

**SECTION 600
MATERIALS****PART 1 GENERAL****600 MATERIALS:**

600.01 GENERAL: The criteria established in the following Specifications sets the minimum standards for materials used in construction of utilities in the City of Broken Arrow. Contractors are urged to provide materials that exceed these minimum standards and if necessary, submit alternative materials for approval.

600.02 APPROVAL OF MATERIALS: The Contractor installing the materials must submit certifications, testing reports, and requests for approval of materials in accordance with the City of Broken Arrow's current utility construction inspection procedure.

601 CONCRETE:

601.01 DESCRIPTION: This specification covers concrete for use in construction of utilities, structures, streets, sidewalks, and drainage structures.

601.02 CRITERIA:

- a. **Specifications:** All concrete used in the City of Broken Arrow will meet the requirements of these Specifications. Contractors shall submit a mix design at the start of each project and shall not deviate from that mix design without written approval.
- b. **Classes of Concrete and Their Uses:**
 1. Class BA1 (3,500 psi): Street paving, curb and gutter, structural applications (i.e., Bridge Decks, Box culvert decks, concrete piles, building foundations, etc.) and other applications as designated by the design engineer.
 2. Class BA2 (3,000 psi): Abutments, retaining walls, culverts, manhole bases, reinforced concrete not requiring class BA1 concrete, and other applications as designated by the Design Engineer.
 3. Class BA3 (2,500 psi): Thrust Blocks, encasement, pipe cradle, and other applications as designated by the Design Engineer.
 4. Class BA4 (2,400 psi): Soil erosion control structures and other applications as designated by the Design Engineer.
 5. Class BA SPECIAL: Applications and strength as designated by the Design Engineer.
 6. Class BA FIBER: (3,500 psi): Concrete lined channels, beaver slides, and other applications as designated by the Design Engineer.
 7. ODOT Class: Mix designs adhering to the latest version of the Oklahoma Department of Transportation Standard Specification for Highway Construction.
- c. **Fiber Mesh Reinforcement:** Fiber reinforcement, if specified, shall comply with the material specifications and performance requirements set forth in ASTM C1116, for Type III Synthetic-Fiber Reinforced Concrete, and as follows. Synthetic reinforcing fibers shall be 100 percent virgin polypropylene fibrillated fibers containing no reprocessed olefin materials. Fibers shall have a specific gravity of 0.9, a minimum tensile strength of 60 ksi, graded per manufacturer, and be specifically manufactured to an optimum gradation for use as concrete reinforcement. Provide a minimum of 1.5 pounds fiber reinforcement per cubic yard of concrete. Fibers shall be added at the batch plant.

602 PIPE BEDDING:

602.01 DESCRIPTION: This specification covers pipe bedding which is the material placed under a pipeline as required by the applicable standard detail.

602.02 CRITERIA:

- a. **Sand Bedding:** Sand bedding shall all pass a 1-inch (25-mm) sieve and shall contain 5 percent to 35 percent of material passing the No. 200 sieve (0.075 mm). The final material shall have a liquid limit of 35 or less and a plasticity index not to exceed eight.
- b. **Crushed Stone Bedding:** Crushed and washed limestone chips with a nominal size of 3/8 inches.
- c. **Select Material Bedding:** Select material from trench excavation if it is satisfactory to the Engineer for such use. Bedding material be friable soil containing no rocks. Clay soil or any soil containing hard lumps shall not be used in the cushion.

603 SELECT BACKFILL:

603.01 DESCRIPTION: This specification covers select backfill which is material placed over a pipeline as required by the applicable standard detail.

603.02 CRITERIA:

- a. **Sand:** Sand backfill may be Arkansas River sand, free from objectionable material and containing not more than 10 percent clay and loam by weight, 100 percent shall pass a 3/4-inch sieve and 95 percent shall pass number four sieve.
- b. **Select Material:** Pipe may be initially backfilled with select material from trench excavation if it is satisfactory to the Engineer for such use. Backfill to 6 inches over the pipe shall be friable soil containing no rock in excess of 1 inch in maximum dimension. Clay soil or any soil containing hard lumps shall not be used in the initial backfill.
- c. **Washed 3/4 Inch Rock:** Limestone rock free of fines with a nominal size of 3/4 inch.
- d. **Crushed Rock:** Shall be ODOT Type A Aggregate Base as specified in Section 703.01 Aggregate for Aggregate Base in the ODOT Standard Specifications.
- e. **Flowable Fill:** Shall be controlled low-strength material as specified in Section 701.19 of the 2019 ODOT Standard Specifications for Highway Construction or most current version.

604 CONDUIT:

604.01 DESCRIPTION: This specification covers all conduit used in pipelines in the City.

604.02 CRITERIA: Conduit (also known as tunnel liner or pipe sleeve) shall conform to, and be tested in accordance with one of the following:

- a. **Concrete Conduit:** Reinforced Concrete Culvert, Storm Drain and Sewer Pipe, ASTM C76, Class IV.
- b. **Galvanized Metal Conduit:** Corrugated galvanized pipe shall not be used in public projects nor placed in public right-of-way.
- c. **Steel Conduit:** 12-gauge steel pipe meeting AWWA Standard for Electrically Welded Steel Water Pipe, AWWA C201 or Mill-Type Steel Water Pipe, AWWA C202, either to have 3/16 inch wall thickness with the interior.

605 POLYETHYLENE WRAP:

605.01 DESCRIPTION: This specification covers polyethylene wrap for ductile iron pipe and ductile or cast iron fittings and valves.

