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DIVISION 4

VALVE SPECIFICATIONS

4.1 General

4.1.1 Scope

Contractor shall furnish all labor, equipment, and material and perform all operations necessary for installation of valves, as shown on the Drawings and specified herein. All valves shall be new and of current manufacture. Replacement parts for the valves shall be available and generally in stock from suppliers within a 100-mile radius of the project site. All valves shall be wrapped in 8 mils of polyethylene, per AWWA C105.

4.1.2 Submittals

Prior to ordering valves, Contractor shall submit data on all valves.

4.2 General Requirements

4.2.1 Pressure Rating

Valves shall be rated for the working pressure and test pressure of the pipeline for which they are being installed. Unless specified otherwise, valves shall have a minimum working pressure of 150 psi.

4.2.2 Actuators

Unless specified otherwise, above-ground valves shall be furnished with hand wheel operators oriented to create the least obstruction and easiest access for operation. Buried actuators shall be furnished with two-inch-square operating nut, valve stem extension, and valve can in accordance with the Standard Drawings. Valve actuators shall conform to the operating requirements of AWWA Standard C507 or C504, as applicable, and shall be designed to hold open and fully closed without creeping or fluttering.

Unless specified otherwise, valves shall be mounted with a manual gear actuator and sized in accordance with AWWA C504 and C540, having a traveling nut or worm-and-gear design, stainless steel fasteners, a 2-inch AWWA operating nut, and the following requirements:

- Gear actuators shall be sized and supplied per AWWA C504 Class 150 or 250 “B.”

  Provide stop limiting devices in the actuators in the OPEN and CLOSED positions. Actuators components located between the input and the stop-limiting devices shall be designed to withstand without damage a pull of 200 pounds for handwheel and an input torque of 300 foot-pounds for 2-inch AWWA operating nuts when operating against the stops for worm gear operators or 450 foot-pounds for traveling nut operators.
Gear actuators shall be enclosed having stainless steel fasteners, lubricated with oil or grease, and provided with seals on shafts to prevent entry of dirt and/or water into the actuator. The actuator, for above-ground ball, butterfly, and plug valve applications, shall contain a dial indicating the position of the valve disc. For below-ground applications, the valves shall be provided with a ground level position indicator (if specified on the construction drawings). Valve actuators shall open by turning counterclockwise.

Unless specified otherwise, valves 3-inch through 36-inch shall be provided with self-locking traveling nut actuator of the manufacturer’s most current design. Valves 42-inch and larger shall be equipped with self-locking worm gear of a one-piece design, bronze or ductile iron, and accurately machine cut. The worm gear shall be hardened alloy steel (ASTM A322, Grade G41500; or ASTM A148, Grade 105-85), thread-ground and polished. Helix angle of the worm gear shall be designed and cut at 3.5 degrees or less to prevent creep, unless other means to prevent creep are employed as approved by Owner’s engineer. The actuator shall prevent creeping of the valve under all flow conditions. Reduction gearing shall meet maximum torque and pull design requirements. The reduction gearings shall operate in a proper lubricant.

Actuators shall be manufactured by AUMA, Mastergear, EIM, Limitorque, Pratt, or approved equal.

Electric Motor Actuator (if applicable) shall be Limitorque MX with weatherproof enclosure, 480VAC 3 Phase or 240VAC single phase where indicated, on/off controls (pulse modulation) with operating timing between 60 and 90 seconds (full open to full closed), local control package including pad lockable local off remote switch, OA contacts (R1-R4), analog transmitter (4-20 mA), and top-mounted hand wheel. The valve gear box and electric motor actuator combination shall be sized to the full pressure rating of the valve.

4.2.3 Valve Ends

Valve ends shall be flanged unless specified otherwise. Flanges shall conform to dimensions and drilling to ANSI B16.1, Class 125 (275 psi maximum) or ANSI B16.2, Class 250 (300 psi maximum) to match the pressure rating of the pipeline. Contractor shall match valve flanges and pipeline flanges.

