

SECTION 40 27 02
PROCESS VALVES AND OPERATORS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Gas Association (AGA): 3, Orifice Metering of Natural Gas and Other Related Hydrocarbon Fluids.
2. American National Standards Institute (ANSI): Z21.15, Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves.
3. American Society of Mechanical Engineers (ASME):
 - a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 - b. B16.44, Manually Operated Metallic Gas Valves for Use in Above Ground Piping Systems up to 5 psi.
4. American Society of Sanitary Engineers (ASSE): 1011, Performance Requirements for Hose Connection Vacuum Breakers.
5. American Water Works Association (AWWA):
 - a. C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - b. C500, Metal-Seated Gate Valves for Water Supply Service.
 - c. C504, Rubber-Seated Butterfly Valves, 3 In. (75 mm) Through 72 In. (1,800 mm).
 - d. C508, Swing-Check Valves for Waterworks Service, 2-In. Through 24-In. (50-mm Through 600-mm) NPS.
 - e. C509, Resilient-Seated Gate Valves for Water Supply Service.
 - f. C510, Double Check Valve Backflow Prevention Assembly.
 - g. C511, Reduced-Pressure Principle Backflow Prevention Assembly.
 - h. C512, Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.
 - i. C515, Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service.
 - j. C541, Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates.
 - k. C542, Electric Motor Actuators for Valves and Slide Gates.
 - l. C550, Protective Interior Coatings for Valves and Hydrants.
 - m. C606, Grooved and Shouldered Joints.
 - n. C800, Underground Service Line Valves and Fittings.

6. ASTM International (ASTM):
 - a. A276, Standard Specification for Stainless Steel Bars and Shapes.
 - b. A351/A351M, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
 - c. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
 - d. A564/A564M, Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.
 - e. B61, Standard Specification for Steam or Valve Bronze Castings.
 - f. B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - g. B98/B98M, Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.
 - h. B127, Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip.
 - i. B139/B139, Standard Specification for Phosphor Bronze Rod, Bar and Shapes.
 - j. B164, Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire.
 - k. B194, Standard Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar.
 - l. B584, Standard Specification for Copper Alloy Sand Castings for General Applications.
 - m. D429, Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates.
 - n. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
 - o. D3222, Standard Specification for Unmodified Poly(Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials.
 - p. D4101, Standard Classification System and Basis for Specification for Polypropylene (PP) Injection and Extrusion Materials.
7. FM Global (FM).
8. International Code Council (ICC) 2021 International Plumbing Code (IPC).
9. Manufacturers Standardization Society (MSS):
 - a. SP-80, Bronze Gate, Globe, Angle, and Check Valves.
 - b. SP-81, Stainless Steel, Bonnetless, Flanged Knife Gate Valves.
 - c. SP-85, Gray Iron Globe and Angle Valves, Flanged and Threaded Ends.
 - d. SP-88, Diaphragm Valves.
 - e. SP-110, Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
10. National Electrical Manufacturers Association (NEMA): 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

11. NSF International (NSF):
 - a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
 - b. NSF/ANSI 372, Drinking Water System Components - Lead Content.
12. UL.
13. University of Southern California (USC) Foundation for Cross-Connection Control and Hydraulic Research.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
 - a. Product data sheets for each make and model. Indicate valve Type Number, applicable Tag Number, and facility name/number or service where used.
 - b. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
 - c. Certification for compliance to NSF/ANSI 61 for valves used for drinking water service.
 - d. Power and control wiring diagrams, including terminals and numbers. Where shown on the Drawings, the network and ethernet communication details to the Plant Control System.
 - e. For each power actuator provided, manufacturer's standard data sheet, with application specific features and options clearly identified.
 - f. Sizing calculations for open-close/throttle and modulating valves.
 - g. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Manufacturer's Certificate of Compliance, in accordance with Section 01 67 00, Product Requirements, for:
 - a. Electric actuators; full compliance with AWWA C542.
 - b. Butterfly valves; full compliance with AWWA C504.
3. Component and attachment testing seismic certificate of compliance as required by Section 01 45 33, Special Inspection, Observation, and Testing.
4. Tests and inspection data.
5. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.

6. Vendor furnished as-built drawings in accordance with Section 01 78 23, Operation and Maintenance Data.
7. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 67 00, Product Requirements.

PART 2 PRODUCTS

2.01 GENERAL

A. Valve Physical Characteristics:

1. Valves to include operator, actuator, handwheel, chain wheel, extension stem, floor stand, operating nut, chain, wrench, and accessories to allow a complete operation from the intended operating level.
2. Valve same size as adjoining pipe, unless otherwise called out on the Drawings.
3. Valve ends to suit adjacent piping.
4. Factory mount operator, actuator, and accessories.
5. Use or reuse of components and materials without a traceable certification is prohibited.

B. Valve Functional Characteristics:

1. Size operators and actuators to operate valve for full range of pressures and velocities.
2. Valve to open by turning counterclockwise, unless otherwise specified.

C. Valve Performance Characteristics:

1. Valve to be suitable for intended service. Renewable parts not to be of a lower quality than specified.
2. Resilient seated valves shall have no leakage (drip-tight) in either direction at valve rated design pressure. All other valves shall have no leakage (drip-tight) in either direction at valve rated design pressure, unless otherwise allowed for in this section or in stated valve standard.
3. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.

2.02 SCHEDULES

- #### **A.**
- Additional requirements relative to this section are shown on Power Actuated Valve Schedule and Self-Regulated Valve Schedule located on the Drawings.

2.03 MATERIALS

A. Physical Characteristics:

1. Bronze and brass valve components and accessories that have surfaces in contact with water to be alloys containing less than 16 percent zinc and 2 percent aluminum.
 - a. Approved alloys are of the following ASTM designations: B61, B62, B98/B98M (Alloy UNS No. C65100, C65500, or C66100), B139/B139M (Alloy UNS No. C51000), B584 (Alloy UNS No. C90300 or C94700), B164, B194, and B127.
 - b. Stainless steel Alloy 18-8 may be substituted for bronze.

B. Functional Characteristics: None.

C. Performance Characteristics:

1. Valve materials in contact with or intended for drinking water service to meet the following requirements:
 - a. Materials to comply with requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements.
 - b. Coatings materials to be formulated from materials deemed acceptable to NSF/ANSI 61.
 - c. Supply certification product is certified as suitable for contact with drinking water by an accredited certification organization in accordance with NSF/ANSI 61. Provide certification for each valve type used for drinking water service.

2.04 FACTORY FINISHING

A. Physical Characteristics: None.

B. Functional Characteristics: None.

C. Performance Requirements:

1. Interior coatings for valves and hydrants shall be in accordance with AWWA C550, unless otherwise specified.
2. Exterior coating for valves and hydrants shall be in accordance with Section 09 90 00, Painting and Coating.
3. Material in contact with potable water shall conform to NSF/ANSI 61.
4. Exposed safety isolation valves and lockout valves with handles, handwheels, or chain wheels shall be "safety yellow."

5. Where epoxy lining and coating are specified, factory finishing shall be as follows:
 - a. In accordance with AWWA C550.
 - b. Either two-part liquid material or heat-activated (fusion) material except only heat-activated material if specified as “fusion” or “fusion bonded” epoxy.
 - c. Minimum 7-mil dry film thickness except where limited by valve operating tolerances.

2.05 VALVES

A. Gate Valves:

1. General:
 - a. Physical Characteristics:
 - 1) Provide 2-inch operating nut and handwheel for AWWA gate valves 12 inches and smaller.
 - 2) Provide totally enclosed spur or bevel gear operator with indicator for AWWA gate valves 14 inches and larger.
 - 3) Mark AWWA gate valves with manufacturer’s name or mark, year of valve casting, valve size, and working water pressure.
 - 4) Supply AWWA gate valves with stainless steel bolting.
 - b. Functional Characteristics: Repaired AWWA gate valves shall not be submitted or supplied.
 - c. Performance Characteristics:
 - 1) AWWA gate valves to be in full compliance with stated AWWA standard and the following requirements:
 - a) Provide Affidavit of Compliance per the applicable AWWA standard for AWWA gate valves.
 - b) AWWA C509 and AWWA C515 valves may be substituted for each other.
2. Type V100 Gate Valve 3 Inches and Smaller:
 - a. Manufacturers and Products:
 - 1) Nonrising Stem:
 - a) Threaded Ends:
 - (1) Crane; Figure 438
 - (2) Or equal.
 - b) Soldered Ends:
 - (1) Crane; Figure 1324
 - (2) Or equal.
 - 2) Rising Stem:
 - a) Threaded Ends:
 - (1) Crane; Figure 428
 - (2) Or equal.