605.02 CRITERIA: When a polyethylene tube is specified or required, it shall be made from virgin polyethylene resin in accordance with ASTM D1248. Thickness shall not be less than .008 inch. The material shall be chemically inert and moisture resistant to form an effective seal against penetration by water or vapor. Tensile strength shall be 1,800 psi with elongation of 500 percent. Tape for polyethylene tube shall be plastic backed adhesive tape, Polykan #900, Scotchrap #50 or approved equal, 2 inches in width. The tube shall be of such length that a 1 foot overlap is provided at each joint in pipe. Minimum flattened polyethylene tube widths for use with specific pipe sizes and joint types:

Nominal Pipe Size	Push-On Joint Flat Tube Width	Mechanical Joint Flat Tube Width
4"	14"	16"
6"	17"	20"
8"	21"	24"
10"	25"	27"
12"	29"	30"
14"	33"	34"
16"	37"	37"
18"	41"	41"
20"	45"	45"
24"	53"	53"

606 WATER LINE - VALVE BOXES, VAULTS, PITS, AND MANHOLES:

606.01 DESCRIPTION: This specification covers all valve enclosures used in the water distribution and sanitary sewer systems.

606.02 CRITERIA:

a. Castings:

1. General: Castings for valve boxes, valve vaults, manholes, and other appurtenances shall conform to and be tested in accordance with the Specifications for Gray Cast Iron ASTM A48, Class 30. Castings shall conform to dimensions shown on the Standard Drawing, shall be bodily filleted at angles and the arises shall be sharp and perfect, true to form and thickness. Frames or covers that are to be located in traveled ways or in any location subject to vehicular traffic shall have all bearing surface machined so that fitting parts will not rattle or rock under traffic and the covers shall fit frames without wedging. Covers shall carry the legend "Water" in 1-inch letters.

2. Water Valve Manhole Frame and Lid: Shall be as shown on Standard Drawing W03 and shall be used on all water valve manholes and valve vaults unless the valve vault frame and lid shown in Standard Drawing W05 is specified.
 3. Valve Vault Frame and Lid: Special requirement frame and lid shall be as shown on Standard Drawing W05.
 4. Valve Boxes: Casting for valve boxes shall conform to and be tested in accordance with Specifications for Gray Cast Iron, ASTM A48, Class 30. Valve boxes shall be screw adjustable with drop covers as shown on Standard Drawing W04.
- b. **Concrete Masonry Units:** Concrete masonry units shall conform to and be tested in accordance with the Specifications for Concrete Masonry, Hollow Load Bearing Concrete Masonry Units, ASTM C90 or Concrete Building Brick ASTM C55, Grade A. Manhole units shall conform to and be tested in accordance with one of the following: Sewer Brick (made from clay or shale), ASTM C32, Grade MA; Concrete Building Brick ASTM C55, Grade A; or Concrete Masonry Units for Construction of Catch Basins and Manholes, ASTM C139.
- c. **Precast Manholes:** Precast manholes shall conform to and be tested in accordance with the Specifications for Precast Reinforced Concrete Manhole Risers and Tops, ASTM C478, flat slab top type.

620 WATER LINE - PVC PIPE, FITTINGS, AND JOINTS:

620.01 DESCRIPTION: This specification covers polyvinyl chloride (PVC) pipe, fittings, and joints used in the water distribution system as main lines or return lines for looping.

620.02 CRITERIA:

- a. **Main Line Pipe:** Polyvinyl chloride (PVC) pipe shall conform to the provisions of AWWA C900 AWWA Standard for PVC Pressure pipe 4 inches through 12 inches for water and shall conform to requirements set forth herein. The size, OD base, pressure class, and type of joint shall be as shown on the Plans. Where not shown otherwise, the pipe shall have cast iron pipe equivalent OD, elastomeric gasket bell joints, and dimension ratio (DR) of 14. Polyvinyl chloride (PVC) pipe shall conform to the provisions of AWWA C905 AWWA Standard for PVC Pressure pipe over 12-inch diameter for water and shall conform to requirements set forth herein. The size, OD base, pressure class, and type of joint shall be as shown on the Plans. Where not shown otherwise, the pipe shall have cast iron pipe equivalent OD, elastomeric gasket bell joints, and dimension ratio (DR) of 14. PVC pipe shall be marked to show that it has been approved by Underwriters Lab., Inc. The Contractor shall furnish an affidavit from the pipe manufacturer that all delivered materials comply with Standard for PVC Pressure Pipe 4 inches through 12 inches for Water and shall conform to requirements set forth herein. Set screw retainer glands manufactured for PVC pipe, may be used to restrain pipe sections.
- b. **Main Line Fittings:** All fittings used for connections shall have mechanical joints, except when specifically designated on the Plans, flanged joints shall be used. Fittings shall conform to the "American National Standard for Gray Iron and Ductile Iron Fittings, 4 inch through 48 inches, for Water and Other Liquids", No. A21.10 (AWWA C153) as latest revised, for 250-psi pressure ratings for gray iron, except that fittings 14 inches and larger in size shall be ductile iron only. When Ductile Iron fittings are used they shall be Class 350 for 2 inches to 24 inches and Class 250 for 30 inches to 48 inches. All fittings shall have cement-mortar lining with a bituminous seal coat in accordance with the "American National Standard for Cement-Mortar Lining for Cast Iron and Ductile Iron Pipe and Fittings for Water", No. A21.4 (AWWA C104). The outside of pipe and fittings shall be coated with a standard

bituminous coal tar or asphalt base coating. Set screw retainer glands manufactured for PVC pipe, may be used to restrain fittings. All glands used for fittings shall be approved for that fitting and shall be of similar manufacture. Solid sleeves for pipe 12 inches or smaller shall be a minimum of 12 inches long. Solid sleeves for pipe larger than 12 inches shall be a minimum of 15 inches long. All bolts shall be stainless steel.

- c. **Main Line Joints:** The size, joint type, and pressure rating shall be as shown on the Plans. Where not otherwise shown, push-on joints shall be used. Pressure ratings shall be 250 psi or more.
- d. **Prohibited Fittings and Glands:** From time to time certain fittings and glands are prohibited from use in the City of Broken Arrow. A current list of prohibited items may be obtained from the Engineering Construction Department.

621 WATER LINE - DUCTILE IRON PIPE, FITTINGS, AND JOINTS:

621.01 DESCRIPTION: This specification covers ductile iron pipe, fittings, and joints pipe used in the water distribution system as main or distribution lines.