4.2.4 Painting and Coating

All epoxy-coated surfaces shall have a minimum dry film thickness of 10 mils, unless otherwise specified. Valve surface preparation before applying coating shall be SSPC SP10 near white metal. All coated surfaces shall be visually and/or electrically examined for minimum thickness and/or defects using non-destructive testing means. Interior ferrous epoxy-coated surfaces shall be holiday free, as determined by a low-voltage wet sponge test, per AWWA C550.

1. Below-Grade: The interior and exterior ferrous surfaces shall have a factory-applied fusion-bonded epoxy coating, in accordance with AWWA C550. If, in the opinion of the manufacturer, fusion-bonded epoxy would not be practical for the valve design, an equivalent coating in 2-part liquid epoxy is acceptable.
Above-Grade: The interior ferrous surfaces shall have a factory-applied fusion-bonded epoxy coating, in accordance with AWWA C550. If, in the opinion of the manufacturer, fusion-bonded epoxy would not be practical for the valve design, an equivalent coating in 2-part liquid epoxy is acceptable.

4.3 Gate Valves

Valves 12-inch and smaller shall be resilient-seated gate valves in accordance with AWWA C-509 (latest). Unless specified otherwise, valves shall have ductile iron bodies and covers (ASTM A-536), non-rising bronze stems, two "O" ring stem seals, and a rubber (EPDM) encapsulated ductile iron disc (ASTM A-536). The valve shall have a full opening flow-way of equal diameter of the normal size of connecting pipe.

4.4 Eccentric Plug Valves (non-lubricated)

Plug valves shall be Eccentric Plug Valves, having eccentric seating with quick camming action. Valves shall be of the non-lubricated eccentric type.

Valve bodies shall be constructed of ASTM A-536 Grade 65-45-12 ductile iron in accordance with AWWA C-517 (if available) or ASTM A216, Grade WCB cast steel and be furnished with a 0.125" welded overlay seat of not less than 90% pure nickel. Seat area shall be raised and completely covered with weld such that the plug face contacts only nickel.

Shaft seals shall be of the multiple V-ring type and shall be externally adjustable and repackable while under pressure without removing the actuator or bonnet from the valve or self-adjusting U-Cup seals. Valves shall have sleeve type metal bearings of stainless steel.

Plugs shall be constructed of ASTM A-536 Grade 65-45-12 ductile iron in accordance with AWWA C-517 or ASTM A216, Grade WCB cast steel and rubber (EPDM) encapsulated. The plug shall have a seating surface eccentrically offset from the center of the plug shaft. The interference between the plug face and body seat, with the plug in the closed position, shall be externally adjustable in the field with the valve in line and under pressure.

Valves shall be pressure rated for 450 psi (3100 kPa). Each valve shall be given a hydrostatic and seat test as follows:

a. Valves shall undergo a hydrostatic test at 675 psi (4650 kPa) without experiencing any leakage. Test duration shall be as required to determine the integrity of the pressure boundary after test pressure has been applied.

b. Valves shall undergo a leakage test with water at 450 psi (3100 kPa). No leakage is permitted.
4.5 **Ball Valves**

Unless otherwise specified, all ball valves larger than six (6) inches shall be in accordance with AWWA C-507 (latest).

Unless specified otherwise, valve materials shall be as follows:

1. Valve Body – Ductile iron ASTM A536 65-45-12 with design pressure rating of 150 psi or 300 psi where indicated (watertight at rated pressure) with integral support legs or pads, suitable for line velocities up to 35 fps, temperatures up to 125 degrees Fahrenheit.
2. Valve Ball – Ductile iron ASTM A536 65-45-12 with watertight shut-off at rated pressure and no obstruction in the waterway.
3. Valve Shaft – Stainless Steel Type 304 for class 150 ball valves or 17-4 PH stainless steel for class 300.
5. Valve Seat – Rubber-seated for pressures under 300 psi or metal-seated for pressures in excess of 300 psi, retained in the valve body by mechanical means without hardware in the flow stream, field adjustable and replaceable.
6. Actuator – Worm gear operator. Actuator components shall withstand an input torque of 450 ft-lbs at extreme actuator positions without damage.
7. Valve Coating Interior – 16 mils holiday free NSF epoxy coating.

