environmental Balancing Bureau.
- L. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

#### 1.4 QUALITY ASSURANCE

- A. Agent Qualifications: Engage a testing, adjusting, and balancing agent certified by AABC.
- B. Testing, Adjusting, and Balancing Reports: Use standard forms from AABC's "National Standards for Testing, Adjusting, and Balancing."
- C. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards.
- D. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

#### 1.5 PROJECT CONDITIONS

- A. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

#### 1.6 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.

#### 1.7 WARRANTY

- A. General Warranty: The national project performance guarantee specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. National Project Performance Guarantee: Provide a guarantee on AABC'S "National Standards" forms stating that AABC will assist in completing the requirements of the Contract Documents if the testing, adjusting, and balancing Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:

#### PART 2 - PRODUCTS (Not Applicable)



## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.
  - 1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
  - 2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine Architect's and Engineer's 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.
- D. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
- E. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- F. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- G. Examine equipment for installation and for properly operating safety interlocks and controls.
- H. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

## 3.2 PREPARATION

- A. Complete system readiness checks and prepare system readiness reports. Verify the following:
  - 1. Permanent electrical power wiring is complete.
  - 2. Automatic temperature-control systems are operational.
  - 3. Equipment and duct access doors are securely closed.
  - 4. Balance and fire dampers are open.

5. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
6. Windows and doors can be closed so design conditions for system operations can be met.

### 3.3 GENERAL TESTING AND BALANCING PROCEDURES

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC national standards and this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.
- C. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

### 3.4 FUNDAMENTAL AIR SYSTEMS' BALANCING PROCEDURES

- A. 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.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- D. Verify that motor starters are equipped with properly sized thermal protection.
- E. Check dampers for proper position to achieve desired airflow path.
- F. Check for airflow blockages.
- G. Check condensate drains for proper connections and functioning.
- H. Check for proper sealing of air-handling unit components.

### 3.5 CONSTANT-VOLUME AIR SYSTEMS' BALANCING PROCEDURES

- A. The procedures in this Article apply to constant-volume supply-, return-, and exhaust-air systems.
- B. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the fan manufacturer.

1. Measure fan static pressures to determine actual static pressure as follows:
    - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
    - b. Measure static pressure directly at the fan outlet or through the flexible connection.
    - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
  2. Adjust fan speed higher or lower than design with the approval of the Architect. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
  3. 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 no overload will occur. Measure amperage in full cooling, full heating, and economizer modes to determine the maximum required brake horsepower.
- C. Adjust volume dampers for main duct, submain ducts, and major branch ducts to design airflows within specified tolerances.
1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
    - a. Where sufficient space in submains 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.
  2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submains and branch ducts to design airflows within specified tolerances.
- D. Measure terminal outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or the outlet manufacturer's written instructions and calculating factors.
- E. Adjust terminal outlets and inlets for each space to design airflows within specified tolerances of design values. Make adjustments using volume dampers rather than extractors and the dampers at the air terminals.
1. Adjust each outlet in the same room or space to within specified tolerances of design quantities without generating noise levels above the limitations prescribed by the Contract Documents.
  2. Adjust patterns of adjustable outlets for proper distribution without drafts.

### 3.6 MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
  - 1. Manufacturer, model, and serial numbers.
  - 2. Motor horsepower rating.
  - 3. Motor rpm.
  - 4. Efficiency rating if high-efficiency motor.
  - 5. Nameplate and measured voltage, each phase.
  - 6. Nameplate and measured amperage, each phase.
  - 7. Starter thermal-protection-element rating.

### 3.7 TEMPERATURE TESTING

- A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of 2 successive 8-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

### 3.8 TOLERANCES

- A. Set HVAC system airflow rates within the following tolerances:
  - 1. Supply, Return, and Exhaust Fans: Plus 10 or minus 5 percent.
  - 2. Supply Air Outlets: Plus or minus 5 percent.
  - 3. Return and Exhaust Air Inlets: Plus or minus 10 percent.

### 3.9 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
  - 1. Include a list of the instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to the certified field report data, include the following:
  - 1. Fan curves.
  - 2. Manufacturers' test data.

3. Field test reports prepared by system and equipment installers.
  4. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.
- D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:
1. Title page.
  2. Name and address of testing, adjusting, and balancing Agent.
  3. Project name.
  4. Project location.
  5. Architect's name and address.
  6. Engineer's name and address.
  7. Contractor's name and address.
  8. Report date.
  9. Signature of testing, adjusting, and balancing Agent who certifies the report.
  10. Summary of contents, including the following:
    - a. Design versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  11. Notes to explain why certain final data in the body of reports vary from design values.
- E. Instrument Calibration Reports: For instrument calibration, include the following:
1. Report Data: Include the following:
    - a. Instrument type and make.
    - b. Serial number.
    - c. Application.
    - d. Dates of use.
    - e. Dates of calibration.

### 3.10 ADDITIONAL TESTS

- A. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial testing, adjusting, and balancing procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions.

END OF SECTION 15990