621.02 CRITERIA:

- a. **Pipe:** Ductile iron shall conform to ASTM A536 with physical properties of Grade 60-42-10. The minimum standard thickness of each size pipe shall be in accordance with the manufacturers published recommendations based on trench conditions, backfill, loading and depth bury. These thicknesses are the minimum required. Greater thicknesses shall be furnished for special requirements as set out in the Construction Specifications or shown on the Plans. Ductile iron pipe shall conform to “American National Standard for Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water and Other Liquids”, No. A 21.51 (AWWA C151). Pipe shall be furnished in 18-foot or 20-foot lengths, except that shorter lengths may be used as necessary at fittings and connections. Minimum pipe class for 4 inch pipe shall be Class 51. For pipe larger than 4 inch through 12 inch pipe the minimum class shall be shall 50. All pipe over 12 inches shall be Class 51. Set screw retainer glands manufactured for ductile iron pipe, may be used to restrain pipe sections.
- b. **Fittings:** All fittings used for connections shall have mechanical joints, except when specifically designated on the plan, flanged joints shall be used. Fittings shall conform to the “American National Standard for Ductile-Iron Fittings, 2 inches through 48 inches”, for Water and Other Liquids, No. A 21.10 (AWWA C 153) and fittings 14 inches and larger in size shall be case from ductile iron only. When Ductile Iron fittings are used they shall be Class 350 for 2 inches to 24 inches and Class 250 for 30 inches to 48 inches. Set screw retainer glands manufactured for ductile iron pipe, may be used to restrain fittings. All glands used for fittings shall be approved for that fitting and shall be of similar manufacture. Solid sleeves for pipe 12 inches or smaller shall be a minimum of 12 inches long. Solid sleeves for pipe larger than 12 inches shall be a minimum of 15 inches long. All bolts shall be fluoropolymer coated.
- c. **Coatings and Linings:** All pipe and fitting shall have cement-mortar lining with a bituminous seal coat in accordance with the “American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water”, No. A 21.4 (AWWA C104). The outside of pipe and fittings shall be coated with a standard bituminous coal-tar or asphalt base coating.
- d. **Prohibited Fittings and Glands:** From time to time certain fittings and glands are prohibited from use in the City of Broken Arrow. A current list of prohibited items may be obtained from the Engineering Construction Department.

622 WATER LINE - PRESTRESSED CONCRETE PIPE, FITTINGS, AND JOINTS:

622.01 DESCRIPTION: This specification covers prestressed concrete pipe, fittings, and joints used in the water distribution system as distribution lines.

622.02 CRITERIA:

- a. **Pipe:** Prestressed concrete pipe and fittings shall conform to and be tested in accordance with the AWWA Standard for Reinforced Concrete Water Pipe Steel Cylinder Type, Prestressed, AWWA C301. All pipe shall be manufactured by an established manufacturer who has had at least 3 years' experience in successfully building this type of pipe. Each length of straight pipe shall be plainly marked to indicate where the head for each pipe is designed and to indicate where the pipe will be used by reference to the layout drawings.
- b. **Fittings:** All specials and fittings shall be either of Type A or Type B and must be built to the details furnished by the manufacturer and approved by the Engineer. Each special shall be plainly marked to indicate where the head for each special is designed and to indicate where the pipe will be used by reference to the layout drawings.
- c. **Joints:** Reinforced concrete pipe and fittings for water lines shall be jointed according to AWWA Standard for Reinforced Concrete Water Pipe Steel Cylinder Type, Prestressed, AWWA C301.

623 WATER LINE - SERVICE LINE AND FITTINGS:

623.01 DESCRIPTION: This specification covers lines and fittings that are used from the tap to the water meter.

623.02 CRITERIA:

- a. **Copper Line:** Copper service pipe shall be a seamless copper tubing cold drawn to size. It shall be Type K soft annealed and shall meet the requirements of ASTM B88.
- b. **Crosslinked Polyethene Pipe:** Crosslinked Polyethene (PEX-A) service line shall be Uponor Aqua PEX or Rehau MUNICIPEX meeting requirements of 3306 designations according to ASTM F876.
 1. 3/4 inch meters shall be supplied by a single 1-inch PEX line.
 - a) Service taps shall match the line nominal diameter.
 2. 1 inch meters shall be supplied by a single 1-1/2-inch PEX line.
 - a) Service taps shall match the line nominal diameter.
- c. **Conduit:** All long services shall be placed in schedule 40 PVC with sealed ends.
- d. **Fittings:** All fittings shall be of cast brass or bronze and shall be finished in a thoroughly workmanlike manner. They shall be sound, clean, free from blow holes, porous places, cracks, or any other defects affecting their strength or appearance, which would indicate inferior quality of metal. All moving parts shall be accurately fitted up so as to work smooth and freely, without binding. They shall be of standard type commonly used and shall be the product of a recognized manufacturer of such fittings. Each casting shall bear the name or trademark of the manufacturer, permanently cast in the metal. Connectors shall be flare or compression type.

624 WATER LINE TAPS:

624.01 DESCRIPTION: This specification covers taps on all main and distribution water lines.

624.02 CRITERIA:

- a. **Service Line Taps (PVC and Ductile Iron Lines):** Service line taps shall have a solid brass body, brass straps, brass bolts, and brass nuts. The gaskets shall be tight sealing and resistant acids, alkalis, and water. Saddles shall be of the two strap design and shall have a pressure rating equal to or greater than the pressure rating of the pipe. The saddles shall be Ford 202b brass service saddles or equal.
- b. **Main Line Taps (PVC and Ductile Iron Lines):** Tapping sleeves shall have a stainless steel body and stainless steel bolts and nuts. Tapping sleeves shall be full circle gasketed through 12-inch diameter, with flanged joint at the valve connection. Tapping sleeves shall conform to and be tested in accordance with the American Standard for Cast Iron Fittings, 2 inch through 48 inch for Water and Other Liquids, AWWA C100. Pressure rating shall be 250 psi. Sleeves shall be Ford FAST style or equal. Tapping valves shall be of the same construction as specified for gate valves with seat opening larger than nominal size to permit full diameter cuts. Inlet ends are to be flanged to attach to the tapping sleeves. Outlet ends are to be mechanical joint. Tapping valves shall be Mueller or equal. Direct taps shall not be used.
- c. **Prestressed Concrete Pipe Taps:** The tap used shall conform to the pipe manufactures recommendations. Tapping sleeves shall have a flanged joint at the valve connection. Tapping sleeves shall conform to and be tested in accordance with the American Standard for Cast Iron Fittings, 2 inch through 48 inch for Water and Other Liquids, AWWA C100. Pressure rating shall be 250 psi. Tapping valves shall be of the same construction as specified for gate valves with seat opening larger than nominal size to permit full diameter cuts. Inlet ends are to be flanged to attach to the tapping sleeves. Outlet ends are to be mechanical joint. Tapping valves shall be Mueller or equal. Direct taps shall not be used.