The valve shall be sized to operate at the design flow and at a valve angle within the manufacturer’s recommended throttling range to prevent cavitation damage. The valve gear box and electric motor actuator combination (if applicable) shall be sized to the full pressure rating of the valve.

4.6 **Butterfly Valves**

Valves larger than 12-inch shall be butterfly valves designed and manufactured in accordance with AWWA C-504 (latest).

Unless specified otherwise, valves materials shall be as follows:

4. Disc Edge – Stainless Steel Type 316.
5. Top Stub Shaft – Stainless Steel ASTM A-276 Type 304 or 17-4 PH.
6. Bottom Stub Shaft – Stainless Steel ASTM A-276 Type 304 or 17-4 PH.
8. Bottom Cover and Cap (if applicable) – Ductile iron ASTM A-536 (65-45-12), if available.
9. Cap Screws – Stainless Steel Type 304.
10. Squeeze Pins (if applicable) – Stainless Steel ASTM A-276 Type 316.
11. Taper Pins (if applicable) – Stainless Steel ASTM A-564 Type 630.
12. Lockwashers (if applicable) – Stainless Steel Type 316.
13. Hex Nuts (if applicable) – Stainless Steel Type 316.
15. Thrust Bearing Stub (if applicable) – Stainless Steel Type 316.
17. Thrust Collar Shims – Brass Alloy.
18. Groove Pin (if applicable) – Steel.
20. Spring Pin – Stainless Steel Type 420.

Valve seats shall be mounted on the valve body. Resilient seats on the valve disc will not be permitted. Valves 20 inches and smaller in diameter shall have a rubber seat permanently bonded to the valve body. Valve seats for valves 24 inches and larger in diameter shall be field-replaceable and constructed of a one-piece, continuous ring. Whenever internal retaining rings and screws are used with rubber seats, they shall be Type 316 stainless steel.

4.7 Triple Offset Metal-Seated Butterfly Valves

Triple offset metal-seated butterfly valves shall be of the high performance design and shall be rated for water working pressures of up to the specified design pressure or 150 psig, whichever is greater. The valves shall incorporate a triple-offset shaft design with an inclined conical seat and seal geometry, which shall create a torque seating operation which shall provide bi-directional zero leakage shut-off and be designed in accordance with ASME B16.34 and B31.1 and B31.3. Valves shall be of the metal seat design, which shall be capable of bi-directional seating against pressures up to the specified design pressure applied to one side of the disc, with zero pressure applied to the other side of the disc, in the CLOSED position, with zero leakage, and without damage or permanent deformation to any part of the valve body, seat, disc, shaft, bearings, or actuator. Each valve shall be tested for seat leakage in both directions with both water and air in accordance with API 598. The valve seating shall be achieved by applying a published, predetermined, and calculated torque value for the valve and this value shall be consistent for all valves of similar size. Valve leakage shall be zero in water and air.

Valve body shall be cast from carbon steel per ASTM A216 Grade WCB with FDA approved fusion-bonded epoxy coating (AWWA C550). Body may be stainless steel per ASTM A351 Grade CF8M. In either case for the carbon steel or the stainless steel body the valve shall be equipped with a 316 stainless steel disc. Fabricated bodies and discs shall not be permitted. The valve seating edge shall be located within the valve body fully protected from the flow stream. Operator mounting bracket will be centered with machined register and minimum of two (2) dowel pins will be used in addition to bracket bolting to absorb torsional load from operator. Valve shaft shall rotate counterclockwise to open.
Valve shafts shall be one-piece 17-4PH or 431 stainless steel construction and shall be designed in accordance with the requirements of API 609, anti-blowout protection. Valve shafts shall be full size for the portion of the shaft that extends through the valve bearings, valve disc, and shaft seal. In the event the shaft is turned down to fit connections to the valve-operating mechanism, the turned-down portion shall have fillets with radii equal to the offset to minimize the possibility of stress concentrations at the junction of the two differential shaft diameters. The turned-down portion of the shaft shall be capable of transmitting torque equivalent to at least 75 percent of the torsional strength of the minimum required shaft diameter and shall be capable of transmitting the maximum actuator torque under conditions of maximum design differential pressure without exceeding a torsional shear stress of 33 percent of Ultimate Tensile Strength. The combined torsional and transverse shear stress shall not exceed 67 percent of Yield Strength in accordance with ASME Sec. III Case N62.6 for the specified material.

For buried applications, the primary shaft seal shall be attained by two cup seals located below the gland inside the valve body. The secondary shaft seal shall be by O-rings, an additional cup seal located inside the gland, and the gland cap. Shaft bearings shall be ductile Ni-resist or Type 316 stainless steel baked PTFE or hard chrome-plated, press-fit shaft bearings (sealed from ingress of particulates or contaminants) with replaceable and energized inboard bearing protectors. Wetted bronze parts shall be in conformance with ASTM B62, containing not more than 7 percent zinc, 2 percent aluminum, 8 percent lead, and 83 percent copper + nickel + silicon. The bearing length shall be no more than 2.0 times the shaft diameter. Use an organic lubricant (such as fluorinated hydrocarbon) with metal bearings; do not use graphite, molybdenum disulfide, or other metallic-based lubricants.

Valves shall have a field replaceable “laminated” seal ring retained in the body or on the disc. The seal ring shall be constructed of Duplex Graphite Laminate Seal Ring mounted in the body or on the disc (with minimum three stainless and two graphite laminates). No elastomers shall be used in the sealing system. Seal ring design shall also include the following parameters:

- The seal ring shall be accessible (replaceable) by positioning the disc in a proper orientation and removing an adjacent pipe spool piece without removing or disassembling the valve.
- The seal ring shall be machined in an inclined conical shape to match the companion surface (in the body or on the disc, as appropriate). The overall geometry of the seal ring shall be formed into an elliptical shape to provide resilient seating.
- Each seal ring shall be identical and interchangeable for valves of the same size.
- The seal ring shall be held securely in place by a retaining ring bolted in place. Retaining ring shall be manufactured of 316 stainless steel regardless of being in the valve body or in the disc. An epoxy coated retaining ring, whether in the valve body or on the disc, is not acceptable.
- A spiral wound gasket shall be provided to prevent leakage around the seal ring. Flat static gaskets shall not be used.
- The seal ring shall be indexed and keyed to assure exact and proper installation or reinstallation, without the use of shims.
4.8  **Check Valves**

4.8.1  12-inch and Larger

Check valves 12-inch and larger shall be swing-type, lever and weight or lever and spring, designed and manufactured in accordance with AWWA C-508 (latest). Valves shall be flanged, cast-iron body, bronze or resilient Buna N seat with stainless steel shaft. The seat and plug shall be hand-replaceable in the field. The full-flow area through the body shall be equal to or greater than the cross-sectional area of the equivalent pipe size.

4.8.2  Smaller than 12-inch

Check valves smaller than 12-inch shall be globe style incline silent.

4.9  **Air and Vacuum Valves**

4.9.1  General

Air and vacuum valves shall be designed to permit automatic escape of large quantities of air from a pipeline when the line is being filled, permit air to enter the pipeline when the line is being emptied, and allow accumulating air to escape while the pipeline is in operation and under pressure.

Air and vacuum valves shall be kept clean and free from dirt, earth, debris, and other deleterious materials prior to, during, and after installation and construction. Each valve shall be protected by the use of an approved canvas or plastic bag or sack completely covering valve and securely fastened to valve riser.