- b) Soldered Ends:
 - (1) Crane; Figure 1334
 - (2) Or equal.
 - b. Physical Characteristics: All-bronze, screwed bonnet, packed gland, single solid wedge gate.
 - c. Functional Characteristics: Multiturn operation.
 - d. Performance Characteristics:
 - 1) Nonrising Stem: Class 125 rated 200 psi CWP, complies with MSS SP-80 Type 1.
 - 2) Rising Stem: Class 125 rated 200 psi CWP, complies with MSS SP-80 Type 2.
- 3. Type V101 Gate Valve 3 Inches and Smaller:
 - a. Manufacturers and Products:
 - 1) Threaded Ends:
 - a) Crane; Figure 428, NPT threaded ends.
 - b) Or equal.
 - 2) Soldered Ends:
 - a) Crane; Figure 1334, soldered ends.
 - b) Or equal.
 - b. Physical Characteristics: All-bronze, screwed bonnet, packed gland, single solid wedge gate, rising stem.
 - c. Functional Characteristics: Multiturn operation.
 - d. Performance Characteristics: Class 125 rated 200 psi CWP, complies with MSS SP-80 Type 2.
- 4. Type V102 Gate Valve 3 Inches and Smaller:
 - a. Manufacturers and Products:
 - 1) Crane; Figure 437.
 - 2) Or equal.
 - b. Physical Characteristics: All-bronze, screwed bonnet, packed gland, NPT threaded ends, single solid wedge gate, nonrising stem.
 - c. Functional Characteristics: Multiturn operation.
 - d. Performance Characteristics: Class 150 rated 150 psi SWP/300 psi CWP, complies with MSS SP-80 Type 1.
- 5. Type V103 Gate Valve 3 Inches and Smaller:
 - a. Manufacturers and Products:
 - 1) Crane; Figure 431.
 - 2) Or equal.
 - b. Physical Characteristics: All-bronze, screwed bonnet, packed gland, NPT threaded ends, single solid wedge gate, rising stem.
 - c. Functional Characteristics: Multiturn operation.
 - d. Performance Characteristics: Class 150 rated 150 psi SWP/300 psi CWP, complies with MSS SP-80 Type 2.

6. Type V132 Resilient Seated Gate Valve 3 Inches to 12 Inches, for Buried Service:
 - a. Manufacturers and Products:
 - 1) M&H Valve; AWWA C509.
 - 2) Or equal.
 - b. Physical Characteristics: Iron body, resilient seat, bronze stem and stem nut, mechanical joint ends, nonrising stem, 2-inch operating nut, full port, fusion epoxy coated inside and outside per AWWA C550.
 - c. Functional Characteristics: Multiturn operation.
 - d. Performance Characteristics:
 - 1) In accordance with AWWA C509.
 - 2) Minimum design working water pressure 200 psig.
 - 3) NSF/ANSI 61 certified.
7. Type V140 Gate Valve 3/4 Inch to 2 Inches:
 - a. Manufacturers and Products:
 - 1) Kennedy; UL/FM.
 - 2) Or equal.
 - b. Physical Characteristics: All bronze, solid wedge disc, outside screw and yoke.
 - c. Functional Characteristics: Valve supervised in OPEN position so closing results in actuation of alarm. Multiturn operation.
 - d. Performance Characteristics: UL listed and FM approved, screwed ends rated 175-pound WOG minimum.
8. Type V150 Knife Gate Valve 24 Inches and Smaller:
 - a. Manufacturers and Products:
 - 1) DeZurik; Series L.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Bonnetless wafer body type, outside stem and yoke.
 - 2) Wetted metal parts and stem, Type 316 stainless steel.
 - 3) Yoke sleeve bronze, gate finish ground both sides with a sharp knife edge.
 - 4) Packing system leak-tight seal around gate, valve superstructure and yoke designed for full peripheral access to gland bolts when valve is equipped with manual or power actuator.
 - 5) Self-cleaning, nonclogging, with round port.
 - 6) Resilient polychloroprene seat, drip-tight shutoff.
 - 7) Stainless-lined, resilient seated knife gate, 150W, 2 inches to 24 inches.
 - 8) Standard configuration is a round port although a V port is available for throttling applications.
 - c. Functional Characteristics: Multiturn operation.

- d. Performance Characteristics:
 - 1) Rated for 150-psi cold water.
 - 2) ASME B16.1 flanged ends.
 - 3) In compliance with MSS SP-81.

B. Globe Valves:

- 1. Type V200 Globe Valve 3 Inches and Smaller:
 - a. Manufacturers and Products:
 - 1) Stockham; Figure B-22T, NPT threaded end.
 - 2) Or equal.
 - b. Physical Characteristics: All-bronze, union bonnet, packed gland, inside screw, rising stem, TFE disc.
 - c. Functional Characteristics: Multiturn operation.
 - d. Performance Characteristics: Class 150 rated 150 psi SWP/300 psi CWP, complies with MSS SP-80 Type 2.
- 2. Type V201 Angle Pattern Valve 2 Inches and Smaller:
 - a. Manufacturers and Products:
 - 1) Stockham; Figure B-222T.
 - 2) Or equal.
 - b. Physical Characteristics: All-bronze, NPT threaded ends, union bonnet, packed gland, inside screw, rising stem, TFE disc.
 - c. Functional Characteristics: Multiturn operation.
 - d. Performance Characteristics: Class 150 rated 150 psi SWP/300 psi CWP, complies with MSS SP-80 Type 2.
- 3. Type V235 Angle Type Hose Valve 3/4 Inch:
 - a. Manufacturers and Products:
 - 1) Surface Pipe Mount Valve, Bent Nose without Flange:
 - a) Acorn; 8126.
 - b) Or equal.
 - 2) Surface Mount through Wall Valve, Bent Nose with Flange:
 - a) Acorn; 8121
 - b) Or equal.
 - 3) Pipe and Pedestal Mounted Valve Located above 6 inches, Straightnose:
 - a) Acorn; 8131.
 - b) Or equal.
 - 4) Pedestal Mounted Valve Located above 6 inches, Straightnose:
 - a) Acorn; 8136.
 - b) Or equal.
 - b. Physical Characteristics: 3/4-inch NPT female inlet, 3/4-inch male hose thread outlet, lockshield bonnet, removable handle.
 - c. Functional Characteristics: Multiturn operation.

- d. Performance Characteristics: Heavy rough brass body rated 125 psi, atmospheric vacuum breaker conforming to ASSE 1011 and IAPMO code.
- 4. Type V236 Globe Style Hose Valve 1 Inch to 3 Inches:
 - a. Manufacturers and Products:
 - 1) Crane Co.; Cat. No. 7TF.
 - 2) Or equal.
 - b. Physical Characteristics: All-bronze, NPT threaded ends, inside screw-type rising stem, TFE disc.
 - c. Functional Characteristics: Multiturn operation.
 - d. Performance Characteristics: Cast brass male NPT by male NHT adapter with hexagonal center wrench nut complies with MSS SP-80, rated 300 WOG.
- 5. Type V237 Angle Pattern Hose Valve 1 Inch to 2 Inches:
 - a. Manufacturers and Products:
 - 1) Crane Co.; Cat. No. 17TF.
 - 2) Or equal.
 - b. Physical Characteristics: All-bronze, NPT threaded ends, inside screw-type rising stem, TFE disc.
 - c. Functional Characteristics: Multiturn operation.
 - d. Performance Characteristics: Cast brass male NPT by male NHT adapter with hexagonal center wrench nut complies with MSS SP-80, rated 300 WOG.

C. Ball Valves:

- 1. Type V300 Ball Valve 3 Inches and Smaller for General Water and Air Service:
 - a. Manufacturers and Products:
 - 1) Conbraco Apollo; 70-100.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Two-piece, standard port, bronze body and end piece.
 - 2) Hard chrome-plated solid bronze or brass ball.
 - 3) RTFE seats and packing.
 - 4) NPT threaded ends.
 - 5) Blowout-proof stem, adjustable packing gland.
 - 6) Zinc-coated steel hand lever operator with vinyl grip.
 - c. Functional Characteristics: Quarter turn operation.
 - d. Performance Characteristics:
 - 1) Rated 600-pound WOG, 150-pound SWP.
 - 2) Complies with MSS SP-110.

2. Type V303 Ball Valve 2 Inches and Smaller for Equipment Air System Shutoff:
 - a. Manufacturers and Products:
 - 1) Conbraco Apollo; 76-100 Series.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Two-piece, NPT threaded ends, ASTM A276 GR 316 or ASTM A351/A351M GR CF8M stainless steel body and end piece.
 - 2) ASTM A276 Type 316 stainless steel ball.
 - 3) Reinforced PTFE seats, seals, and packing.
 - 4) Blowout-proof stem, adjustable packing gland,
 - 5) Stainless steel lever operator with vinyl grip.
 - c. Functional Characteristics:
 - 1) Safety exhaust port to exhaust downstream side when valve is in closed position.
 - 2) Quarter turn operation.
 - d. Performance Characteristics:
 - 1) Rated 125 psig.
 - 2) Meets OSHA Regulation 29 CFR Part 1910.147 requirements.
3. Type V304 Ball Valve 2 Inches and Smaller for General Water and Air Service:
 - a. Manufacturers and Products:
 - 1) Threaded Ends:
 - a) Conbraco Apollo; 82-100.
 - b) Or equal.
 - 2) Solder Ends:
 - a) Conbraco Apollo; 82-200.
 - b) Or equal.
 - b. Physical Characteristics: Three-piece, full port, NPT threaded ends, bronze body and end pieces, hard chrome plated solid bronze or brass ball, RTFE seats and packing, blowout-proof stem, zinc-plated steel hand lever operator with vinyl grip.
 - c. Functional Characteristics: Quarter turn operation.
 - d. Performance Characteristics: Rated 600-pound WOG, 150 psi SWP, complies with MSS SP-110.
4. Type V306 Stainless Steel Ball Valve 3 Inches and Smaller:
 - a. Manufacturers and Products:
 - 1) Conbraco Apollo; 76-100 or 76-AR Series.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Two-piece, standard port, ASTM A276 GR 316 or ASTM A351/A351M GR CF8M stainless steel body and end piece.
 - 2) ASTM A276 Type 316 stainless steel ball.