625 WATER LINE - VALVES:

625.01 DESCRIPTION: This specification covers all valves used in the water distribution system.

625.02 CRITERIA:

- a. **Resilient Seated Gate Valve:** Valves shall conform to AWWA C509, Standard for Resilient Seated Gate Valve. Wedge shall be constructed of ductile iron, fully encapsulated in synthetic rubber except for guide and wedge nut areas. Wedge rubber shall be molded in place and bonded to the ductile iron portion, and shall not be mechanically attached with screws, rivets or similar fasteners. Wedge shall seat against surfaces arranged symmetrically about the centerline of the operating stem, so that seating is equally effective regardless of direction of pressure unbalance across the wedge. All seating surfaces in body shall be inclined to the vertical at a minimum angle of 32 degrees (when stem is in a vertical position) to eliminate abrasive wear of rubber sealing surfaces. Stem shall be sealed by at least two O-rings; all stem seals shall be replaceable with valve wide while open and subjected to full rate pressure. Waterway shall be smooth and have no depressions or cavities in seat area where foreign material can lodge and present closure or sealing. Valve body and bonnet shall be epoxy coated, inside and out. All exterior/exposed bolts shall be made of stainless steel. All valves shall be manufactured by AVK, American Flow Control, East Jordan, Clow, Mueller, or Kennedy.
- b. **Butterfly Valves:** Butterfly valves shall be of the tight closing, rubber-seat type, with rubber seats which are securely fastened to the valve body. No metal-to-metal seating surfaces will be permitted. Valves shall be bubble-tight at rated pressures and shall be satisfactory for applications involving valve operation after long periods of inactivity. Valve discs shall

rotate 90 degrees from full open position to the tight-shut position. Valves 24 inch and larger shall be capable of providing bubble-tight shutoff with disc up to plus one-quarter inch off dead center position. Valves shall meet the full requirements of AWWA C504-74, Class 150B. The valve bodies shall be mechanical joint end or flanged valves as shown on the Plans. Valve bodies shall be constructed of cast iron, ASTM A126, Class B. Flange drilling shall be in accordance with ANSI B16.1 Standard for cast iron flanges. Two trunnions for shaft bearings shall be integral with each valve body. Body thickness shall be strictly in accordance with AWWA C504-74. Valve discs shall be constructed of cast iron or ductile iron with stainless steel seating edge. Discs shall be secured to shafts by stainless steel pins sized to transmit torques required and withstand stresses imposed under specified operating conditions. Shafts of all valves shall be turned, ground and polished. Valve shafts shall be constructed of 18-8 Type 304 Stainless steel. Shaft diameters must meet minimum requirements established by AWWA C504-74, Class 150B. Valve seats shall be of a synthetic rubber compound. Valve seats shall be field adjustable and replaceable without dismantling operator, disc, or shaft, and without removing the valve from the line. Seats shall be retained in the valve body by mechanical means without retaining rings, segments, screws or hardware of any kind in the flow stream. Seats shall be continuous throughout 360 degrees and shall have a plurality of grooves mating with a spherically shaped stainless steel disc edge seating surface. Seats attached to the valve disc are not acceptable. Valve bearings shall be fitted with sleeve type bearings. Bearings shall be corrosion resistant and self-lubricating. Bearing load shall not exceed one-fifth of the compressive strength of the bearing or shaft material. Placing shall be self adjusting chevron type. Valve operators shall conform to the operating requirements of AWWA C504-74 and shall be designed to hold the valve in any intermediate position between full open fully closed without creeping or fluttering. The buried nut manual operator shall be of the traveling nut, self-locking type and shall be equipped with mechanical stop limiting devices to prevent over-travel of the disc in the closed or open positions. Operator components shall withstand an input torque or 450 ft/lbs at extreme operator positions without damage. The manufacturer shall have manufactured tight-closing, rubber seat butterfly valves for a period of at least five years. All valves shall be manufactured by the Henry Pratt Company, Crispin, Kennedy, Mueller or approved equal.

- c. **Air Relief Valves:** Air relief valves shall be heavy-duty combination air release and vacuum type for 300 psi water working pressure, testing to 300 psi, two inch in size. Body, cover, and baffle shall be cast iron. All internal parts to be either highest quality stainless steel or bronze, the inside of the valve coated with rust inhibitor. Only the following makes or approved equal will be permitted: ARI, Apco No. 245C, Crispin, Val-Matic.
- d. **Check Valves:** Check valves shall conform to and be tested in accordance with the AWWA Standard for Swing-Check Valves for Ordinary Water Works Service, AWWA C508. They shall be horizontally mounted, single disc, swing type with a full diameter passage providing minimum pressure loss. Valves shall be of the non-slamming type designed for the future installation of outside lever and weight. Disc faces and seat rings shall be bronze. Ends shall fit the pipe or fitting to which attached (push-on, mechanical, or flanged). Only the following makes or approved equal will be permitted: Crane, Darling, Ludlow-Rensselaer, M & H Mueller, AP Smith.
- e. **Ball Valves:** Ball valves shall be: double-seated with natural or synthetic rubber, bronze or monel metal seats; designed for 150 psi working pressure; flanged end; O-ring rotor bearing seals; constructed of high tensile strength cast iron; equipped with totally enclosed manual operators, with open-closed indicator and hand wheel with standard size square wrench nut for one man operation and 150 psi unbalance across the valve. Valves shall be tested by and shall withstand without leak, a hydrostatic pressure of; (1) 250 psi on the valve body with the rotor in the open position; and (2) 150 psi on each side of the valve with the opposite side

upon to atmosphere. Four copies of the test results and manufacturer's drawings shall be submitted for approval prior to delivery of the valve. Only the following makes or approved equal will be permitted: Allis-Chalmers, Henry Pratt or Willamette Iron and Steel.