4.9.2  Water Systems

Air and vacuum valves shall be combination valves and shall have cast iron bodies and covers, stainless steel floats rated 1,000 psi, all bronze or stainless steel internal working parts, and stainless steel pressure seats. Valves shall not be epoxy lined. Inlets shall be flanged or threaded, as specified, and outlets shall be threaded and the same nominal sizes as the inlets, minimum. Valves shall be subjected to a factory hydrostatic test at a pressure equal to 200% of the rated working pressure with no harmful deflections or other defects.

Air and vacuum valve outlets shall be adequately screened to prevent the entrance of foreign substances or materials. Air and vacuum valves assemblies shall be installed in accordance with the Standard Drawings. Where valves contain more than a single outlet, each outlet shall be adequately screened.
4.9.3 Wastewater Systems

Air and vacuum valves shall be combination valves and shall have cast-iron bodies and covers, one upper and one lower stainless steel float (rated at 1,000 psi) connected by a common stainless steel float guide, all brass internal working parts and Buna-N seats. Valves shall not be epoxy lined. Inlets shall be flanged or threaded as specified.

Air and vacuum valves shall be furnished with a shut-off valve, blow-off valve, quick disconnect coupling and a backflushing hose (minimum length of 6 feet).

4.10 Hydraulic Operated Control Valves

4.10.1 General

Hydraulic operated control valves shall be furnished and installed as specified herein and shown on the Construction Drawings. The basic valve shall be provided with external systems to modulate the pressure to the diaphragm to provide the specific control desired.

4.10.2 Basic Valve

The valve shall be a hydraulic operated diaphragm-actuated globe, as shown on the Drawings. It shall contain a resilient synthetic rubber disc having a rectangular cross-section and contained on 3½ sides by a disc retainer and forming a tight seal against a single removable seat insert. The diaphragm assembly containing a valve stem shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. This diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve separating operating pressure from line pressure. The diaphragm shall consist of nylon fabric bonded with synthetic rubber and shall not be used as a seating surface. Packing glands and/or stuffing boxes are not permitted and there shall be no pistons operating the valve. All necessary repairs shall be possible without removing the valve from the line. The body and cover materials shall be as specified on the plans. The main trim shall be 303 stainless steel. The rubber components shall be Buna N synthetic rubber. The valve body and cover, interior and exterior, shall be epoxy coated. Coating shall be applied using the fusion method and shall have a minimum coating thickness of 12 mils.

4.10.3 Pressure Relief Valve (Sole-Source Item per Approved List of Materials)

In general, the pressure relief valve shall consist of the basic valve with pilot control system which will maintain a constant upstream pressure by bypassing or relieving excess pressure and shall maintain close pressure limits without causing surges. The pilot control shall be a direct acting adjustable spring-loaded diaphragm valve designed to permit flow when controlling pressure exceeds spring setting. The pilot control system shall operate such that as excess line pressure is dissipated the main valve shall gradually close to a positive, drip-tight seating. The pilot control system shall be cast bronze ASTM B-62 with 303 stainless steel trim. The pressure relief valve shall have pressure relief ranges of 20 to 200 psi unless specified otherwise. The valve shall be furnished complete with an external Y-strainer, flow control valve, three shut-off valves and connecting tubing.
4.10.4 Pressure Reducing Valve (Sole-Source Item per Approved List of Materials)

In general, the pressure-reducing valve shall consist of the basic valve and pilot control system to maintain a constant downstream pressure regardless of varying inlet pressure. The pilot control shall be a direct-acting adjustable spring-loaded normally open diaphragm valve designed to permit flow when controlled pressure is less than the spring setting. The control system shall include a fixed orifice. The pilot control system shall be cast bronze ASTM B-62 with 303 stainless steel trim. The pressure reducing valve shall have pressure reducing ranges of 15 to 75 psi unless specified otherwise. The valve shall be furnished complete with a restriction tube fitting, external Y-strainer, closing speed control valve, opening speed control valve, three shut-off valves, and connecting tubing.

4.10.5 Altitude Valve

The altitude valve shall consist of the basic valve and pilot control system which shall control the high water level in a storage reservoir. The valve shall be available in various models to provide choices of one-way flow, two-way flow, two-way flow with delayed opening for return flow, or one-way flow with delayed opening. The valve shall be a non-throttling type valve and shall remain fully open until a shut-off point in the reservoir is reached. The pilot control shall be of a diaphragm actuated 3-way type that operates on the differential pressure between the height of the water in the reservoir and an adjustable spring-load. The entire valve and control system shall be designed so that no surface water can be drawn into the pilot system or main valve at any time. The pilot control system shall be cast bronze ASTM B-62 with 303 stainless steel trim. Unless specified otherwise, the valve shall be a two-way type which closes at high water level in the reservoir and opens for return flow when pressure at the valve inlet lowers below the reservoir pressure. The valve shall only require connection to the reservoir to sense the reservoir pressure level. Unless specified otherwise the valve shall have a range of 5 to 40 feet of water. The valve shall be furnished complete with an external Y-strainer, three shut-off valves, and connecting tubing.

4.10.6 Pump Control Valve for Well Pumping Plant

The pump control valve shall consist of the basic valve with pilot control system to eliminate pipeline surges caused by the starting and stopping of deep well pumps. Operation shall be completely automatic, fully hydraulic and electrically controlled by a solenoid control valve. With the pump off, the pump control valve shall be wide open. When the pump is started, the solenoid shall be energized and the valve shall begin to close slowly. When the pump is shut off, the pump control valve solenoid shall be de-energized and a limit switch on the valve shall keep the pump motor circuit closed and the pump operating. The pump control valve shall slowly open. When the pump control valve is fully open, the limit switch shall open, stopping the pump. Pressure from the system side of the check valve shall be connected and utilized for pilot valve operation. A microswitch shall be provided as part of the equipment to control the pump circuitry. The pilot control system shall be cast bronze ASTM B-62 with 303 stainless steel trim. The solenoid control valve enclosure shall be suitable for outdoor use. The pump control valve shall be furnished complete with shut-off valves, line strainer, solenoid control, opening and closing rate flow control valves, and connecting tubing.
4.10.7 Pump Control Valve for Booster Pumps

The booster pump control valve shall consist of the basic valve with pilot control system to eliminate pipeline surges caused by starting and stopping of the pump. The pump shall start with the pump control valve in the closed position. When the pump starts, the solenoid control valve shall be energized and the pump control valve shall open slowly, gradually increasing line pressure to the full pumping head. When the pump is shut off, the solenoid control valve shall be de-energized and the pump control valve shall close slowly, gradually reducing flow while the pump continues to run. When the pump control valve is fully closed, a limit switch assembly mounted on the pump control valve shall cause the pump to stop.

The control of the pump control valve shall be by means of an externally mounted four-way solenoid pilot valve. External Y-strainers shall be provided to protect the control system. Check valves shall be provided in the control system and shall be of the diaphragm type. The booster pump control valve shall utilize line pressure for operation. The booster pump control valve shall be furnished with a built in lift-type check feature to prevent reverse flow. Said check feature shall operate independently of the solenoid control. A limit switch shall be provided and shall be adjustable over the entire range of valve travel. The pilot control system shall be cast bronze ASTM B-62 with 303 stainless steel trim. The solenoid control valve enclosure shall be suitable for outdoor use. The control system shall be furnished complete with shut-off valves, Y-strainer, two check valves, solenoid control, opening and closing rate flow control valves, and connecting tubing.

4.11 Fire Hydrants

Fire hydrants shall be wet-barrel-type designed and manufactured in accordance with AWWA C-503. Hydrants shall be as specified on the Drawings and shall be installed in accordance with the Standard Drawings. The fire hydrant body shall be ductile iron or bronze. Protective coatings and painting shall be in accordance with Section 4.2.4 herein and the Standard Drawings.