- 3) Reinforced PTFE seats, seals, and packing.
 - 4) NPT threaded ends.
 - 5) Adjustable packing gland, blowout proof stainless steel stem.
 - 6) Stainless steel lever operator with vinyl grip or ISO mounting pad for actuated valves.
- c. Functional Characteristics: Quarter turn operation.
- d. Performance Characteristics:
 - 1) Rated 1,000 psig CWP (minimum).
 - 2) Complies with MSS SP-110.
- 5. Type V330 PVC Ball Valve 4 Inches and Smaller:
 - a. Manufacturers and Products:
 - 1) Nibco; Chemtrol.
 - 2) Or equal.
 - b. Physical Characteristics: Polyvinyl chloride (PVC) body, ball, and stem, end entry, double union design, solvent-weld socket ends or flanged ends, elastomer seat, polytetrafluoroethylene (PTFE) O-ring stem seals, to block flow in both directions. Provide pressure relief hole drilled on low pressure side of ball.
 - c. Functional Characteristics: quarter turn operation.
 - d. Performance Characteristics: Rated 150 psi at 73 degrees F, with ASTM D1784, Type I, Grade 1 polyvinyl chloride.
- 6. Type V335 CPVC Ball Valve 2 Inches and Smaller:
 - a. Manufacturers and Products:
 - 1) Nibco; Chemtrol.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Chlorinated polyvinyl chloride (CPVC) body, ball, and stem.
 - 2) End entry, double union design, solvent-weld socket ends, or flanged ends drilled to ASME B16.1.
 - 3) Elastomer seat, with replaceable Polytetrafluoroethylene (PTFE) or fluoroelastomer (FKM) O-ring stem seals, to block flow in both directions.
 - 4) Provide pressure relief hole drilled on low pressure side of ball.
 - c. Functional Characteristics: Quarter turn operation.
 - d. Performance Characteristics: Rated 150 psi at 100 degrees F, 80 psi at 140 degrees F. with ASTM D1784, Type IV, Grade 1 chlorinated polyvinyl chloride.
- 7. Type V337 PP Ball Valve 2 Inches and Smaller:
 - a. Manufacturers and Products:
 - 1) Nibco; Chemtrol.
 - 2) Or equal.

- b. Physical Characteristics:
 - 1) Polypropylene (PP) body, ball, and stem.
 - 2) Color: Black with minimum 2.5 percent carbon suitable for long term outdoor service.
 - 3) End entry, double union design, heat fusion-weld socket ends, or flanged ends drilled to ASME B16.1.
 - 4) Elastomer seat, with replaceable Polytetrafluoroethylene (PTFE) or fluoroelastomer (FKM) O-ring stem seals, to block flow in both directions.
 - 5) Provide pressure relief hole drilled on low pressure side of ball.
 - c. Functional Characteristics: Quarter turn operation.
 - d. Performance Characteristics: ASTM D4101.
- 8. Type V339 PVDF Ball Valve 2 Inches and Smaller:
 - a. Manufacturers and Products:
 - 1) Nibco; Chemtrol.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Polyvinylidene Fluoride (PVDF) body, ball, and stem.
 - 2) Color: Red for UV protection.
 - 3) End entry, double union design, heat fusion-weld socket ends, or flanged ends drilled to ASME B16.1.
 - 4) Elastomer seat, with replaceable Polytetrafluoroethylene (PTFE) or fluoroelastomer (FKM) O-ring stem seals, to block flow in both directions.
 - 5) Provide pressure relief hole drilled on low pressure side of ball.
 - c. Functional Characteristics: Quarter turn operation.
 - d. Performance Characteristics: ASTM D3222.
- 9. Type V364 Curb Stop Ball Valve 3/4 Inch to 2 Inches:
 - a. Manufacturers and Products:
 - 1) Mueller Co.; 300 Ball Curb Valve
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Brass body and plug, top and port sealing O-rings, closed bottom.
 - 2) Blow-out-proof Stem, key to ball connection.
 - 3) Double stem O-rings.
 - 4) Fluorocarbon coated ball, with stainless steel seats.
 - 5) AWWA C800 type, full depth FIP threaded inlet and outlet, with options for alternate connecting fittings to suit connecting pipe.
 - c. Functional Characteristics: Quarter turn operation.
 - d. Performance Characteristics:
 - 1) Maximum working pressure up to 300 psi
 - 2) Certified NSF 61.

D. Plug Valves:

1. Type V400 Eccentric Plug Valve 2 Inches and Smaller:
 - a. Manufacturers and Products:
 - 1) DeZurik; Style PEC.
 - 2) Or equal.
 - b. Physical Characteristics: Nonlubricated type, cast-iron body, threaded ends, lever operator, cast-iron plug with round or rectangular port, plug coated with nitrile rubber, stem bearing lubricated stainless steel or bronze, stem seal multiple V-rings, or U-cups with O-rings of nitrile rubber.
 - c. Functional Characteristics: Quarter turn operation.
 - d. Performance Characteristics:
 - 1) Rated 175 psig CWP.
 - 2) Drip-tight shutoff with pressure from either direction.
2. Type V405 Eccentric Plug Valve 3 Inches to 12 Inches:
 - a. Manufacturers and Products:
 - 1) DeZurik; Style PEC.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Nonlubricated type, cast-iron body epoxy coated and lined, exposed service flanged ends per ASME B16.1 or grooved ends in accordance with AWWA C606 for rigid joints, buried service mechanical joint ends, unless otherwise shown
 - 2) Plug cast iron with round or rectangular port of no less than 80 percent of connecting pipe area and coated with nitrile rubber, seats welded nickel, stem bearings lubricated stainless steel or bronze, stem seal multiple V-rings, or U-cups with O-rings of nitrile rubber, grit seals on both upper and lower bearings.
 - 3) For buried service, provide external epoxy coating.
 - 4) Operators:
 - a) Three-Inch to 4-Inch Valves: Wrench lever manual.
 - b) Six-Inch to 12-Inch Valves: Totally enclosed, geared, manual operator with handwheel, 2-inch nut or chain wheel. Size operator for 1.5 times maximum operating shutoff pressure differential for direct and reverse pressure, whichever is higher. For buried service, provide completely sealed operator filled with heavy lubricant and 2-inch nut.
 - c. Functional Characteristics: Quarter turn operation.
 - d. Performance Characteristics:
 - 1) Rated 175 psig CWP.
 - 2) Drip-tight shutoff with pressure from either direction.

3. Type V406 Eccentric Plug Valve 14 Inches to 20 Inches:
 - a. Manufacturers and Products:
 - 1) DeZurik; Style PEC.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Nonlubricated type, drip-tight shutoff with pressure from either direction, cast-iron body, exposed service flanged ends per ASME B16.1 or grooved ends in accordance with AWWA C606 for rigid joints, buried service mechanical joints ends, unless otherwise shown, plug cast iron with round or rectangular port of no less than 80 percent of connecting pipe area and coated with nitrile rubber, seats welded nickel, stem bearings lubricated stainless steel or bronze, stem seal multiple V-rings or U-cups with O-rings of nitrile rubber, grit seals on both upper and lower bearings.
 - 2) Totally enclosed, geared, manual operator with handwheel, 2-inch nut or chain wheel. Size operator for 1.5 times maximum operating shutoff pressure differential for direct and reverse pressure, whichever is higher. For buried service, provide completely sealed operator filled with heavy lubricant and 2-inch nut.
 - 3) For buried service, provide external epoxy coating.
 - c. Functional Characteristics: Quarter turn operation.
 - d. Performance Characteristics: Rated 150 psig CWP.
4. Type V464 Corporation Stop 3/4 Inch to 2 Inches:
 - a. Manufacturers and Products:
 - 1) Mueller Co.; Mark II Oriseal.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Brass body and plug, top and port sealing O-rings, closed bottom.
 - 2) Large Tee Head indicates open/close. Note: larger valves are single directional flow.
 - 3) AWWA C800 type, tapered threaded inlet, except when connecting to tapped fittings which require IPS tapered threads, outlet compression connection or IPS threads to suit connecting pipe.
 - c. Functional Characteristics: Quarter turn operation.
 - d. Performance Characteristics:
 - 1) Rated up to 175 psi.
 - 2) Certified NSF 61.

E. Butterfly Valves:

1. General:

a. Physical Characteristics:

- 1) Provide linings and coatings per AWWA, unless otherwise indicated on the Drawings or specified herein.
- 2) No travel stops for disc on interior of body.
- 3) Non-AWWA butterfly valves to meet the following actuator requirements:
 - a) For above ground installations, provide handle and notch plate for valves 6 inches and smaller and heavy-duty, totally enclosed gearbox type operators with handwheel, position indicator and travel stops for valves 8 inches and larger, unless otherwise shown on the Drawings or specified herein.

b. Functional Characteristics:

- 1) Quarter turn operation.
- 2) Suitable for throttling operations and infrequent operation after periods of inactivity.
- 3) Self-adjusting V-type or O-ring shaft seals.

c. Performance Characteristics:

- 1) In full compliance with AWWA C504 and following requirements:
 - a) Elastomer seats which are bonded or vulcanized to the body shall have adhesive integrity of bond between seat and body assured by testing, with minimum 75-pound pull in accordance with ASTM D429, Method B.
 - b) Bubble-tight with rated pressure applied from either side. Test valves with pressure applied in both directions.
 - c) Isolate metal-to-metal thrust bearing surfaces from flowstream.
 - d) Provide traveling nut or worm gear actuator with handwheel. Valve actuators to meet the requirements of AWWA C504.
 - e) Buried service operators shall withstand 450 foot-pounds of input torque at fully open and fully closed positions.
 - f) Valves to be in full compliance with NSF/ANSI 61. Provide NSF/ANSI 61 certificate for each valve.

2. Type V500 Butterfly Valve Water Works Service 3 Inches to 72 Inches:

a. Manufacturers and Products:

- 1) DeZurik; AWWA Valve.
- 2) Or equal.

- b. Physical Characteristics:
 - 1) Short body type, flanged ends.
 - 2) Cast-iron body epoxy coated and lined, cast or ductile iron disc, Type 304 stainless steel shafts, nitrile rubber seat bonded or molded in body only, and stainless-steel seating surface.
 - c. Functional Characteristics: Quarter turn operation.
 - d. Performance Characteristics:
 - 1) AWWA C504, Class 150B Valves.
 - 2) ASME B16.1, Class 125, Flanges.
 - 3) Provide epoxy lining and coating in compliance with AWWA C550.
3. Type V510 Lug Style Butterfly Valve, Resilient Seated, 2 Inches to 20 Inches for Low Pressure Process Air Service:
- a. Manufacturers and Products:
 - 1) Bray Controls; Series 31.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Lug style cast-iron body epoxy coated and lined.
 - 2) Aluminum bronze discs, Type 316 stainless steel one-piece stem.
 - 3) Self-lubricating sleeve type bushings, EPDM replaceable resilient seat.
 - c. Functional Characteristics:
 - 1) Quarter turn operation.
 - 2) Open/closed service.
 - d. Performance Characteristics:
 - 1) Operating temperatures up to 250 degrees F, 150 psi working pressure rating.
 - 2) Bubble-tight at 50 psi differential pressure.
 - 3) Valve body to fit between ASME B16.1 Class 125/150 flanges.
4. Type V514 High Performance Butterfly Valve 2 Inches to 36 Inches:
- a. Manufacturers and Products:
 - 1) DeZurik; BHP Series.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Lugstyle, high performance type, Type 316 stainless steel body.
 - 2) Type 316 stainless steel single or double offset disc, with Type 316 stainless steel shaft and taper pins.
 - 3) PTFE seat, PTFE stem packing, stainless steel with RTFE thrust washer.

- c. Functional Characteristics:
 - 1) Throttling, modulating and open/closed service.
 - 2) Quarter turn operation.
- d. Performance Characteristics: ASME B16.5 Class 150.

F. Check and Flap Valves:

- 1. Type V600 Check Valve 2 Inches and Smaller:
 - a. Manufacturers and Products:
 - 1) Threaded Ends:
 - a) Stockham; Figure B-319.
 - b) Or equal.
 - 2) Soldered Ends:
 - a) Stockham; Figure B-309.
 - b) Or equal.
 - b. Physical Characteristics: All bronze, threaded cap, threaded or soldered ends, swing type replaceable bronze disc.
 - c. Functional Characteristics: Prevent backflow
 - d. Performance Characteristics: Rated 125-pound SWP, 200-pound WOG.
- 2. Type V604 Check Valve 2-1/2 Inches to 12 Inches:
 - a. Manufacturers and Products:
 - 1) Stockham G 931; List 37, Clearway check valve.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Flanged end, cast-iron body epoxy coated and lined.
 - 2) Bronze mounted swing type, solid bronze or cast-iron disc, bronze seat ring.
 - c. Functional Characteristics: Prevent backflow.
 - d. Performance Characteristics: Rated 125 pound SWG, 200 pound WOG.
- 3. Type V606 Check Valve 2-1/2 Inches to 12 Inches:
 - a. Manufacturers and Products:
 - 1) Stockham; G 931.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Flanged end, cast-iron body epoxy coated and lined.
 - 2) Bronze mounted swing type, solid bronze or cast-iron disc, bronze seat ring, outside lever and weight.
 - c. Functional Characteristics: Prevent backflow.
 - d. Performance Characteristics: Rated 125 pound SWG, 200 pound WOG.
- 4. Type V608 Swing Check Valve 2 Inches to 24 Inches:
 - a. Manufacturers and Products:
 - 1) Pratt, AWWA C508 Check Valves
 - 2) Or equal.

- b. Physical Characteristics: 125-pound flanged ends, cast-iron body, bronze body ring seat, bronze or cast-iron clapper/disc with nitrile rubber disc seat, stainless steel hinge shaft. Valves to be fitted with adjustable outside lever and weight.
 - c. Functional Characteristics: Prevent backflow.
 - d. Performance Characteristics: Meet requirements of AWWA C508. Valves, 2 inches through 12 inches rated 200-pound WWP and 14 inches through 24 inches rated 150-pound WWP.
- 5. Type V612 Double Disc Swing Check Valve 2 Inches to 12 Inches:
 - a. Manufacturers and Products:
 - 1) Crane/Stockham; WG 970.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Wafer style, spring loaded, cast-iron body epoxy coated and lined.
 - 2) Aluminum-bronze or ductile iron discs.
 - 3) EPDM resilient seats, and Type 316 stainless steel spring, hinge pin, and stop pin.
 - c. Functional Characteristics: Prevent backflow.
 - d. Performance Characteristics: Rated 200 psi nonshock working pressure.
- 6. Type V620 Silent Check Valve 2 Inches to 10 Inches:
 - a. Manufacturers and Products:
 - 1) APCO; Series 300.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Wafer style, iron body, center guided valve, bronze trim.
 - 2) Nitrile rubber seat, stainless steel springs.
 - c. Functional Characteristics: Prevent backflow.
 - d. Performance Characteristics: Rated 150 pound WOG.
- 7. Type V630 PVC Ball Check Valve 4 Inches and Smaller:
 - a. Manufacturers and Products:
 - 1) ASAHI/America.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) ASTM D1784, Type I, Grade 1 polyvinyl chloride (PVC) ball and body, dual union socket weld ends.
 - 2) Fluoroelastomer (FKM) seat and seal.
 - c. Functional Characteristics: Prevent backflow.
 - d. Performance Characteristics: Rated 150 psi at 73 degrees F.
- 8. Type V631 CPVC Ball Check Valve 4 Inches and Smaller:
 - a. Manufacturers and Products:
 - 1) ASAHI/America.
 - 2) Or equal.

- b. Physical Characteristics:
 - 1) ASTM D1784 Cell Class 23477B (CPVC) ball and body, single or dual union socket weld ends.
 - 2) Fluoroelastomer (FKM) seat and seal.
 - c. Functional Characteristics: Prevent backflow.
 - d. Performance Characteristics: Rated 150 psi at 73 degrees F, 110 psi at 140 degrees F.
- 9. Type V633 PVC Swing Check Valve 4 Inches and Smaller:
 - a. Manufacturers and Products:
 - 1) ASAHI/America.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) ASTM D1784, Type I, Grade 1 polyvinyl chloride (PVC) body and flapper, dual union socket weld ends.
 - 2) Fluoroelastomer (FKM) seat and seal.
 - c. Functional Characteristics: Prevent backflow.
 - d. Performance Characteristics: Rated 150 psi at 73 degrees F.
- 10. Type V634 Rubber Flapper Check Valve 2 Inches to 24 Inches:
 - a. Manufacturers and Products:
 - 1) APCO; Series 100.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Iron body, ASME B16.1, Class 125 flanges.
 - 2) steel-reinforced nitrile rubber flapper raised seating ring
 - c. Functional Characteristics: Prevent backflow.
 - d. Performance Characteristics: Rated 150 pound CWP.
- 11. Type V644 Double Check Valve Assembly 2-1/2 Inch to 10 Inches:
 - a. Manufacturers and Products:
 - 1) Febco; Model 850.
 - 2) Or equal.
 - b. Physical Characteristics: Two resilient seated check valves, nonrising stem resilient-seated isolation valves, bronze ball valve test cock, in accordance with AWWA C510.
 - c. Functional Characteristics: Backflow preventer used to protect potable water supplies in accordance with national plumbing codes from health hazard (toxic) cross-connections.
 - d. Performance Characteristics:
 - 1) Rated 175 psi maximum working pressure.
 - 2) Meets requirements of USC Foundation For Cross-Connection Control and Hydraulic Research.
- 12. Type V694 Check Valve 1 Inch to 48 Inches:
 - a. Manufacturers and Products:
 - 1) Red Valve Co.; Tideflex Check Valve Series TF 1 or 35 1.
 - 2) Or equal.

- b. Physical Characteristics:
 - 1) Elastomer type flanged or slip-on, contoured duckbilled shaped exit, flat bottom and off-set bill design, curved bill for 18 inches and larger.
 - 2) Elastomer nylon-reinforced neoprene.
 - 3) Round entry area to match pipe, with two optional connection types.
 - a) Flanges steel backing flange type, drilled to ASME B16.1, Class 125.
 - b) Plain-end valve attached with two Type 316 stainless steel adjustable bands.
- c. Functional Characteristics: Prevent backflow.
- d. Performance Characteristics:
 - 1) Valve to open with approximately 2 inches of line pressure and return to CLOSED position under zero flow condition.
 - 2) Rated for 50-psi minimum operating pressure.

G. Self-Regulated Automatic Valves:

- 1. Type V710 Pressure-Reducing Valve 3 Inches and Smaller:
 - a. Manufacturers and Products:
 - 1) Watts; Series 223.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Direct diaphragm operated, spring controlled, cast iron body.
 - 2) NPT threaded ends.
 - c. Functional Characteristics: Control downstream pressure to set point.
 - d. Performance Characteristics:
 - 1) 200-psig rated minimum.
 - 2) Size/Rating: As shown on Self-Regulated Valve Schedule on the Drawings.
- 2. Type V714 Pressure-Reducing Valve (PRV) Globe Valve:
 - a. Manufacturers and Products:
 - 1) Cla-Val; Model 90-99 with Hytrol Series 100-01 globe valves.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Hydraulically operated, diaphragm actuated, pilot controlled, full internal port globe valve.
 - 2) Globe valve, ASTM A536 ductile iron body, ASME B16.42 Class 150 flanged ends, rated 250 psi.
 - 3) Type 316 stainless steel trim, stem, pilot tubing, externally mounted strainers with cocks.
 - 4) NSF61 EPDM diaphragm and elastomers.

- 5) NSF61 certified and FDA approved fusion bonded epoxy interior lining in accordance with AWWA C550 and exterior coating in accordance with AWWA C213.
 - c. Functional Characteristics: Maintains constant downstream pressure regardless of fluctuations in flow or upstream pressure.
 - d. Performance Characteristics:
 - 1) Pressure Class Rated: 250 psi.
 - 2) Size/Rating: As shown in Self-Regulating Valve Schedule as shown on the Drawings.
3. Type V720 PVC Pressure Relief, By-Pass Relief, Back-Pressure Regulator, Back-Pressure, Anti-Siphon Valve 1/2 Inch to 2 Inches:
- a. Manufacturers and Products:
 - 1) Plast-O-Matic; Series RVDT.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Direct acting diaphragm, spring controlled.
 - 2) in-line pattern, NPT threaded inlet and outlet.
 - 3) PVC body, Polytetrafluoroethylene (PTFE) or fluoroelastomer (FKM) diaphragm, PVC or Polytetrafluoroethylene (PTFE) piston, high-density polyethylene or stainless steel adjusting bolt and locknut, stainless steel or coated steel spring, stainless steel fasteners.
 - c. Functional Characteristics:
 - 1) Control upstream pressure to set point.
 - 2) Use for chemical services.
 - d. Performance Characteristics:
 - 1) 150-psi design pressure.
 - 2) Set pressure adjustable from 10 psi to 100 psi, minimum.
 - 3) Set pressure per Self-Regulated Valve Schedule as shown on the Drawings.
4. Type V730 Pressure-Relief Valve 3 Inches and Smaller:
- a. Manufacturers and Products:
 - 1) Cla Val; Model 50-01.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Direct diaphragm, spring controlled, cast-iron body epoxy coated and lined, spring case, nitrile seat, polychloroprene diaphragm, stainless steel valve stem.
 - 2) NPT threaded ends.
 - c. Functional Characteristics: Designed to open when upstream pressure reaches setpoint;
 - d. Performance Characteristics:
 - 1) 200 psi rated.
 - 2) Opens when upstream pressure reaches a maximum set point.

- 3) Size/Rating: As shown in Self-Regulated Valve Schedule as shown on the Drawings.
- 5. Type V744 Air Release Valve 1/2 Inch to 2 Inches:
 - a. Manufacturers and Products:
 - 1) Val-Matic Valve; Series 15A to 45.6.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Materials: Cast-iron or ductile iron body and cover, stainless steel float and trim.
 - 2) NPT threaded inlet and outlet.
 - c. Functional Characteristics: Suitable for water service, automatically exhaust small amounts of entrained air that accumulates in a system. In CLOSED position, seat against resilient seat to prevent water leakage.
 - d. Performance Characteristics:
 - 1) Rated working pressure of 150 psi.
 - 2) Built and tested to AWWA C512.
 - 3) Size/Rating: As shown in Self-Regulated Valve Schedule as shown on the Drawings.
- 6. Type V746 Combination Air Release Valve 1 Inch to 16 Inches:
 - a. Manufacturers and Products:
 - 1) Val-Matic Valve; Series 201C to 203C or 104/22 to 116/38.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Materials: Cast-iron or ductile iron body and cover, stainless steel float and trim.
 - 2) Valve single body or dual body, air release valve mounted on air and vacuum valve, isolation valve mounted between the dual valves.
 - 3) 1-inch through 3-inch valves with NPT threaded inlet and outlet, 4-inch and larger valves with ASME B16.1 Class 125 flanged inlet and cover outlet.
 - c. Functional Characteristics: Suitable for water service, combines operating features of air and vacuum valve and air release valve. Air and vacuum portion to automatically exhaust air during filling of system and allow air to re-enter during draining or when vacuum occurs. Air release portion to automatically exhaust entrained air that accumulates in system.
 - d. Performance Characteristics:
 - 1) Rated working pressure of 150 psi.
 - 2) Built and tested to AWWA C512.
 - 3) Size/Rating: As shown in Self-Regulated Valve Schedule as shown on the Drawings.

7. Type V750 Sewage Air and Vacuum Valve 1 Inches to 8 Inches:
 - a. Manufacturers and Products:
 - 1) Val-Matic Valve; Series 301 to 306.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Materials: Cast-iron or ductile iron body epoxy coated and lined and cover, concave or skirted stainless steel float and trim, nitrile rubber seat.
 - 2) One-inch through 3-inch valves with NPT threaded inlet and outlet, 4-inch and larger valves with ASME B16.1 Class 125 flanged inlet and threaded cover outlet.
 - c. Functional Characteristics: Suitable for sewage service; automatically exhausts air during system filling and allows air to re-enter during draining or when vacuum occurs.
 - d. Performance Characteristics:
 - 1) Rated working pressure of 150 psi.
 - 2) Built and tested to AWWA C512.
 - 3) Sewage air and vacuum valve fitted with blowoff valve, flushing valve with quick disconnect couplings, and a minimum 5 feet of hose with quick disconnect couplings to permit backflushing after installation without dismantling valve.
 - 4) Size/Rating: As shown in Self-Regulated Valve Schedule as shown on the Drawings.
8. Type V752 Sewage Air Release Valve 2 Inches to 4 Inches:
 - a. Manufacturers and Products:
 - 1) Val-Matic Valve; Series 48 or 49.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Materials: Cast-iron or ductile iron body epoxy coated and lined and cover with NPT threaded inlet and NPT threaded outlet, concave or skirted stainless steel float and trim; nitrile rubber resilient seat.
 - c. Functional Characteristics: Suitable for sewage service; automatically exhausts entrained air that accumulates in a system.
 - d. Performance Characteristics:
 - 1) Rated working pressure of 150 psi.
 - 2) Built and tested to AWWA C512.
 - 3) Sewage air release valve fitted with blowoff valve, flushing valve with quick disconnect couplings, and a minimum 5 feet of hose with quick disconnect couplings to permit backflushing after installation without dismantling valve.
 - 4) Size/Rating: As shown in Self-Regulated Valve Schedule as shown on the Drawings.

H. Miscellaneous Valves:

1. Type V915 Mud Valve 4 Inches to 24 Inches:
 - a. Manufacturers and Products:
 - 1) Troy Valve.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Type 316 stainless steel frame,, yoke, and plug; heavy-duty 125-pound flange style.
 - 2) Nitrile rubber plug seat, nonrising stem, Type 316 stainless steel stem and stem nut, 2-inch square operating nut.
 - 3) Cast-iron floor box where indicated, Type 316 stainless steel extension stem and stem guides. Stem guides spaced for L/R of 200 maximum.
 - c. Functional Characteristics: Multi-turn operation.
 - d. Performance Characteristics: See Piping Plan drawings for valve size.
2. Type V925 Sampling Valve:
 - a. Manufacturers and Products:
 - 1) Strahman Valves, Inc.; Piston Type Sampling Valve.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Type 316 stainless steel wetted parts, hand operated iron crank, piston to extend to inner surface of vessel or pipe, sealed by two compressible replaceable Polytetrafluoroethylene (PTFE) rings, one above discharge port and other below discharge port.
 - 2) One-inch NPT inlet and 1-inch NPT outlet.
 - c. Functional Characteristics: Sampling valve. Valve piston extends to inner surface of pipe or vessel to prevent plugging and allows live sampling.
 - d. Performance Characteristics: Comply with ASME 16.34, ASME B31.3, and ASME 16.10.
3. Type V940 Solenoid Valve 1/2 Inch to 2 Inches:
 - a. Manufacturers and Products:
 - 1) ASCO Series 210.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Two-way internal pilot operated diaphragm type, brass body, nitrile rubber resilient seat suitable for air or water.
 - 2) Solenoid coil molded epoxy, NEMA insulation Class F, 120 V ac, 60 Hz.
 - 3) Solenoid enclosure NEMA 250, watertight Type 4.
 - c. Functional Characteristics: Solenoid valve, for air or water service.

- d. Performance Characteristics:
 - 1) Rated for ambient temperatures 32 degrees F to 125 degrees F.
 - 2) Zero minimum differential pressure.
 - 3) Max. operating pressure 125 psi.
 - 4) Maximum fluid temperature 180 degrees F.
 - 5) UL listed
 - 6) Lead-free comply with NSF/ANSI 372.
 - 7) Size and normal position (when de-energized) as indicated on Power Actuated Valve Schedule as shown on the Drawings.
- 4. Type V930 Fire Hydrant (FH):
 - a. Manufacturers and Products:
 - 1) U.S. Pipe Foundry; Model Metropolitan M-94.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Nominal Size: 6 inch.
 - 2) 6-inch Class 150 ductile iron mechanical joint (MJ) inlet shoe.
 - 3) 5-1/4-inch Storz pumper nozzle outlet.
 - 4) Two 2-1/2-inch hose nozzles each with 1-1/2-inch AWWA pentagon operating nut, each hose nozzle located at 90 degrees offset on either side of pumper nozzle.
 - 5) Ductile iron ASTM A536 valve body
 - 6) AWWA C550 epoxy interior lining and exterior coating NSF61 and NSF372 certified.
 - 7) Exterior UV-resistant high gloss two-part polyurethane enamel paint coating.
 - 8) Purple in color to match existing. Color selection shall be approved by submittal prior to procurement of hydrants or paint coatings.
 - c. Functional Characteristics:
 - 1) Fire hydrant used primarily if needed for fire protection.
 - 2) Also used for flushing when refilling pipeline with water or draining when winterizing pipeline, water sampling port, and blowoff at dead-ends of pipeline.
 - 3) Self-draining, non-freezing.
 - d. Performance Characteristics:
 - 1) Maximum Operating Flow Rate: 500 gpm.
 - 2) Minimum Operating Pressure: 20 psig.
 - 3) UL Listed and FM Approved.

2.06 OPERATORS AND ACTUATORS

A. Manual Operators:

1. Physical Characteristics:
 - a. Operator self-locking type or equipped with self-locking device.
 - b. Position indicator on quarter-turn valves.
 - c. Worm and gear operators one-piece design, worm-gears of gear bronze material. Worm of hardened alloy steel with thread ground and polished. Traveling nut type operator's threaded steel reach rod with internally threaded bronze or ductile iron nut.
 - d. Exposed Operator:
 - 1) Galvanized and painted handwheel.
 - 2) Cranks on gear type operator.
 - 3) Chain wheel operator with tieback, extension stem, floor stand, and other accessories to permit operation from normal operation level.
 - 4) Valve handles to take a padlock, and wheels a chain and padlock.
 - e. Buried Operator:
 - 1) Buried service operators on valves larger than 2-1/2 inches shall have a 2-inch AWWA operating nut. Buried operators on valves 2 inches and smaller shall have cross handle for operation by forked key. Enclose moving parts of valve and operator in housing to prevent contact with the soil.
 - 2) Buried service operators to be grease packed and gasketed to withstand submersion in water to 20 feet minimum.
 - 3) Buried valves shall have extension stems, bonnets, and valve boxes.
 - a) See buried valve box standard details for more information.
2. Functional Characteristics: Support full operation of valve, allowing for fully closed to fully open position.
3. Performance Characteristics:
 - a. For AWWA valves, operator force not to exceed requirements of applicable valve standard. Provide gear reduction operator when force exceeds requirements.
 - b. For non-AWWA valves, operator force not to exceed applicable industry standard or 80 pounds, whichever is less, under operating condition, including initial breakaway. Provide gear reduction operator when force exceeds requirements.

B. Electric Operators, 120 Volts:

1. Manufacturers and Products:
 - a. Rotork Controls.
 - b. Or equal.
2. Physical Characteristics:
 - a. Unit shall be low profile to reduce amount of required space and weigh 15 pounds or less.
 - b. Size to 1-1/2 times required operating torque. Motor stall torque not to exceed torque capacity of the valve.
 - c. Provide operator mounting bracket to mount operator to valve providing minimal torque to piping system when operating.
 - d. Electronic Control:
 - 1) Torque Limiting Switches: Two single pole, double throw mechanical switches. Switches operate at any point in valve travel.
 - 2) Jammed-valve detection and protection.
 - 3) Motor over-temperature detection and protection.
 - 4) Travel limit switches, single pole double throw.
3. Functional Characteristics:
 - a. Open-Close (O/C) Service:
 - 1) Duty cycle for intermittent ON-OFF operation shall be 25 percent.
 - 2) Operator shall power to OPEN and power to CLOSE.
 - 3) Local Indication and Control:
 - a) Integral mechanical valve POSITION indication, 0 percent to 100 percent OPENED.
 - b) Integral OPENED and CLOSED indication lights.
 - c) Integral LOCAL-OFF-REMOTE (L-O-R).
 - d) Integral OPEN maintained switch which causes the valve to stroke full OPENED, even if OPEN switch is released, while L-O-R switch is in LOCAL.
 - e) Integral CLOSE maintained switch which causes valve to stroke full CLOSED, even if CLOSED switch is released, while L-O-R switch is in LOCAL.
 - 4) Remote Indication and Control:
 - a) Relay contact that closes when valve is capable of being controlled remotely (L-O-R switch in REMOTE) for connection to and monitoring by plant control system.
 - b) Limit switch that closes when valve is fully OPENED for connection to and monitoring by plant control system.
 - c) Limit switch that closes when valve is fully CLOSED for connection to and monitoring by plant control system.

- b. Modulating (M) Service:
 - 1) Operator rated for continuous duty with servo shall be rated for 100 percent modulating operation.
 - 2) Operator shall modulate based on an externally applied 4 mA dc to 20 mA dc signal.
 - 3) Operator shall be equipped with an electronic servo module for valve modulation.
 - a) Module shall provide serial communications with provided cable for setup of valve operation.
 - 4) Local Indication and Control:
 - a) Integral mechanical valve POSITION indication, 0 percent to 100 percent OPENED.
 - b) Integral OPENED and CLOSED indication lights.
 - c) Integral LOCAL-OFF-REMOTE (L-O-R).
 - d) Integral OPEN momentary switch which causes valve to stroke towards OPENED, as long as OPEN switch is held, while L-O-R switch is in LOCAL.
 - e) Integral CLOSE momentary switch which causes valve to stroke towards CLOSED, as long as CLOSED switch is held, while L-O-R switch is in LOCAL.
 - f) Position valve proportionally 0 to 100 percent OPEN with external 4 mA dc to 20 mA dc signal while in REMOTE.
 - 5) Remote Indication and Control:
 - a) Relay contact that closes when valve is capable of being controlled remotely (L-O-R switch in REMOTE) for connection to and monitoring by plant control system.
 - b) Limit switch that closes when valve is fully OPENED for connection to and monitoring by plant control system.
 - c) Limit switch that closes when valve is fully CLOSED for connection to and monitoring by plant control system.
 - d) Current Position Transmitter, 4 mA dc to 20 mA dc signal in proportion to 0 percent to 100 percent OPENED, with 0.5 percent accuracy and 0.5 percent repeatability, capable of driving a 750-ohm load, for connection to and monitoring by Plant Control System.
- 4. Performance Characteristics:
 - a. Operator Operation, General:
 - 1) Suitable for full 90-degree rotation of quarter-turn valves.
 - 2) Manually override handwheel.
 - 3) Mechanical valve position indication.

- b. Control Features: Electric motor actuators with features as noted above, and as modified/supplemented in Power Actuated Valve Schedule as shown on the Drawings.

C. Electric Motor Actuators, 480 Volts:

- 1. Manufacturers and Products:
 - a. Rotork Controls.
 - b. Or equal.
- 2. Physical Characteristics:
 - a. Comply with latest version of AWWA C542.
 - b. Size to 1-1/2 times required operating torque. Motor stall torque not to exceed torque capacity of valve.
 - c. Controls integral with actuator and fully equipped as specified in AWWA C542.
 - d. Stem protection for rising stem valves.
 - e. Indicator colors shall be in accordance with Section 40 90 00, Instrumentation and Control for Process Systems.
 - f. For valves indicated in Power Actuated Valve Schedule as shown on the Drawings, provide battery pack to allow valve actuation to a fail-closed, open, or percent open position upon loss of power.
 - 1) Capability to restore normal valve operation upon main power supply restoration.
 - 2) Battery shall automatically charge from the actuator's main power supply during normal operation.
 - 3) Battery charge level shall be able to be monitored locally.
- 3. Functional Characteristics:
 - a. Open-Close (O/C)/Throttling (T) Service:
 - 1) Size motors for one complete OPEN-CLOSE-OPEN cycle no less than once every 10 minutes.
 - 2) Actuator suitable for throttling operation of valve at intermediate positions.
 - 3) LOCAL-OFF-REMOTE Selector Switch, padlockable in each position:
 - a) Integral OPEN-STOP-CLOSE momentary pushbuttons with seal-in circuits to control valve in LOCAL position.
 - b) Remote OPEN-STOP-CLOSE momentary control dry contact inputs in REMOTE position. Integral seal-in circuits for remote OPEN and CLOSE commands; valve travel stops when remote STOP contact opens.
 - c) Auxiliary contact that closes in REMOTE position.
 - 4) OPEN and CLOSED indicating lights.
 - 5) Integral reversing motor starter with built-in overload protection.

- b. Modulating (M) Service:
 - 1) Size actuators for continuous modulating duty.
 - 2) Feedback potentiometer, or equivalent, and integral electronic positioner/comparator circuit to maintain valve position.
 - 3) HAND-OFF-AUTO (LOCAL-OFF-REMOTE) Selector Switch, padlockable in each position:
 - a) Integral OPEN-STOP-CLOSE momentary pushbuttons with seal-in circuits to control valve in HAND (LOCAL) position.
 - b) 4 mA dc to 20 mA dc input signal to control valve in AUTO (REMOTE) position.
 - c) Auxiliary contact that closes in AUTO (REMOTE) position.
 - 4) OPEN and CLOSED indicating lights.
 - 5) Ac motor with solid state reversing starter or dc motor with solid state reversing controller, and built-in overload protection. Controller capable of 1,200 starts per hour.
 - 6) Duty cycle limit timer and adjustable band width, or equivalent, to prevent actuator hunting.
 - 7) Valve position output converter that generates isolated 4 mA dc to 20 mA dc signal in proportion to valve position, and is capable of driving into loads of up to 500 ohms at 24V dc.
- c. Limit Switch:
 - 1) Single-pole, double-throw (SPDT) type, field adjustable, with contacts rated for 5 amps at 120V ac.
 - 2) Each valve actuator to have a minimum of two auxiliary transfer contacts at end position, one for valve FULL OPEN and one for valve FULL CLOSED.
 - 3) Housed in actuator control enclosure.
- 4. Performance Characteristics:
 - a. Actuator Operation—General:
 - 1) Suitable for full 90-degree rotation of quarter-turn valves or for use on multiturn valves, as applicable.
 - 2) Manual override handwheel.
 - 3) Valve position indication.
 - 4) Operate from FULL CLOSED to FULL OPEN positions or the reverse in the number of seconds given in Power Actuated Valve Schedule as shown on the Drawings.
 - 5) Nonintrusive Electronic Control: Local controls, diagnostics, and calibration, including limit and torque settings, shall be accomplished nonintrusively. Electronic valve position display with capability to show continuous torque output. If applicable, provide two hand-held

configuration units for every 10 actuators provided, two minimum.

- b. Control Features: Electric motor actuators with features as noted above, and as modified/supplemented in Power Actuated Valve Schedule as shown on the Drawings.

D. Pneumatic Actuators:

- 1. General:
 - a. Actuator complete with air sets, exhaust mufflers, speed controls, pilot solenoids, safety vented isolation valves, and accessories.
 - b. Suitable for full operation range of valve at air supply pressure indicated.
 - c. Position indication and stop limiting devices on all actuators.
- 2. Vane Style Actuator:
 - a. Manufacturers and Products:
 - 1) Kinetrol.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Pressure die-cast aluminum housing with corrosion resistant fusion bonded epoxy finish, type 304 stainless steel bolting, and Type 304 stainless steel adjustable end stops.
 - 2) Electroless nickel-plated steel shaft and vane, single-component machined or cast part.
 - 3) Dual-opposed polyurethane lip seals with Type 304 stainless steel expander.
 - 4) Visual Indicator: High visibility, OPEN-CLOSED indication, color coded, chemical resistant, clear polycarbonate cover.
 - c. Functional Characteristics:
 - 1) Double acting or spring return to required fail position.
 - 2) Geared Manual Override: Geared type with declutchable handwheel, torque rated for application.
 - d. Performance Characteristics:
 - 1) In compliance with AWWA C541.
 - 2) Operate on an air supply of 80 psig.
 - 3) Suitable for non-lubricated air.
- 3. Cylinder Actuator:
 - a. Manufacturers and Products:
 - 1) Rotork.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Nonswivel type totally enclosed:
 - a) Travel stops and position indicator.
 - b) Factory lubricated and sealed requiring no additional lubrication.

- 2) Actuators used on quarter-turn valves to include a totally enclosed valve actuating mechanism. Actuating mechanism to be factory lubricated and sealed.
- c. Functional Characteristics:
 - 1) Double acting or spring return to required fail position.
 - 2) Manual override per manufacturers standard.
- d. Performance Characteristics:
 - 1) In compliance with AWWA C541.
 - 2) Operate on an air supply of 80 psig.
 - 3) Suitable for non-lubricated air.
4. Accessories:
 - a. Air Set:
 - 1) General: Air set to include pressure regulator with internal relief, filter, outlet pressure gauge. The regulator shall include a safety vented lockout isolation valve upstream.
 - 2) Physical Characteristics: Aluminum body and handwheel.
 - 3) Functional Characteristics:
 - a) Gauge range 1-1/3 to 2 times maximum operating pressure.
 - b) Provide an adjustable reduced pressure range as required by the valve actuator.
 - 4) Performance Characteristics: Reduce the inlet pressure from up to 150 psig to the required valve actuator operating pressure.
 - b. Air Exhaust Muffler:
 - 1) General: Located in the exhaust port of all actuator pilot solenoid valves.
 - 2) Manufacturers and Products:
 - a) Allied Witan Co.; Air Exhaust Muffler.
 - b) Or equal.
 - 3) Physical Characteristics:
 - a) Male or Female NPT inlet connection.
 - b) Materials of Construction: aluminum end, zinc-plated steel and cellulose fiber element.
 - 4) Functional Characteristics: Design to take air exhaust noise discharged from valve ports and muffle it with optimized constant velocity flow factor.
 - 5) Performance Characteristics: Rated for air exhaust applications up to 125 psig.
 - c. Limit Switch:
 - 1) Physical Characteristics: Designed for mounting on the valve actuator.
 - 2) Functional Characteristics:
 - a) Single-pole, double-throw (SPDT) type.
 - b) Adjustable for OPEN and CLOSED valve positions.

- 3) Performance Characteristics:
 - a) Rated 10 amps at 120 volts ac.
 - b) Housed in NEMA 4X enclosure.
- d. Positioner:
 - 1) Physical Characteristics:
 - a) Corrosion-resistant enclosures for positioners and transducers to be splash-proof and moisture-proof with gasketed covers.
 - b) Provided with gauges for supply and output pressure.
 - 2) Functional Characteristics:
 - a) For modulating actuators, shall be pneumatic force balance instruments to control valve position as a function of input signal. Accomplish positive positioning of valve by a mechanical feedback connection from valve actuating mechanism. Position feedback through a characterized linear cam to allow adjustment of valve positioning and input signal. Positioner suitable for double acting or spring return actuator
 - 3) Performance Characteristics:
 - a) Positioner to have zero and span adjustment and be field reversible for direct or reverse action.
 - b) Positioner to receive a 4 mA to 20 mA dc input signal. Positioner for dc input signal with transducers shall convert electrical signal to appropriate pneumatic signal. Transducer integral with positioner or separate component. If separate, factory mount transducer on pneumatic operator. Line electric power not required for transducers.
- e. Pilot Solenoid Valve:
 - 1) Physical Characteristics:
 - a) Pilot operated diaphragm type solenoid valve with brass body and resilient seat.
 - b) Internal parts corrosion-resistant.
 - 2) Functional Characteristics:
 - a) Solenoid valve shall pilot control actuator in appropriate configuration for type of open-close actuator being controlled. Double acting actuator shall have four-way solenoid valve, and spring return actuator shall have three-way solenoid valve. Dual coil valve shall not change position unless one coil is energized while the other is de-energized.
 - 3) Performance Characteristics:
 - a) Valve with minimum operating pressure differential no greater than 10 psig and maximum operating pressure differential no less than 150 psig.

- b) Solenoid valve to have Class F molded coils for operation on 120 volts ac, 60-Hz, unless otherwise indicated. Solenoid enclosure as defined in NEMA 250, Type 4X

2.07 ACCESSORIES

A. Tagging:

- 1. Physical Characteristics: 1-1/2-inch diameter heavy brass or stainless steel tag attached with No. 16 solid brass or stainless steel jack chain for each valve, bearing valve tag number shown on Power Actuated Valve Schedule and Self-Regulated Valve Schedule as shown on the Drawings.
- 2. Functional Characteristics: To provide unique valve and instrument identification.
- 3. Performance Characteristics: None.

B. Limit Switch:

- 1. Physical Characteristics:
 - a. Factory installed NEMA 4X limit switch by actuator manufacturer.
 - b. SPST, rated at 5 amps, 120V ac.
- 2. Functional Characteristics: Provides signal back to PLC or SCADA as to valve functional position.
- 3. Performance Characteristics: None.

C. T-Handled Operating Wrench:

- 1. Manufacturers and Products:
 - a. Mueller; No. A-24610.
 - b. Or equal.
- 2. Physical Characteristics:
 - a. Material: Galvanized steel.
 - b. Operating wrenches shall be 4 feet long.
 - c. One each galvanized operating keys for cross handled valves.
- 3. Functional Characteristics: Designed for operation of buried valve through nut on valve or valve extension stem.
- 4. Performance Characteristics: None.

D. Extension Bonnet for Valve Operator:

- 1. Manufacturers:
 - a. DeZurik.
 - b. Or equal.

2. Physical Characteristics: Complete with enclosed stem, extension, support brackets, and accessories for valve and operator.
3. Functional Characteristics: Designed to increase length of bonnet and stem between the valve operator or actuator and the valve body.
4. Performance Characteristics: Extension required to withstand maximum torque applied by manual operator or electric actuator without plastic deformation or damage to the valve, stem, operator, or other accessories provided.

E. Floor Stand:

1. Manufacturers and Products:
 - a. Mueller, Figure A 26426.
 - b. Or equal.
2. Physical Characteristics:
 - a. Nonrising, heavy pattern, indicating type.
 - b. Complete with solid extension stem, coupling, handwheel, stem guide brackets, and yoke attachment.
 - c. Anchor Bolts: Type 304 stainless steel.
3. Functional Characteristics:
 - a. Stem Guide: Space such that stem L/R ratio does not exceed 200.
4. Performance Characteristics: Stem length as required to connect valve operating nut and floor stand.

F. Floor Box:

1. Manufacturers and Products:
 - a. Neenah Foundry; R 7506.
 - b. Or equal.
2. Physical Characteristics:
 - a. Plain type, for support of nonrising type stem.
 - b. Complete with solid extension stem, operating nut, and stem guide brackets.
 - c. Anchor Bolts: Type 304 stainless steel.
3. Functional Characteristics: Stem length as required to extend valve operating nut to within 3 inches of finish floor.
4. Performance Characteristics:
 - a. Stem Guide: Space such that stem L/R ratio does not exceed 200.

G. Chain Wheel and Guide:

1. Manufacturers and Products:
 - a. DeZurik Corp.; Series W or LWG.
 - b. Or equal.

2. Physical Characteristics:
 - a. Handwheel, direct-mounted type.
 - b. Complete with chain and mounting appurtenances.
 - c. Materials: Galvanized or cadmium-plated steel.
3. Functional Characteristics: Designed for operation of valves installed in elevated, inaccessible locations to permit operation from normal operation level.
4. Performance Characteristics: Refer to the Drawings for elevations of valves relative to operating floor to determine chain length required.

H. Cast-Iron Valve Box:

1. Manufacturers and Products:
 - a. East Jordan Iron Works; Cast-Iron Valve Boxes.
 - b. Or equal.
2. Physical Characteristics:
 - a. Sliding type, with minimum of 5-1/4-inch ID shaft.
 - b. Box: Cast iron with minimum depth of 9 inches.
 - c. Lid: Cast iron, minimum depth 3 inches, nonlocking type, marked with WATER, SEWER, or GAS for the service.
 - d. Extensions: Cast iron, or PVC pipe.
 - e. Two-piece box and lid for valves 4 inches through 12 inches, three-piece box and lid for valves larger than 12 inches with base sized for valve.
 - f. Valve extension stem for valves with operating nuts 3 feet or greater below finish grade.
3. Functional Characteristics: Protect valve stem and provide access for operation.
4. Performance Characteristics: Designed for traffic loads.

I. Concrete Valve Box:

1. Manufacturers and Products:
 - a. BES Concrete Products; G Series.
 - b. Or equal.
2. Physical Characteristics:
 - a. Sliding type, with minimum of 10-inch ID shaft.
 - b. Box: High-density, reinforced concrete, minimum depth 12 inches, cast-iron ring seat.
 - c. Lid: Cast iron, minimum depth 3 inches, locking type, marked WATER, SEWER, GAS, where applicable.
 - d. Extensions: Concrete or cast-iron pipe.
3. Functional Characteristics: Protect valve stem and provide access for operation. .
4. Performance Characteristics: Designed for traffic loads.

J. Indicator Post Assembly:

1. Manufacturers and Products:
 - a. Mueller; A-20806.
 - b. Or equal.
2. Physical Characteristics:
 - a. Cast or ductile iron post head, bell, and wrench with cast or ductile iron or steel barrel.
 - b. Plexiglas or equal protected window to indicate OPEN and CLOSED position.
 - c. Padlockable eye bolt for wrench.
3. Functional Characteristics:
 - a. Adjustable bury depth. Bury depth as required for valve installation.
 - b. Indicate whether the valve is open, closed or in mid-travel.
4. Performance Characteristics: UL Listed and FM Approved.

PART 3 EXECUTION

3.01 INSTALLATION

A. Flange Ends:

1. Flanged valve bolt holes shall straddle vertical centerline of pipe.
2. Clean flanged faces, insert gasket and bolts, and tighten nuts progressively and uniformly.

B. Screwed/Threaded Ends:

1. Clean threads by wire brushing or swabbing.
2. Apply joint compound.

C. PVC and CPVC Valves: Install using solvents approved for valve service conditions.

D. Valve Installation and Orientation:

1. General:
 - a. Install valves so handles operate from fully open to fully closed without encountering obstructions.
 - b. Install valves in location for easy access for routine operation and maintenance.
 - c. Install valves per manufacturer's recommendations.
2. Gate, Globe, and Ball Valves:
 - a. Install operating stem vertical when valve is installed in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above finished floor, unless otherwise shown.

- b. Install operating stem horizontal in horizontal runs of pipe having centerline elevations greater than 4 feet 6 inches above finish floor, unless otherwise shown.
 - 3. Eccentric Plug Valves:
 - a. Unless otherwise restricted or shown on the Drawings, install valve as follows:
 - 1) Liquids with suspended solids service with horizontal flow: Install valve with stem in horizontal position with plug up when valve is open. Install valve with seat end upstream (flow to produce unseating pressure).
 - 2) Liquids with suspended solids service with vertical flow: Install valve with seat in highest portion of valve (seat up).
 - 3) Clean Liquids and Gas Service: Install valve with seat end downstream of higher pressure when valve is closed (higher pressure forces plug into seat).
 - 4. Butterfly Valves:
 - a. Unless otherwise restricted or shown on the Drawings, install valve a minimum of 8 diameters downstream of a horizontal elbow or branch tee with shaft in horizontal position.
 - b. For vertical elbow or branch tee immediately upstream of valve, install valve with shaft in vertical position.
 - c. For horizontal elbow or branch tee immediately upstream of valve, install valve with shaft in horizontal position.
 - d. When installed immediately downstream of swing check, install valve with shaft perpendicular to swing check shaft.
 - e. For free inlet or discharge into basins and tanks, install valve with shaft in vertical position.
 - 5. Check Valves:
 - a. Install valve in accordance with manufacturer's instructions and provide required distance from immediate upstream fitting.
 - b. Install valve in vertical flow (up) piping only for gas services.
 - c. Install swing check valve with shaft in horizontal position.
 - d. Install double disc swing check valve to be perpendicular to flow pattern when discs are open.
 - 6. Solenoid Valves: Install in accordance with manufacturer's instructions.
- E. Install line size ball valve and union upstream of each solenoid valve, in-line flow switch, or other in-line electrical device, excluding magnetic flowmeters, for isolation during maintenance.
- F. Locate valve to provide accessibility for control and maintenance. Install access doors in finished walls and plaster ceilings for valve access.
- G. Extension Stem for Operator: Where depth of valve operating nut is 3 feet or greater below finish grade, furnish operating extension stem with 2-inch operating nut to bring operating nut to a point within 6 inches of finish grade.

- H. Torque Tube: Where operator for quarter-turn valve is located on floor stand, furnish extension stem torque tube of a type properly sized for maximum torque capacity of valve.
- I. Floor Box and Stem: Steel extension stem length shall locate operating nut in floor box.
- J. Chain Wheel and Guide: Install chain wheel and guide assemblies or chain lever assemblies on manually operated valves over 6 feet 9 inches above finish floor. Install chain to within 3 feet of finish floor. Where chains hang in normally traveled areas, use appropriate "L" type tie-back anchors. Install chains to within operator horizontal reach of 2 feet 6 inches maximum, measured from normal operator standing location or station.

3.02 FIELD COATING

- A. Provide field-applied coating in accordance with Section 09 90 00, Painting and Coating.

3.03 TESTS AND INSPECTION

- A. Valve may be either tested while testing pipelines, or as a separate step.
- B. Test that valves open and close smoothly under operating pressure conditions. Test that two-way valves open and close smoothly under operating pressure conditions from both directions.
- C. Inspect air and vacuum valves as pipe is being filled to verify venting and seating is fully functional.
- D. Count and record number of turns to open and close valve; account for discrepancies with manufacturer's data.
- E. Set, verify, and record set pressures for relief and regulating valves.
- F. Automatic valves to be tested in conjunction with control system testing. Set opening and closing speeds, limit switches, as required or recommended by Contracting Officer.
- G. Test hydrostatic relief valve seating; record leakage. Adjust and retest to maximum leakage of 0.1 gpm per foot of seat periphery.

3.04 MANUFACTURER'S SERVICES

- A. Valve(s) as listed below require manufacturer's field services:
 - 1. Power Actuated Valves and Self-Regulating Valves as shown on the Drawings.

B. Manufacturer's Representative:

1. Present at Site for minimum person-days listed below, travel time excluded:
 - a. 2 person-days for installation assistance and inspection.
 - b. 1 person-day for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.

C. See Section 01 67 00, Product Requirements, and Process equipment testing and facility startup in accordance with Section 01 91 14, Process Equipment Testing and Facility Startup.

3.05 VALVE SCHEDULES

- A. The Power Actuated Valve Schedule and Self-Regulated Valve Schedule as shown on the Drawings.

END OF SECTION