- f. **Valve Operators:** Valves, operator housing, supports and connections shall have provisions for four-bolt mounting. Operators shall be equipped with a 2-inch-square operating nut and shall be fully grease packed and gasketed for buried service. Operators shall have a link-lever arrangement providing for characterized closure of the valve. Valves shall close with a clockwise rotation of the nut. Operators shall be of the Pratt MDT type or approved equal and matching valve manufacturer if available.
- g. **Valve Painting:** All surfaces of the valve shall be clean, dry and free from grease before painting. The valve interior and exterior surfaces except for seating shall be evenly coated with asphalt varnish or epoxy paint in accordance with Federal Specifications TT-V-51 and AWWA C504-74. Hydrostatic and leakage tests shall be conducted in strict accordance with AWWA C504-74, Section 12.

626 FIRE HYDRANTS AND EXTENSIONS:

626.01 DESCRIPTION: This specification covers all fire hydrants and extensions used in the water distribution system.

626.02 CRITERIA:

- a. **Characteristics:** Fire hydrants shall be dry-top traffic model designs conforming to AWWA C-502 - Standard for Dry Barrel Fire Hydrants with the following selective and design specifications:
 1. Working Pressure: Minimum 250 psi.
 2. Size of Valve Opening: Minimum 4-1/2 inch.
 3. Direction to Turn to Open: Left (counterclockwise).
 4. Size and Shape of Operating Nuts: 1-1/2-inch Pentagon.
 5. Size and Shape of Nozzle Cap Nuts: 1-1/2-inch Pentagon.
 6. Pumper Nozzle Threading: National Standard.
 7. Hose Nozzle Threading: National Standard.
 8. Number and Size of Hose Connections: 2-2 inch; 1-4 inch.
 9. Nozzle Attachment to Barrel: Threaded or lug locked.
 10. Upper Valve Plat Material: Bronze.
 11. Seat Ring Material: Bronze.
 12. Seat Ring Thread: Bronze to Bronze.
 13. Bonnet Lubrication Point: Externally accessible.
 14. Bonnet Weather Cap: Required.
 15. Color Above Ground: Red enamel.
 16. Minimum Bury Depth: 3 feet.
 17. Size and Type of Inlet Connection: 6-inch mechanical joint.
- b. Grease hydrants shall be maintained with a calcium soap-based food grade grease.
- c. All hydrants shall be dry top design in which the operating stem threads and the bearing systems are sealed from the waterway and from external elements by O-rings. Lubrication shall occur each time the hydrants are operated. Only the following hydrants will be permitted:
 1. American Flow Control; Darling Mark 73-5*.
 2. East Jordan; Water Master 4.5CD350 3-way Nozzle*.
 3. Mueller; Super Centurion A421.

4. Clow; 4-1/2 inch Medallion F2545.

- d. **Painting:** Hydrants shall be provided with red machinery enamel as manufactured by Glidden, DuPont or equal.

627 DIG THROUGH LOCATOR TAPE: Shall be a foil tape colored blue with “Water Line Buried” printed on the tape. It shall be Terra Tape Sentry Line 620 or approved equal.

650 SANITARY SEWER - PVC PIPE, FITTINGS, AND JOINTS:

650.01 DESCRIPTION: This specification covers all PVC pipe used in the sanitary sewer collection system as both gravity sewers and force mains.

650.02 CRITERIA:

a. **Gravity Sewers:**

1. Pipe: Polyvinyl Chloride Pipe (PVC) shall conform to ASTM D3034-73, SDR 35. The material used in the pipe shall be virgin PVC material, except that scrap material from the manufacturing process may be reused. The wall thickness of the pipe shall be a side-to-diameter ratio of not more than 35. All pipe shall be suitable for use as a gravity sewer. Provisions must be made for contraction and expansion of each joint with a rubber ring. The bell shall consist of an integral wall section with a solid cross-section rubber ring, factory assembled, securely locked into place to prevent displacement and shall conform to ASTM D1869. The standard length of PVC pipe shall be 20 feet. Joint length may be reduced to 13 feet when construction conditions require the use of a trench box. The pipe stiffness shall be determined in accordance with the ASTM D2412 and the minimum pipe stiffness at 5 percent deflection shall be 46 for all sizes when tested in accordance with ASTM Designation. The Contractor shall furnish an affidavit from the pipe manufacturer that all delivered materials comply with the requirements of the Specifications.
2. Fittings: All fittings shall meet applicable pipe specifications and shall have bell and/or spigot configuration identical to that of the pipe.
3. Joints: All pipe shall have integral bell with a rubber gasket to form a water-tight joint.
4. Joint Length: Unless authorized in writing, by the City, full joints shall be 20 feet in length. Joint length may be reduced to 13 feet when construction conditions require the use of a trench box.

b. **Force Mains:**

1. Pipe: Polyvinyl chloride (PVC) pipe shall conform to the provisions of AWWA C900 AWWA Standard for PVC Pressure pipe 4 inches through 12 inches for water and shall conform to requirements set forth herein. The size, OD base, pressure class, and type of joint shall be as shown on the Plans. Where not shown otherwise, the pipe shall have ductile iron pipe equivalent OD, elastomeric gasket bell joints, and dimension ratio (DR) of 18. PVC pipe shall be marked to show that it has been approved by Underwriters Lab., Inc. The Contractor shall furnish an affidavit from the pipe manufacturer that all delivered materials comply with the requirements of the Specifications.
2. Fittings: All fittings used for connections shall have mechanical joints, except when specifically designated on the Plans, flanged joints shall be used. Fittings shall conform to the “American National Standard for Gray Iron and Ductile Iron Fittings, 4 inch through 48 inch, for Water and Other Liquids”, No. A21.10 (AWWA C153) as latest revised, for 250 psi pressure ratings for gray iron, except that fittings 14 inches and larger in size shall be ductile iron only. When Ductile Iron fittings are used they

shall be Class 350. All fittings shall have cement-mortar lining with a bituminous seal coat in accordance with the “American National Standard for Cement-Mortar Lining for Cast Iron and Ductile Iron Pipe and Fittings for Water,” No. A21.4 (AWWA C104). The outside of pipe and fittings shall be coated with a standard bituminous coal tar or asphalt base coating.

3. Joints: The size, joint type, and pressure rating and type of iron shall be as shown on the Plans. Where not otherwise shown, push-on joints shall be used. Pressure ratings shall be 250 psi or more, and the iron may be either gray iron or ductile iron.
4. Joint Length: Unless authorized in writing, by the City, full joints shall be 20 feet in length. Joint length may be reduced to 13 feet when construction conditions require the use of a trench box.

651 SANITARY SEWER - DUCTILE IRON PIPE, FITTINGS, AND JOINTS:

651.01 DESCRIPTION: This specification covers all ductile iron pipe used in the sanitary sewer collection system as aerial crossings or force main crossings. This material may be used for very limited applications and requires written approval of the Engineering and Construction Department Director.

651.02 CRITERIA:

- a. **Pipe:** Ductile iron shall conform to ASTM A536 with physical properties of Grade 60-42-10. The minimum standard thickness of each size pipe shall be in accordance with the manufacturers published recommendations based on trench conditions, backfill, loading and depth bury. These thicknesses are the minimum required. Greater thicknesses shall be furnished for special requirements as set out in the Construction Specifications or shown on the Plans. Ductile iron pipe shall conform to “American National Standard for Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water and Other Liquids”, No. A21.51 (AWWA C151). Pipe shall be furnished in 18-foot or 20-foot lengths, except that shorter lengths may be used as necessary at fittings and connections.
- b. **Fittings:** All fittings used for connections shall have either mechanical joints or bell and spigot joints, except, when specifically designated on the plan, flanged joints shall be used. Fittings shall conform to the “American National Standard for Ductile-Iron Fittings, 2 inches through 48 inches”, for Water and Other Liquids; No. A 21.10 (AWWA C110) and fittings 14 inches and larger in size shall be case from ductile iron only. When Ductile Iron fittings are used they shall be Class 350.
- c. **Joints:** All pipe shall be furnished with a mechanical joint conforming to the “American Pressure Pipe and Fitting”, No. A21.11 (AWWA C111).
- d. **Coatings and Linings:** All pipe and fittings shall have calcium aluminate mortar lining with a bituminous seal coat in accordance with the “American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water”, No. A21.4 (AWWA C104). The outside of pipe and fittings shall be coated with a standard bituminous coal-tar or asphalt base coating.

652 SANITARY SEWER - REINFORCED CONCRETE PIPE, FITTINGS, AND JOINTS:

652.01 DESCRIPTION: This specification covers all reinforced concrete pipe used in the sanitary sewer collection system.

652.02 CRITERIA:

- a. **Pipe and Fittings:** Reinforced concrete sewer pipe shall conform to and be tested in accordance with the specifications of the ASTM C76, for “Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe”, of the class as shown on the Drawings. No lengths of pipe shall be less than 8 feet. All concrete pipe shall be coated inside with two coats (minimum of 30 mils total) of a coal tar epoxy, Koppers Bitumastic 300M, High Build or Tnemec Hi-Build Tneme-Tar, or equal, in accordance with manufacture’s recommended application methods.
- b. **Joints:** Joints shall be Bureau of Reclamation R4 bell and spigot. Gaskets shall be neoprene or polysprene seal type as specified by the Design Engineer.

653 SANITARY SEWER - TAPS:

653.01 DESCRIPTION: This specification covers all taps on pipes used in the sanitary sewer collection system.

653.02 CRITERIA:

- a. All service connections to PVC sewers shall be with PVC saddles placed in accordance with manufacturer’s recommendations. Connections shall be epoxied and bound in place with suitable straps. The pipe material and fittings shall be similar and equal to John-Mansville PVC Gravity Sewer Pipe and Fittings, TRX-11. The alternative tapping system shall be inserta-tees or approved equal. Inserta-tees shall be for the type of pipe being tapped and installed in accordance with the manufacture’s recommendations.

654 SANITARY SEWER - VALVES:

654.01 DESCRIPTION: This specification covers all valves used in the sanitary sewer collection system.

654.02 CRITERIA: All valves must be suitable for use in a sanitary sewer environment and must meet the following requirements:

- a. **Resilient Seated Gate Valve:** Valves shall conform to AWWA C509, Standard for Resilient Seated Gate Valve. Wedge shall be constructed of ductile iron, fully encapsulated in synthetic rubber except for guide and wedge nut areas. Wedge rubber shall be molded in place and bonded to the ductile iron portion, and shall not be mechanically attached with screws, rivets or similar fasteners. Wedge shall seat against surfaces arranged symmetrically about the centerline of the operating stem, so that seating is equally effective regardless of direction of pressure unbalance across the wedge. All seating surfaces in body shall be inclined to the vertical at a minimum angle of 32 degrees (when stem is in a vertical position) to eliminate abrasive wear of rubber sealing surfaces. Stem shall be sealed by at least two O-rings; all stem seals shall be replaceable with valve wide while open and subjected to full rate pressure. Waterway shall be smooth and have no depressions or cavities in seat area where foreign material can lodge and present closure or sealing. Valve body and bonnet shall be epoxy coated, inside and out. All exterior/exposed bolts shall be made of stainless steel. All valves shall be manufactured by AVK, American Flow Control, East Jordan, Clow, Mueller, or Kennedy.
- b. **Resilient Seated Eccentric Plug Valve:** Plug valves shall conform to AWWA C517, Standard for Resilient Seated Cast-Iron Eccentric Plug Valves. Plug valves shall be of the tight-closing resilient-faced plug type and shall be of eccentric construction such that the

opening movement of the closing member (plug) results in the closing member rising off the body seat contact. Port areas shall be equal to at least 80 percent of the nominal size pipe area. Valves inside structures shall be flanged. Buried plug valves shall be mechanical joint. Valves shall be drop tight at rated pressure of 150 psi and shall be satisfactory for applications involving throttling service and/or frequent operation. During normal open/close operation, the valve closing member (plug) shall rotate approximately 90 degrees from the full-open position to the tight shut position. Valve bodies shall be constructed of cast iron. The valve body shall be fitted with a bolted bonnet or cover that permits visual examination of the packing without removing operator. The lower trunnion shall be cast integral with the valve body. The valve plug shall be constructed of cast iron. The plug shall have a cylindrical seat surface which is eccentrically off set from the center of the plug shafts. The plug shafts shall be integral. The plug shall have a synthetic rubber bonded to all surfaces except shafts and thrust bearing surface. Valve body seats shall be constructed of a welded-in overlay of not less than 90 percent pure nickel on all body seat surfaces in contact with the plug face. Valves shall be fitted with sleeve type bearings. Bearings shall be corrosion resistant and constructed of Teflon fiber. Thrust bearings shall be provided at the top and bottom faced surfaces of the plug. Thrust bearings shall be woven Teflon fiber. All exterior/exposed bolts shall be made of stainless steel. All valves shall be manufactured by AVK, American Flow Control, East Jordan, Clow, Mueller, or Kennedy.

1. **Plug Valve Operators:** Manual valves shall have lever or worm gear actuators with handwheels, chainwheels, tee wrenches, extension stems, floorstands, etc., as shown on the Plans. Lever actuators shall be furnished for valves 8 inches or smaller where the maximum shutoff pressure is 25 psi or less as indicated on the Plans. Worm gear actuators shall be furnished for all valves 4 inches or larger where the maximum reverse shutoff pressure is greater than 25 psi as indicated on the Plans. Worm gear actuators shall be sized for pressure as indicated on the Plans. All gearing shall be enclosed in a semi-steel housing and be suitable for running in a lubricant with seals provided on all shafts to prevent entry of dirt and water into the actuator. The actuator shaft and the quadrant shall be supported on permanently lubricated bronze bearings. Actuators shall clearly indicate valve position and an adjustable stop shall be provided to set closing torque. This adjustable stop shall be the only adjustment necessary to set the clearance between the valve plug and the seat while the valve is in line and under pressure. Handwheel and chainwheel sizes for worm gear actuators shall be no smaller than 6-inch diameter and no larger than twice the diameter of the actuator's gear sector. All exposed nuts, bolts, and washers shall be zinc plated.
2. **Buried Service:** Valves and gear actuators for buried or submerged service shall have seals on all shafts and gaskets on the valve and actuator covers to prevent the entry of water. Actuator mounting brackets for buried or submerged service shall be totally enclosed and shall have gasket seals. All exposed nuts, bolts, springs, and washers shall be stainless steel.
- c. **Air Relief Valves:** Air relief valves shall be heavy-duty combination air release and vacuum type for 300 psi water working pressure, testing to 300 psi, 2-inch in size. Body, cover, and baffle shall be cast iron. All internal parts to be either highest quality stainless steel or bronze, the inside of the valve coated with rust inhibitor. Only the following makes or approved equal will be permitted: ARI Flow control, APCO, and Val-Matic.
- d. **Check Valves:** Check valves shall conform to and be tested in accordance with the AWWA Standard for Swing-Check Valves for Ordinary Water Works Service, AWWA C508. They shall be horizontally mounted, single disc, swing type with a full diameter passage providing minimum pressure loss. Valves shall be of the non-slamming type designed for the future installation of outside lever and weight. Disc faces and seat rings shall be bronze. Ends shall

fit the pipe or fitting to which attached (push-on, mechanical, or flanged). Only the following makes or approved equal will be permitted: Crane, Darling, Ludlow-Rensselaer, M & H Mueller, AP Smith.

- e. **Ball Valves:** Ball valves shall be: double-seated with natural or synthetic rubber, bronze or monel metal seats; designed for 150 psi working pressure; flanged end; O-ring rotor bearing seals; constructed of high tensile strength cast iron; equipped with totally enclosed manual operators, with open-closed indicator and hand wheel with standard size square wrench nut for one man operation and 150 psi unbalance across the valve. Valves shall be tested by and shall withstand without leak, a hydrostatic pressure of; (1) 250 psi on the valve body with the rotor in the open position; and (2) 150 psi on each side of the valve with the opposite side open to atmosphere. Four copies of the test results and manufacturer's drawings shall be submitted for approval prior to delivery of the valve. Only the following makes or approved equal will be permitted: Allis-Chambers, Henry Pratt or Willamette Iron and Steel.
- f. **Valve Operators:** Valves, operator housing, supports and connections shall have provisions for four-bolt mounting. Operators shall be equipped with a 2 inch square operating nut and shall be fully grease packed and gasketed for buried service. Operators shall have a link-lever arrangement providing for characterized closure of the valve. Valves shall close with a clockwise rotation of the nut. Operators shall be of the Pratt MDT type or approved equal and matching valve manufacturer if available.
- g. **Valve Painting:** All surfaces of the valve shall be clean, dry and free from grease before painting. The valve interior and exterior surfaces except for seating shall be evenly coated with asphalt varnish or epoxy paint in accordance with Federal Specifications TT-V-51 and AWWA C504-74. Hydrostatic and leakage tests shall be conducted in strict accordance with AWWA C504-74, Section 12.

655 SANITARY SEWER - MANHOLES:

655.01 DESCRIPTION: This specification covers all manholes used in the sanitary sewer collection system, except for manholes used for valves.

655.02 CRITERIA:

- a. **Castings:** Castings for manholes shall conform to and be tested in accordance with the specifications for Gray Cast Iron ASTM A48, Class 35b. Castings shall conform to dimensions shown on the Standard Drawing, shall be bodily filleted at angles and the arises shall be sharp and perfect, true to form and thickness. Frames or covers that are to be located in traveled ways or in any location subject to vehicular traffic shall have all bearing surface machined so that fitting parts will not rattle or rock under traffic and the covers shall fit frames without wedging. Covers shall carry the legend "Broken Arrow Sewer" in 1-inch letters minimum. Manhole frame and cover shall be as shown on Standard Drawing SS09 and SS09a. The ring and lid shall be connected to the manhole with a non-shrink grout and asphaltic mastic shall be placed on the interior joint.
- b. **Precast Sections:** Precast manhole sections to include bases shall conform to and be tested in accordance with the specifications for Precast Reinforced Concrete Manhole Risers and Tops, ASTM C478. The sides shall have a minimum thickness of 5 inches and a maximum thickness of 8 inches. The minimum interior diameter shall be 4 feet. The precast manholes shall be as shown in Standard Drawing SS08. Cast Iron steps shall be placed in the manhole beginning 15 inches above the invert and 15 inches on center to within 18 inches of the top of the manhole. Steps shall be as shown on Standard Drawing SS11. The joints and lifting holes shall be grouted inside and outside with a non-shrink grout. The exterior of all joints

and lifting holes shall be covered with asphaltic mastic, as specified in Section 658, for a distance of 4 inches past the grouted area in all directions.

- c. **Elevation Adjustment Rings:** Shall be fabricated of 3,000 psi concrete in thicknesses of 2 inches to 4 inches. Solid polypropylene adjustment rings are acceptable in all thickness dimensions supplied by the manufacturer and installed per manufacturer specifications. Hollow core high density polyethene will not be permitted. Rings shall be fabricated and installed as shown on Standard Drawings SS07 and SS08.
- d. **Brick Manholes:** Brick manholes may only be used for sanitary sewer with the written approval of the Engineering and Construction Department Director. These manholes will be coated on the exterior with an approved asphaltic coating as specified in Section 658. All other requirements for precast manholes will be met.
- e. **Cast in Place Manholes:** Shall conform to the requirements in Standard Drawing SS07.
- f. **Coatings:** Concrete manholes that have gravity lines larger than 12 inches or are on the receiving end of a force main shall have an interior epoxy coating consisting of 100 percent solids such as Raven 405 or approved equal.
- g. **Fiberglass Manholes:** Fiberglass sanitary sewer manholes are acceptable for use in the collections system for any manholes required to be 5-feet in diameter or larger. Shall be manufactured such that all stub-outs shall be factory installed. Manholes shall have concrete foundations and anti-floatation rings. Full design drawings and calculations shall be provided prior to fabrication.

656 SANITARY SEWER - LAMPHOLE CASTINGS:

656.01 DESCRIPTION: This specification covers all lamphole castings used in the sanitary sewer collection system.

656.02 CRITERIA: Castings for lampholes shall conform to and be tested in accordance with the specifications for Gray Cast Iron ASTM A48, Class 35b. Castings shall conform to dimensions shown on the Standard Drawing, shall be bodily filleted at angles and the arises shall be sharp and perfect, true to form and thickness. Frames or covers that are to be located in traveled ways or in any location subject to vehicular traffic shall have all bearing surface machined so that fitting parts will not rattle or rock under traffic and the covers shall fit frames without wedging. All castings shall be thoroughly cleaned and given two coats of bituminous paint. Reference Standard Drawing SS10 for additional frame and cover specifications.

657 DIG THROUGH LOCATOR TAPE: Shall be a foil tape colored green with "Sewer Line Buried" printed on the tape. It shall be Terra Tape Sentry Line 620 or approved equal.

658 ASPHALTIC MASTIC: Shall be an asphaltic mastic coating compound such as BIDCO Sealants BIDCO; 56 or approved equal.

659 HIGH DENSITY POLYETHYLENE (HDPE) – SANITARY SEWER:

659.01 DESCRIPTION: This specification covers all HDPE pipe used in the sanitary sewer collection system as force mains or as gravity only as allowed by the Director of Engineering and Construction.

659.02 CRITERIA:

- a. **Pipe:** HDPE Pipe shall be manufactured from a PE4710 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material will meet the specifications of ASTM D3350 with a cell classification of PE:445574C. Pipe shall have a manufacturing standard of

ASTM F714. Pipe shall be ductile pipe size (DIPS) and the DR shown on the Plans and/or in the bid proposal. The pipe shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. HDPE pipe shall be marked by manufacturer to show appropriate approvals and classifications. The Contractor shall furnish an affidavit from the pipe manufacturer that all delivered materials comply with the requirements of the Specifications.

- b. **Butt Fusion Fittings:** Fittings shall be PE4710 HDPE, Cell Classification of 445574C as determined by ASTM D3350. Butt Fusion Fittings shall have a manufacturing standard of ASTM D3261. Molded and fabricated fittings shall have the same pressure rating as the pipe unless otherwise specified on the plans. Fabricated fittings are to be manufactured using a Data Logger. Temperature, fusion pressure and a graphic representation of the fusion cycle shall be part of the quality control records.
- c. **Electrofusion Fittings:** Fittings shall be PE4710 HDPE, Cell Classification 445574C as determined by ASTM D3350. Electrofusion Fittings shall have a manufacturing standard of ASTM F1055. Fittings shall have the same pressure rating as the pipe unless otherwise specified on the Plans.
- d. **Flanged and Mechanical Joint Adapters:** Flanged and Mechanical Joint Adapters shall be PE 4710 HDPE, Cell Classification of 445574C as determined by ASTM D3350. Flanged and Mechanical Joint Adapters shall have a manufacturing standard of ASTM D3261. Fittings shall have the same pressure rating as the pipe unless otherwise specified on the Plans.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION