

## DIVISION 15

### PIPING, VALVES, GATES, AND SPECIALTIES

#### 150000 GENERAL

Piping shall be installed as indicated on the Plans. If the Contractor desires to change any of the piping layouts shown on the Plans, he shall submit to the Engineer, for approval, his detailed proposed layouts.

Any pipe which does not meet specifications or has been rejected, shall be removed from the jobsite and disposed of by the Contractor at no extra cost to the Owner.

Where new fittings are to be cut into or attached to existing piping or where connections are to be made to existing piping, the Contractor shall furnish and install the necessary sleeves, flanges, nipples, couplings, fittings, etc. needed to accomplish the cutting-in or connections, whether specifically indicated on the Plans or not.

Lines under low head shall be laid flat or with a continuous grade so that there will be no air traps or humps in them, except at the ends where means for venting shall be provided.

In no case shall copper or copper alloy pipe or fittings carrying water or water based solutions or slurries be attached to cast iron or steel pipe except by means of a dielectric coupling expressly made for this purpose and service.

All pipe which will operate under pressure shall be properly blocked at all fittings where the pipeline changes direction, changes size, or ends, using concrete thrust blocks in trenches and suitable anchors in structures. Concrete thrust blocks shall be sized so as to give bearing against undisturbed vertical earth banks sufficient to absorb the thrust from line pressure, allowing an earth bearing of 200 pounds per square foot per foot of depth below natural grade to a maximum of 1,000 pounds per square foot. (Earth bearing value may be increased, if substantiated by soils analysis.) The line pressure shall be the product of the nominal cross sectional area of the pipe and the test pressures as specified for each type of pipe. The concrete shall be placed, unless specifically indicated otherwise on the Plans, so that the pipe joints and fittings will be accessible.

#### 150010 EXPOSED PIPING

Where not detailed, exposed pipe shall be installed in straight runs parallel to the axes of the structures. Pipe runs shall be horizontal and vertical except that gravity drain lines shall be pitched down in the direction of flow not less than 1/8 inch per foot.

No exposed piping shall be erected until all equipment to which the pipe is to be attached has been installed and it can be determined where piping and fittings shall be located to make a neat efficient arrangement.

The Plans shall be taken as diagrammatic for piping that is not shown in detail. Sizes of piping and their locations are indicated, but it is not intended to show every offset and fitting nor every structural difficulty that will be encountered during the installation of the work.

The alignment of pipes shall be varied from that indicated on the Plans, without extra expense to the Owner where necessary to avoid structural or mechanical difficulties or to avoid the work of any other trades. The Contractor shall furnish such parts and pieces as may be necessary to provide a complete and operable system.

Pipework shall be suspended and supported in such manner as to prevent sagging or overstressing of pipe and connections and, furthermore, shall be supported so that no item of the piping system will transfer any load or stress to any equipment.

Air bleeder cocks shall be installed at all high points in pipe systems and pump cases and shall be of the size indicated on the Plans or minimum of 1 inch. Air bleeder cocks shall be 1- or 2-inch plug valves in accordance with these Specifications.

Piping shall be made up with a sufficient number of unions or flanged joints to permit ready breaking of lines as necessary for inspection and maintenance, in addition to such joints as are definitely shown on the Plans.

Pipe and fittings shall be assembled so there will be no distortion or springing of the pipelines. Flanges, unions, flexible couplings, and other connections shall come together at the proper orientation. The fit shall not be made by springing any piping nor shall orientation alignment be corrected by taking up on any flange bolts. Flange bolts, union halves, flexible connectors, etc. shall slip freely into place. If the proper fit is not obtained, the piping shall be altered to fit.

#### 150011 WALL AND SLAB PENETRATIONS

No pipe shall pass through or be built into any reinforced masonry or concrete wall, floor, ceiling, roof, pilaster, column, pier, or beam, unless it is inside of a sleeve. Exceptions will be indicated on the Plans with a specific note, or specified in the Specifications, and unless so stated in words, no exception shall be considered as having been allowed in the Contract Documents. Such sleeves shall have an inside diameter not less than the outside diameter of the pipe plus 1 inch, except that for pipe smaller than 1 inch the ID of the sleeve shall be not less than twice the OD of the pipe. Such sleeves shall be placed not closer than three diameters center to center, nor shall they impair the strength of construction. The arrangement of sleeves shall be such that pipe can be pulled out of a sleeve and replaced without disturbing the structural member. Ends of sleeves shall be flush with surfaces of concrete, masonry, or plaster.

Where pipes pass through floors, walls, or ceilings of finished spaces within the Operations Building, the end of the pipe sleeve shall be concealed with an appropriate escutcheon. Escutcheon plates shall be chrome-plated steel plates, Dearborn Brass Company, No. 1149; Keeney Manufacturing Company, No. 102 or 105; Beaton and Corbin No. 1 or 13; or equal. The space between the pipes and sleeves shall be sealed as indicated on the Plans.

Openings around any pipes through interior walls or floor of chlorine rooms and chlorine storage rooms shall be sealed gastight with synthetic rubber caulking compound.

#### 150020 BURIED PIPING

All pipelines laid in open trenches shall conform to applicable parts of DIVISION 2.

Where not otherwise indicated on the Plans, all buried lines shall be laid with a minimum of a 4-foot cover without air traps or humps. Where two lines of similar service run parallel to each other, they may be laid in the same trench as close together as possible and still provide adequate room for jointing.

The laying of the pipe shall be in finished trenches free from water or debris and shall be commenced at the lowest point. Pipe shall be laid on an unyielding foundation with uniform bearing under the full length of the barrel. If the pipe bears top or bottom markings, it shall be placed with the markings in the proper position. All adjustments to line and grade shall be made by scraping away or filling in under the pipe. If the joints are the type which require external grouting, banding, or pointing, space shall be provided under and immediately in front of the bell end of each section laid of such shape and size as to permit sufficient room for the grouting, banding, or pointing of the joints.

Before excavation is started for any run of underground piping, the Contractor shall locate and expose all existing structures, piping, conduit, etc., which intersect the line of the piping, to avoid possible damage to these during excavation operations and so that it may be determined if there will be any conflicts in location. In the event of conflicts in location or grade or both, between new piping and existing piping, the Contractor shall make adjustments in location or grade of new piping as directed by the Engineer. These adjustments, including additional fittings, shall be made at no additional cost to the Owner.

Unless otherwise shown on the Plans or specified, where pipe of any type is to be encased in concrete, the encasement shall provide a minimum of 6 inches of concrete completely around the pipe, shall fill the bottom of the trench from bank to bank, if not formed, and shall be reinforced with four continuous longitudinal reinforcing bars, one in each corner of the encasement. Concrete shall be Class C. The length of encasement shown on the Plans, or specified, shall be the minimum length, and the encasement shall end at each end at a joint in the pipe. Reinforcing bars shall be No. 4 for encasement of pipe 36 inches and smaller and No. 6 for encasement of pipe larger than 36 inches.

Where buried cast iron, ductile iron, reinforced concrete, vitrified clay, or similar rigid pipe enters a structure, it shall be by means of a coupling or wall piece cast into the wall, having a mechanical push-on, or similar flexible joint as specified or shown on the Plans at the outside face of the wall. An additional similar joint shall be installed in the line at the edge of the structure excavation where the pipe trench leaves undisturbed ground. For steel pipe a single joint may be used located not more than 2 feet from the outside face of the wall.

#### 150030 CLEANING AND TESTING

The interior of all pipelines, above or below grade, shall be thoroughly cleaned of all adhering matter and other debris to the approval of the Engineer. No testing of any pipeline shall be started until the cleaning is complete and approved.

Special precautions required in the cleaning of a particular pipeline shall be as stated in the various parts of this Division of these Specifications.

All pipelines, above or below grade, shall be tested to the pressures indicated in the various parts of this Division of these Specifications. Any piping for which test pressure is not specified shall be tested under a pressure of 25 psi above the operating head or as directed by the Engineer.

Pipe underground may be tested before backfilling unless otherwise specified, and pipes to be encased in concrete or under concrete slabs shall be tested before the encasement or slabs are poured.

The Contractor shall furnish all necessary personnel, supplies, equipment, bulkheads, and whatever additional equipment is required to make any and all tests specified and shall make any and all repairs, including relaying if necessary, to any and all pipelines failing to pass the testing requirements of these Specifications.

The Contractor shall give the Engineer a list of the scheduled pipeline tests by noon of the day preceding the scheduled test or tests. The Contractor shall notify the Engineer by written memorandum of his readiness (not just his intention) to test a line or portion of line. All bulkheads, thrust blocks, anchors, temporary connections, pumps, etc. shall be in place before the Contractor's notification of readiness is given to the Engineer. After testing, all pipes shall be flushed or blown out and left clean.

In testing with water, the test pressure specified shall be the pressure at the lowest point in the piping concerned. In testing with water, the lines shall be examined and any visible leaks repaired. In testing with air, the lines shall be examined and tested with soap suds and any leaks repaired. Testing shall be repeated until the lines are in satisfactory condition.

Despite any previous testing, any leaks developing before the end of the one year guarantee period shall be repaired by the Contractor at no additional expense to the Owner.

#### 150031 SPECIAL PIPING TESTS

Plumbing piping, natural gas piping, and bottled gas piping shall be tested in accordance with local and State Codes and Underwriters' requirements.

#### 150032 GAS AND AIR PIPING TESTS

All gas air lines shall be tested with air at the pressure specified under PIPING TEST SCHEDULE.

#### 150036 POTABLE WATER LINES

Water pipelines shall be disinfected, prior to being placed in service, by filling the pipeline with a chlorine solution, expelling all air from the pipeline, and retaining the solution in the pipeline for 24 hours. The strength of the chlorine solution shall be such that at the end of the 24-hour period the solution shall contain a chlorine residual of not less than 10 ppm at all points in the pipeline. Disinfection of the pipelines shall conform to AWWA C 651-99 except as modified herein. All details of the procedure shall be subject to the approval of the Engineer.

The effectiveness of the disinfection of the water lines shall be demonstrated by laboratory examination of samples in accordance with AWWA C 651-99. Should the initial treatment fail to result in a disinfected system, the Contractor shall repeat chlorination of the system until satisfactory results are obtained, all at no additional cost to the Owner. The Owner will furnish the water required for the initial disinfection, if additional disinfection is required then the Contractor shall pay for such additional water.

## 150060 PIPING SCHEDULE

Where not specifically noted on the Plans or otherwise specified, pipe shall be installed in accordance with the following schedule.

Pipe listed as "aboveground" shall include that within buildings, tunnels, or other structures without regard to its elevation. "Underground" piping shall be taken to mean only that piping actually buried in the soil or cast in concrete masonry. "Underwater" piping shall mean piping which extends below tops of walls or concrete deck into basins or concrete tanks containing water.

The Contractor may, at his expense, furnish piping of the same material as shown in the PIPING SCHEDULE but of greater pressure rating than that specified. Where bell and spigot joints are shown on the Plans or specified, mechanical joints or push-on joints may be used.

The Contractor is responsible for furnishing and installing all necessary piping to make all equipment and other parts of the plant functional. Should the type of pipe for a given use be not shown, the following paragraphs shall serve as a guide with the approval of the Engineer in the selection of the proper pipe to use for a given service. Water piping less than 4 inches in size may be galvanized steel pipe (aboveground), rigid plastic pipe (underground), or copper pipe. Water pipe 4 inches and over in size may be cement lined ductile iron pipe.

<u>Legend</u>	<u>Use</u>	<u>Piping</u>	<u>Joints/Fittings</u>	<u>Test Pressure</u>
PSP	Pump Station Piping	Fabricated Steel / Ductile Iron Class 350	150# Flanged or Grooved Joint	150 psi

All valves installed in a given line shall be designed to withstand the test pressure as listed above for that particular line and shall be fabricated with ends to fit the piping.

## 150070 CONNECTION TO IN-SERVICE LINES

Existing pipe to which connections are to be made shall be exposed by the Contractor as directed by the Engineer, to permit field changes in line, grade, or fittings, if necessary.

All connections to existing lines shall be constructed according to the Plans and Specifications.

When shutdown of an in-service line is necessary in order to connect to the new lines, a conference between the Contractor's representative, the Engineer, and operating supervisory personnel shall establish the time and procedures to insure that the shutdown will be for the shortest possible time. If necessary, shutdowns may be scheduled during other than normal working hours, at no additional cost to the Owner.

## 150100 CAST IRON AND DUCTILE IRON PIPE

Cast iron pipe specified or indicated in the Contract Documents shall be substituted with ductile iron pipe.

Ductile iron pipe shall conform to the requirements of ANSI A 21.50 and ANSI A 21.51 (AWWA C 150 and AWWA C 151). Ductile iron pipe fitted with threaded flanges shall conform to ANSI 21.15 (AWWA C 115).

Unless shown otherwise on the Plans, the minimum acceptable rating shall be Class 350.

#### 150101 GROOVED-END DUCTILE IRON PIPE - GENERAL

Grooved-end pipe with mechanical pipe couplings (victaulic type) and fittings may be installed in place of flanged systems at aboveground locations and in approved services on this project. Grooved-end pipe shall not be used for systems which may be steamed.

Pipe and fittings shall be cut with a radius groove. Method of grooving shall be in accordance with mechanical pipe coupling manufacturer's specifications. Pipe to be grooved shall have wall thicknesses not less than the minimum recommended by the coupling manufacturer for cut-grooving. Connections to valves and flanged-end pipe shall be by grooved-end to flanged pipe adapter flange or flanged adapter nipple. Grooved pipe and fitting ends shall be lightly coated with lubricant approved by the coupling manufacturer prior to placing gasket. Pipe sizes 4-inch through 18-inch nominal diameter shall be Class 54, minimum; pipe sizes 20-inch nominal diameter shall be Class 55, minimum; pipe sizes 24-inch in nominal diameter shall be Class 56, minimum. Grooved-end pipe shall be supported in accordance with manufacturer's recommendations. In addition, at least one support shall be used between any two couplings.

The Contractor shall submit a listing of services and locations where he proposes to use grooved-end pipe prior to start of installation of any grooved-end piping. This listing shall be subject to the Engineer's acceptance, and acceptance in writing by the Engineer will be required prior to the delivery of any grooved piping materials to the site of the Work.

The Contractor shall submit for review complete information showing fittings, gaskets, mechanical pipe couplings, grooving of pipe and pipe lining or coating prior to installation of any pipe. All materials proposed for use are subject to Engineer's acceptance.

Mechanical pipe couplings and grooved-end pipe shall be installed in accordance with the coupling manufacturer's representative's recommendations.

#### 150102 GROOVED-END DUCTILE IRON PIPE COUPLINGS AND FITTINGS

Grooved-end ductile iron pipe shall be joined by mechanical pipe couplings. Mechanical couplings shall be self-centering and shall engage and lock in place the grooved pipe and pipe fitting ends in a positive watertight couple. Couplings shall be fabricated in two or more parts of malleable iron in accordance with ASTM A 47, Grade 32510. Couplings shall be the flexible grooved type for radius grooved pipe.

Coupling assembly shall be securely held together by two or more steel bolts and nuts of heat-treated carbon steel. Nuts and bolts shall be in accordance with ASTM A 183 and ASTM A 194, Grade 2.

Couplings shall hold in place a composition water-sealing gasket designed so that internal water pressure serves to increase the seal's water tightness. Sealing gaskets shall be chlorinated butyl in accordance with

ASTM D 2000, Grade No. 3BA615A14B13 with special heat-resistance test of 16 hours at 350 degrees F and maximum elongation change of minus 30 percent.

All pipe fittings used in connection with mechanical pipe couplings shall be radius grooved for grooved-end ductile iron pipe. Radius grooved cast iron fittings shall conform to the requirements of ANSI B 16.1. The outside surface of pipe between the groove and pipe end must be smooth and free from deep pits or swells and shall provide a leak tight surface for the gasket.

#### 150110 JOINTS

Where so indicated or specified, joints shall be made with flexible couplings or with mechanical couplings for grooved or shouldered end pipe. Unless otherwise noted, joints that are not buried in the ground shall be flanged joints. All other joints shall be mechanical joints, or push-on joints. Mechanical joint, or push-on joint pipelines shall have flanges where necessary for valves and clean out connections.

#### 150111 FLANGED JOINTS

Flanges may be cast integrally with the pipe, in which case they shall conform to ANSI B 16.1 as to diameter, thickness, drilling, and other characteristics, or they may be screwed on the threaded ends of the pipe. Screwed-on flanges shall conform to ANSI B 16.1 as to material, diameter, thickness, drilling, and other characteristics, but shall have long hubs threaded specially for ductile iron pipe. Pipe shall be Class 53, minimum. Screwed-on flanges shall be attached to the pipe by the pipe manufacturer, and after attachment the faces of the flanges and the ends of the pipe shall be refaced so that the end of the pipe will be even with the face of the flange and both will be perpendicular to the axis of the pipe. Bolt holes on the two flanges on a piece of pipe shall be in perfect alignment. Bolts shall conform to ANSI B 16.1 except that flanges underground, in concrete pipe valve boxes, or in water shall have cast iron bolts and nuts, Type 304 or Type 316 stainless steel, or Everdur bolts and nuts.

Cast iron bolts and nuts shall be made of material having at least 50,000 psi tensile strength. The cast iron bolts used with mechanical joints will be acceptable.

Where cap screws or stud bolts are required, flanges shall be provided with tapped holes for such cap screws or stud bolts.

Gaskets shall be ring gaskets suitable for the intended application, manufactured by Garlock, Cranite, or equal.

All flange bolts shall be cut and finished to project not more than 1/4 inch beyond outside face of nut after joint is assembled.

#### 150112 MECHANICAL JOINTS

Mechanical joints shall be in accordance with ANSI A 21.11 (AWWA C 111). Bolts shall be Core-10 T-bolts or equal.

### 150113 PUSH-ON JOINTS

Push-on rubber gasket joints shall be in accordance with ANSI A 21.11 (AWWA C 111).

Any product which is used to coat, seal, patch or otherwise attach itself to the interior surface of any piping material in such a way as to come into contact with the drinking water, shall comply with National Sanitation Foundation (NSF) Standard 61. Pipes bearing appropriate markings indicating NSF approval and lubricant containers with NSF labels will provide sufficient evidence of compliance with this requirement.

### 150115 RESTRAINED PUSH-ON JOINTS

Restrained push-on joints shall be designed for working pressures of 350 psi for sizes 4-inch through 24-inch and 250 psi for sizes 30-inch through 54-inch. The restraining system shall be comprised of ductile iron locking segments inserted through slots in the bell face and providing positive axial lock between the bell interior surface and a retainer weldment on the spigot end of the pipe. An alternate system shall have positive restraint against joint separation by a retainer weldment through a boltless system.

### 150120 FITTINGS

Except as otherwise provided, fittings for cast iron or ductile iron pipe shall be as specified in ANSI A 21.10 (AWWA 110), of the same pressure rating and same joint configuration as the pipe with which they are used.

### 150121 PUSH-ON

Push-on rubber gasket joint fittings shall have bodies as specified above with bells dimensioned and arranged to match the push-on joints on the pipe. Mechanical joint fittings may be used with push-on rubber gasketed joint pipe.

### 150122 FLEXIBLE FITTINGS

Flexible fittings applicable to cast iron pipe shall be as specified under the PIPING SPECIALTIES section of these Specifications.

### 150130 LINING AND COATING

Except as otherwise specified, all cast iron and ductile iron pipe and fittings shall be smooth cement-lined in accordance with ANSI A 21.4 (AWWA C 104). Special attention shall be given to the lining of fittings. Lining shall be applied to bare metal. All lining shall extend to the faces of flanges, to the end of spigots, or to the shoulder of hubs, as the case may be.

In addition, all cast iron and ductile iron pipe and fittings shall be coated inside and outside with bituminous material except that pipe which is to be painted shall not be coated on the outside.

Pipe used in sewage or sludge piping systems shall not be cement-lined.

### 150140 HANDLING OF PIPE AND FITTINGS

Pipe and fittings shall be carefully handled during loading, unloading, and installation. No pipe shall be dropped from cars or trucks to the ground. All pipe shall be carefully lowered to the ground by mechanical means. In shipping, pipe and fittings shall be blocked in such manner as to prevent damage to castings or cement lining. Any broken or chipped lining shall be carefully patched to the satisfaction of the Engineer. Where it is impossible to repair broken or damaged lining in pipe because of its size, the pipe shall be rejected as unfit for use unless facilities are provided for relining pipe in accordance with these Specifications. Pipe shall not be dropped or pounded to fit grade.

All mechanical joint or bell and spigot pipe shall be laid with 1/8-inch space between the spigot and shoulder of the pocket.

### 150160 CORROSION PROTECTION

Ductile iron pipe underground shall be protected against external corrosion by loose polyethylene sleeves in accordance with AWWA C 105. Optional method "A" per C105 shall be used as follows:

1. Cut a section of polyethylene tube approximately two feet longer than the pipe section. Remove all lumps of clay, mud, cinders, or other material that might have accumulated on the pipe surface during storage. Slip the polyethylene tube around the pipe, starting at the spigot end. Bunch the tube accordion-fashion on the end of the pipe. Pull back the overhanging end of the tube until it clears the pipe end.
2. Dig a shallow bell hole in the trench bottom at the joint location to facilitate installation of the polyethylene tube. Lower the pipe into the trench and make up the pipe joint with the preceding section of pipe.
3. Move the cable to the bell end of the pipe and lift the pipe slightly to provide enough clearance to easily slide the tube. Spread the tube over the entire barrel of the pipe. *Note: Make sure that no dirt or other bedding material becomes trapped between the wrap and the pipe.*
4. Make the overlap of the polyethylene tube by pulling back the bunched polyethylene from the preceding length of pipe and securing it in place using tape, plastic tie straps, or any other material capable of holding the polyethylene encasement snugly against the pipe.
5. Overlap the secured tube end with the tube end of the new pipe section. Secure the new tube end in place.
6. Take up slack in the tube along the barrel of the pipe to make a snug, but not tight, fit. Fold excess polyethylene back over the top of the pipe.
7. Secure the fold at several locations along the pipe barrel (approximately every three feet.)

8. Repair all small rips, tears, or other tube damage with adhesive tape. If the polyethylene is badly damaged, repair the damaged area with a sheet of polyethylene and seal the edges of the repair with adhesive tape.
9. Carefully backfill the pipe according to the AWWA C600 standard for backfill procedure. To prevent damage during backfilling, allow adequate slack in the tube at the joint. Backfill should be free of cinders, rocks, boulders, nails, sticks, or other materials that might damage the polyethylene. Avoid damaging the polyethylene when using tamping devices.

#### 150170 TESTING

All pipelines for which testing is not otherwise specified shall be tested for watertightness by subjecting each section to Hydrostatic Pressure and Leakage Tests in accordance with applicable provisions of AWWA C 600, except as modified below. The Contractor shall provide all vents, piping, plugs, bulkheads, valves, bracing, blocking, pump, measuring device, and all other equipment necessary for making the tests. The Owner will furnish the water required for the first test, if more than one test is required then the Contractor shall pay for the water required to make the additional tests. Each section of a new line between sectionalizing valves or between the last sectionalizing valve and the end of the project shall be tested separately as required in AWWA C 600, and/or as modified in these Specifications, except that any such section less than 500 feet in length may be tested with the adjacent section, if both sections of line have the same pipe class rating. No section greater than ½-mile in total pipe length shall be tested without special written permission of the Engineer. The duration of each test shall be at least 2 hours.

If two or more sections are tested together, the total leakage shall not exceed that allowable for the shortest section.

#### 150171 PRESSURE TEST

All pipelines shall be tested by subjecting each section to a pressure, measured at the lowest end of the section, of at least 125 percent of the class rating or design pressure of pipe under test.

The test may be made before or after backfilling. However, if mechanical compaction is to be used in the backfilling operations as spelled out in AWWA C 600, the test shall not be made until the backfilling is completed and compacted. All connections, blowoffs, hydrants, and valves shall be tested with the main as far as is practicable.

The test section shall be slowly filled with potable water, and all air shall be vented from the line. The rate of filling shall be as determined by the Engineer, with at least 24-hour notice required before tests are scheduled. While the test section is under test pressure, a visual inspection for leaks shall be made along the pipeline, and all visible leaks repaired. The pressure test shall not begin until the pipe has been filled with water for at least 24 hours to allow for absorption.

#### 150172 LEAKAGE TEST

Leakage test shall be made after pressure test has been satisfactorily completed and all backfilling and compaction is completed to top of trench. The Contractor shall furnish the necessary apparatus, and assistance to conduct the test.

To pass the leakage test, the leakage from the pipeline shall not exceed the leakage allowed by AWWA C600 Section 4 Hydrostatic Testing. A copy of this test is in the Appendix.

Should the test on any section of the pipeline show leakage greater than specified above, the Contractor shall locate and repair the defective pipe, fittings, or joint until the leakage is within the specified allowance of two-hour duration. All repairs and retests, if required, shall be made without additional cost to the Owner.

Connections to the existing pipelines or existing valves shall not be made until after that section of the new construction has satisfactorily passed the hydrostatic tests.

#### 150200 STEEL PIPE

Except as otherwise specified or indicated on the Plans, steel pipe and fittings shall be as follows.

Steel pipe 12 inches and smaller in nominal diameter shall be seamless or straight seam electric resistance welded pipe conforming to the requirements of ASTM A 53 or ASTM A 120. Pipe 6 inches and smaller shall be Schedule 40. Pipe over 6 inches but not larger than 12 inches shall be no lighter than Schedule 20.

Steel pipe over 12 inches in nominal diameter shall be in accordance with AWWA C 200, except that butt strap, riveted, or swaged joints may not be used. Pipe over 12 inches in diameter shall have a wall thickness of not less than 1/4-inch to 72-inch diameter and 5/16-inch over 72-inch diameter, unless indicated otherwise on the Plans. All pipe shall be black unless indicated otherwise on the Plans or specified to be galvanized. If galvanized, it shall be galvanized in accordance with ASTM A 120. The working stress for any of the steels specified as acceptable for fabrication of pipe shall not exceed 50 percent of the yield point of the steel used.

Wherever Dresser or Victaulic couplings are to be used on pipe 24 inches in diameter, or over, having a wall thickness of less than 1/2 inch, stub ends not less than 6 inches long and 1/2 inch in thickness shall be provided for insertion into the couplings.

Steel pipe for liquid or gaseous dry chlorine shall be ASTM A 106, Grade A, Schedule 80, assembled with 300 psi malleable iron fittings and ammonia type flanges.

Steel pipe and fittings shall be designed in accordance with AWWA Manual M11.

#### 150201 GROOVED-END STEEL PIPE - GENERAL

Grooved-end pipe with mechanical pipe couplings (Victaulic type) and fittings may be installed in place of flanged systems at above locations and in approved services on this project. Grooved-end pipe shall not be used underground or underwater unless indicated otherwise on the Plans.

Pipe and fittings shall be cut grooved. Method of grooving shall be in accordance with mechanical pipe coupling manufacturer's specifications. Pipe to be grooved shall have wall thicknesses not less than the minimum recommended by the coupling manufacturer for cut-grooving. Connections to valves and flanged-end pipe shall be by grooved-end to flanged pipe adapter flange or flanged adapter nipple. Grooved pipe and fitting ends shall be lightly coated with lubricant approved by the coupling manufacturer prior to placing gasket.

Grooved-end pipe shall be supported in accordance with manufacturer's recommendations. In addition, at least one support shall be used between any two couplings.

The Contractor shall submit for review complete information showing fittings, gaskets, mechanical pipe couplings, grooving of pipe and pipe lining or coating prior to installation of any pipe. All materials proposed for use are subject to the Engineer's approval.

Mechanical pipe couplings and grooved-end pipe shall be installed in accordance with the coupling manufacturer's representative's recommendations.

#### 150202 GROOVED-END STEEL PIPE COUPLINGS AND FITTINGS

Steel pipe may be grooved-end and joined by mechanical pipe couplings. Mechanical couplings shall be self-centering and shall engage and lock in place the grooved pipe and pipe fitting ends in a positive watertight couple. Coupling housing clamps shall be fabricated in two or more parts of malleable iron castings, in accordance with ASTM A 47, Grade 32510. Coupling assembly shall be securely held together by two or more steel bolts and nuts of heat-treated carbon steel. Nuts and bolts shall be in accordance with ASTM A 183 and A 194, Grade 2.

Couplings shall hold in place a composition water-sealing gasket designed so that internal water pressure serves to increase the seal's water tightness.

Gaskets for use with cement lined steel pipe shall be captured between the ends of the pipe to protect the exposed metal from corrosion. Gaskets shall be Buna-N in accordance with ASTM D 2000, Grade No. 4AA615A13B13.

All pipe fittings used in connection with pipe couplings shall be radius grooved. Pipe fittings shall be malleable iron castings in accordance with ASTM A 47, Grade II, or ductile iron Grade 60-45-10 in accordance with ASTM A 536.

#### 150210 JOINTS

Steel pipe joints shall be screwed, welded, flanged, or flexible joints as is appropriate to the pipe size and application, except that galvanized pipe shall not be welded. Welding shall be in accordance with AWWA C 206.

Piping shall be made up with a sufficient number of unions, flexible couplings, or flanged joints to permit ready breaking of lines for maintenance in addition to any unions or flanges indicated on the Plans. The Engineer may direct the location of any unions, flexible couplings, or flanged joints, in addition to those indicated on the Plans, at his discretion.

Unions shall be railroad type with bronze-to-iron seat, galvanized if used with galvanized pipe. Flanged joints may be used instead of unions.

Unless otherwise specified or indicated on the Plans, pipe joints shall be of the type specified below. Pipe smaller than 2 inches shall have screwed joints or flexible couplings. Pipe 2 inches through 4 inches shall

have screwed, flanged, or welded joints, or flexible couplings. Pipe larger than 4 inches shall have flanged or welded joints or flexible couplings.

Threading shall be done with clean, sharp dies. Pipe threads carelessly made, wavy, rough, or chewed shall be rejected. All screwed joints shall be tightly and neatly made up with an application of Teflon tape or approved paste compound applied to the male threads only, except that liquid and dry chlorine lines and liquid LPG lines shall be made up with litharge and glycerine.

Flanges shall come together at the proper orientation with no air gaps between the flanges after the gaskets are in place. The fit shall not be made by springing any piping, nor shall the orientation alignment be corrected by taking up on any flange bolts. Flange bolts shall slip freely into place with absolutely no binding. If the proper fit is not obtained, the piping shall be altered. Machined flanges or tapered fillers shall be used to accomplish changes in grade or to slope lines for drainage.

All welded joints shall be electric welded. Welding shall be in accordance with AWWA C 206. Qualification of welders shall be as covered in AWWA C 206. All testing of welders shall be at the Contractor's expense, including cost of test nipples, welding rod, and equipment.

#### 150220 FITTINGS

Fittings used with screwed pipe shall be 150 pounds malleable iron banded screwed fittings in accordance with ANSI B 16.3, galvanized in accordance with ASTM A 153 if used with galvanized pipe, or cast iron drainage screwed fittings in accordance with ANSI B 16.12, galvanized in accordance with ASTM A 153 if used with galvanized pipe. Drainage fittings shall be used with drain lines, and other lines which are required to be graded.

Flanged fittings 12 inches and smaller shall be 125 pounds cast iron flanged fittings in accordance with ANSI B 16.1 or 150 pounds steel flanged fittings in accordance with ANSI B 16.5. Flanged fittings for pipe larger than 12-inch may be as above or may be fabricated from sections of steel pipe in accordance with AWWA C 208, with flanges as specified in AWWA C 207.

Companion flanges 4 inches and smaller may be 125 pounds screwed cast iron companion flanges in accordance with ANSI B 16.1 or 150-pound slip-on or welding neck steel flanges in accordance with ANSI B 16.5, except that ammonia type flanges shall be used on chlorine liquid or gas piping. Companion flanges for pipe from 4 inches to and including 12 inches shall be slip-on or welding neck flanges in accordance with ANSI B 16.5.

Companion flanges for pipe larger than 12 inches may be as above or may be steel plate or raised hub flanges in accordance with AWWA C 207.

Slip-on flanges shall be attached to pipe by two fillet welds, in accordance with AWWA C 207. Welding neck flanges shall be secured by full penetration butt welds without backing rings. After welding in place, the faces of flanges shall be perpendicular to the axis of the pipe, or, in the case of fittings, at the proper angle to each other, and bolt holes shall be in proper alignment. Flanges shall be shop welded to pipe or fittings before lining is applied.

Machined flanges or tapered fillers shall be used to accomplish changes in grade, or to slope lines for drainage.

Flange bolts shall be in accordance with ANSIB 16.1, except that flanges underground or in water shall have Type 304 or Type 316 stainless steel, or Everdur bolts and nuts.

All flange bolts shall be cut and finished to project not more than 1/4 inch beyond outside face of nut after joint is assembled. Where cap screws or stud bolts are required, flanges shall be provided with tapped holes for such cap screws or stud bolts.

Gaskets shall be ring gaskets of 1/16-inch Cranite, Garlock, or equal.

Welding fittings for pipe 8 inches and smaller in size shall be butt-welding fittings in accordance with ANSIB 16.9, standard wall or standard weight. Welding fittings for pipe larger than 8 inches shall be butt-welding fittings in accordance with ANSIB 16.9, or may be made up out of sections of pipe welded together, except where smooth bends are indicated in air lines.

Fittings made up of sections of pipe welded together shall be made of pipe of at least the same wall thickness as the pipe with which used, and bends shall be miter bends, fabricated in accordance with AWWA C 208 and as supplemented by AWWA Manual No. M11. Welding of these made-up fittings shall be in accordance with AWWA C 206.

Outlets and four branch fittings shall be designed and fabricated in accordance with AWWA Manual No. M11.

#### 150230 LINING

Except as otherwise provided, lining in steel pipe shall be as follows.

#### 150231 CEMENT MORTAR LINING

Steel pipe specified or shown on the Plans to be cement mortar lined may be shop lined in accordance with AWWA C 205, or lined after installation by means of a pipe lining machine. If a lining machine is used, it must be approved by the Engineer and be capable of applying a lining comparable in density and smoothness and of the same thickness as the above specified shop applied lining. In-place lining shall conform to applicable portions of AWWA C 602.

#### 150240 PIPE COATING

Aboveground steel pipe shall be painted as provided in DIVISION 9 of these Specifications.

Except as otherwise provided, all buried steel pipe shall be protected by the following coating systems applied in strict accordance with the manufacturer's instructions.

Pipe coating shall extend 6 inches above finish grade or finish floor, and shall be neatly terminated.

Before coating, pipe surface shall be free of dust, dirt, loose rust, moisture, welding residue, oil, and grease. Surface shall then be power tool cleaned or commercial blast cleaned to conform to SSPC Specification SP-3 or SP-6.

#### 150241 CEMENT MORTAR COATING

Steel pipe specified or shown to be cement mortar coated shall be coated in accordance with AWWA C 205 modified as follows:

Portland cement shall conform to ASTM C 150, Type II, low alkali.

Sand shall conform to the requirements of AWWA C 205 except that the total percentage of all deleterious material shall not exceed 3 percent.

#### 152100 PIPING SPECIALTIES

The Contractor shall furnish and install, wherever shown on the Plans, as called for in these Specifications, or as required for proper operation of equipment, all items specified under this heading including gaskets, bolts, caulking materials, hangers, supports, guides, anchors, and such incidental materials and equipment as are required to make the items complete and ready for use.

#### 152110 FLEXIBLE PIPE COUPLINGS

Where shown on the Plans or specified, or elsewhere as approved by the Engineer for the Contractor's convenience, flexible couplings shall be furnished and installed.

Flexible couplings shall be galvanized when on galvanized pipe or on pipe which are epoxy or cement lined, or when underground. When flexible type couplings are used as expansion joints, the ends of the pipe shall be separated to allow for expansion.

For cast iron pipes, flexible couplings shall be Dresser Style 53; Rockwell Series 430; Baker Series 228; or equal.

For steel pipes, flexible couplings shall be Dresser Style 38; Rockwell Series 411; or equal, except where other Styles are required for special conditions. Where indicated on the Plans, flexible couplings shall be suitable for connecting pipes which have different outside diameters.

Flanged coupling adapters shall have not less than two anchor studs each.

Where flexible couplings are installed underground, Type 316 stainless steel bolts shall be used. The entire coupling shall be given a 20-mil coat of T.C. Mastic as manufactured by the Tape Coat Company, Inc.; Bitumastic No. 50 as manufactured by Koppers Company, Inc.; or equal.

Victaulic couplings, to be used where indicated on the Plans, shall be as manufactured by Victaulic Company of America, Gustin-Bacon, or equal. Victaulic couplings for cast iron pipe shall be Style 31. Couplings for steel pipe shall be Style 77. Adapter bands shall be welded to the ends of the steel pipe as necessary to permit proper installation of couplings.

Gaskets for all couplings except those on the air piping system shall be neoprene rubber, or equal. Gaskets for couplings in the air piping system shall be suitable for operation at a temperature of 250 degrees F.

All flexible couplings shall have tie downs unless directed otherwise with a written note on the Plans.

#### 152135 PIPE SADDLES

Pipe saddles shall be furnished and installed where indicated on the Plans. Pipe saddles shall be Series 336 or Series 338 as manufactured by R. H. Baker and Company, Inc.; Style 304 as manufactured by Ford Meter Box Company, Inc.; or equal. Pipe saddles shall be Type 304 stainless steel with rubber gaskets. Threads on bolts shall have anti-gall coating. Size of the tapped boss shall be as indicated on the Plans.

#### 153000 VALVES

The Contractor shall furnish all valves where indicated on the Plans, as called for in these Specifications, or as required for proper operation of the equipment in general. Unless otherwise indicated on the Plans or specified in other sections of these Specifications, valves shall conform to the requirements as specified herein.

Valves shall be manufactured by a manufacturer whose valves have had successful operational experience in comparable service.

The valve manufacturer shall furnish detailed technical information as required by the Engineer for evaluating the quality of the valves and as required by the Contractor for proper valve installation. The technical information shall include complete dimensions, weights, and material lists. No valve will be approved for installation until the required information has been received and approved.

The Contractor shall furnish three sets of complete installation operation and maintenance instructions for each type of valve furnished. Instructions shall be bound in a cover.

Wherever stainless steel is specified in this section, it shall be AISI Type 316, or Type 304 unless otherwise specified.

Where valve, gate, and operator bolts and nuts are submerged in sewage or water, occur in an enclosed space above sewage or water, are installed below the tops of walls of structures containing sewage or water and are installed at openings in concrete or metal decks, bolts and nuts shall be stainless steel unless specifically noted otherwise. Where dissimilar metals are being bolted, stainless steel bolts shall be used. Underground bolts shall be low-alloy steel in accordance with AWWA C 111, unless specifically noted to be otherwise.

The zinc content of bronze or brass used in any valve parts shall not exceed 6 percent. The aluminum content of bronze shall not exceed 2 percent.

The method of connection of valves to each piping system shall be as detailed on the Plans. In general, unless otherwise indicated on the Plans or specified, all valves 3-inch size and larger shall have flanged ends or shall be designed for bolting to flanged pipe, and all valves less than 3-inch size shall have screwed ends.

The Contractor shall furnish to the pipe supplier, after flanged valves and flanged check valves are selected, the face-to-face dimensions of all flanged valves and check valves to be installed in flanged pipelines so that the pipe may be fabricated to the proper length.

All buried valves shall have cast iron valve boxes. The boxes shall be asphalt varnished, or enameled cast iron, adjustable to grade, and installed perpendicularly, centered around and covering the upper portions of the valve or valve operator. The box shall not be supported in any manner by the valve, valve operator, or the pipe. The top of each valve box shall be placed flush with finish grade unless otherwise directed by the Engineer. Valve boxes shall be two-piece Mueller Company, Tyler Pipe Industries Inc., or equal.

All buried valves and other valves located below the operating deck or level, specified or noted to be key operated, shall have an operator shaft extension from the valve or valve operator to finish grade or deck level, a 2-inch square AWWA operating nut, and cover or box and cover, as may be required.

Except as otherwise specified, all buried valves shall be painted with two coats of asphalt varnish in accordance with the requirements of AWWA Standard C 500. This protective coating shall be protected from damage until valve is backfilled. After installation the valves shall be wrapped with polyethylene as specified for cast iron pipe.

Globe and gate valves shall be installed with stems horizontal or vertical above the pipe, except as specifically indicated otherwise.

All butterfly valves and plug valves above grade not specified to have geared operators shall be fitted with ell or tee wrench or handles for operation. Wrenches shall be secured to the valve head or stem except that if a wrench so secured constitutes a hazard to personnel it shall be stowed immediately adjacent to the valve on or in a suitable hanger, bracket, or receptacle.

Where proper operation and utilization of equipment and facilities requires installation of valves not shown or specified, the Contractor shall provide and install, upon approval by the Engineer, valves similar and comparable to valves specified for similar and comparable duty in other parts of the project, without additional cost to the Owner.

#### 153010 INSTALLATION OF VALVES

The Contractor shall furnish all labor, materials, and equipment necessary to install the valves complete in place at the locations indicated on the Plans in accordance with the details and these Specifications.

The Contractor shall furnish all incidental materials necessary for installation of the valves such as flange gaskets, flange bolts and nuts, valve boxes and covers, and all other materials required for the complete installation.

The Contractor shall provide the necessary concrete bases and blocking to support the valves.

Manually operated valves and gates located not more than 6 feet above the operating level shall be provided with tee handles, wrenches, or handwheels as is appropriate. Valves over 5 feet to center line shall be rolled toward the operating side to make the handwheel or wrench more accessible to the operator of average height. Valves located below the operating level or deck shall be provided with extensions for key operation

or floor stands and handwheels as appropriate. Valves over 6 feet above the operating level shall be fitted with chain operated handles or valve wheels as appropriate. Chains shall reach to approximately 4 feet above the operating level. If, when not in use, chains constitute a nuisance or hazard to operating personnel, they shall be provided with hold backs or other means of keeping them out of the way. Valves shall be installed in all cases so that handles clear all obstructions when moved from full-open to full-closed position.

### 153100 BUTTERFLY VALVES

Butterfly valves and operators shall conform to AWWA Standard for Rubber-Seated Butterfly Valves, AWWA C 504, except as modified or supplemented herein.

Butterfly valves may be short body or long body at the option of the Contractor and as determined by their location in the pipe system. Wafer valves may be used at some locations subject to each location being approved by the Engineer. Wafer butterfly valves shall not be used as an isolation valve where equipment and/or piping may be required to be removed from one side of the valve. Wafer valves may be used only between pipe flanges and in locations where the opening of the valve disc will not interfere with adjacent piping, fittings, check valves, and other equipment. Short body valves may be used only in locations where the disc will not interfere with adjacent pipe fittings, valves, or equipment.

Valves and operators shall be designed for a flow through the valve corresponding to a pipeline velocity of 16 feet per second with the vane in the position of maximum coefficient of torque or for the maximum torque that may occur under the specified operating conditions of flow, pressure, valve angle, including seating, unseating, and bearing torque, with the safety factors as required in AWWA C 504 standards and as recommended in Table 2A, Appendix A, of AWWA C 504, whichever is greater.

Records of tests shall be furnished as specified in AWWA C 504. Valve discs for valves on liquid service shall be stainless steel disc to 12 inches and stainless steel disc or stainless steel mating edge on ni-resist cast iron or cast iron disc above 12 inches. Method of attaching edge to disc shall be subject to approval by the Engineer.

The valve shaft, keys, dowel pins, or taper pins used for attaching the valve shaft to the valve disc shall be Type 304 or Type 316 stainless steel or equivalent corrosion resistant material. All portions of the shaft bearings shall be stainless steel, bronze, nylon, or fiberglass and Teflon in accordance with AWWA C 504.

All nuts and screws used with clamps and discs for rubber seats shall be securely held from loosening from vibration or cavitation effects.

Valve disc shall seat in a position of 90 degrees to the pipe axis and shall rotate 90 degrees between full open and tight closed position.

Valves shall be installed with valve shafts horizontal.

Butterfly valves above ground shall be provided with 150 lb flanges and buried valves shall be mechanical joint of suitable pressure rating. Maximum shutoff pressure shall be 200 psi.

Manual operators for valves less than 6-inch diameter shall be the hand lever type. All hand lever operators shall be provided with a locking device so that the valve can be locked in any position with a wing nut. The

locking device shall be rigid and shall not allow any vibration or chattering of the valve. The hand lever shall be 12 inches long and shall be provided with a rubber hand grip.

Valves larger than 6 inches that are buried in the ground shall be provided with a totally enclosed worm gear operator mounted on the valve. The valve shaft shall extend from the valve to the operator and shall be as specified for valve shafts. The operator shall be gasketed for watertightness. Operators shall be suitable for buried service and shall have an operator shaft extension to finished grade, a 2-inch square AWWA nut, valve box, and cover.

Manual operators on aboveground butterfly valves larger than 6 inches shall be geared operators except that valves 10 inches and smaller on low pressure air service may be lever operated.

Manual and motorized operators shall comply with the requirements of paragraphs 154500 through 15460 as applicable to the required installation indicated on the Plans.

Protective coatings shall be as specified in Section 15 of AWWA C 504.

Butterfly valves shall be as manufactured by Henry Pratt Company.

#### 153200 GATE VALVES ABOVEGROUND

Gate valves under 3 inches in size for clear water and air service shall be bronze, double disc, rising stem, screwed end valves Lunkenheimer Figure 2125, Jenkins Figure 62, or equal. Gate valves 3 inches in size and larger shall be flanged 200-pound iron body, bronze mounted, nonrising stem, parallel seat Mueller or equal, with stems of silicon bronze conforming to ASTM B 98, Alloy No. 661, or equal. Each valve shall be furnished with handwheel and shall open counterclockwise. Valves shall be suitable for 250 psi.

#### 153210 GATE VALVES UNDERGROUND

Gate valves for buried installation shall be iron body, resilient seat, nonrising stem, conforming to AWWA C 509, with double O-ring stem seal and epoxy coated in conformance with AWWA C550. Valves shall open counterclockwise. Valve ends shall be flanged or mechanical joint as required for the type of pipe used. Maximum shutoff pressure shall be 200 psi. Operators shall be suitable for buried service and shall have an operator shaft extension to finished grade, a 2-inch square AWWA nut, valve box, and cover.

#### 153400 CHECK VALVES

Except as otherwise specified, shown on the Plans, or approved by the Engineer, check valves shall be as follows: Check valves shall be for 150-pound or better service and suitable for operation in either horizontal or vertical position.

#### 153400.10 PLASTIC BODY CHECK VALVES

Except as otherwise specified, shown on the Plans, or approved by the Engineer, check valves shall be as follows: Check valves shall be for 200 psi or better service and suitable for operation in either horizontal or vertical position. All PVC check valves shall be true union unless approved otherwise.

### 153411 SLANTING DISC CHECK VALVES

Where shown on the Plans, the Contractor shall furnish and install slanting disc check valves that begin to close as the forward flow diminishes and is fully closed at zero velocity, preventing flow reversal. The valve shall be designed for a working pressure of 150 psi. The seat and disc ring must be hand replaceable in the field without removing the valve from its installation or without machining. The valve shall be incorporate drop tight seating design and shall have an integral disc position indicator.

The body shall be cast iron. The seat and disc shall be bronze in accordance with ASTM B584. A Buna-N seal shall be furnished to provide zero leakage. Valves shall be epoxy lined and coated in conformance with AWWA C550. The leakage rate shall not exceed one-tenth the allowable rate allowed by the AWWAC508-82. The check valve needs to be provided bottom side dashpots to eliminate surges and dampen hydraulic pressure waves. The dashpot shall be field adjustable.

The headloss thru the valve shall not exceed the values specified below:

8-inch check valve 2-ft headloss @ 3000 gallons per minute  
6-inch check valve 0.75-ft headloss @ 1000 gallons per minute

The valves shall be APCO series 800-B, Valmatic Tilted Disc, or approved equal.

### 153500 BALL VALVES

Where shown on the Plans, the Contractor shall furnish and install ball valves of the type and material shown or specified. Except as otherwise specified, all ball valves shall have TFE seats and TFE or Viton stem seals. Valves shall be suitable for working pressure not less than 250 psi. Stem packing shall be manually adjustable while valve is under pressure. Valves shall be non-lubricated, and capable of sealing in either flow direction.

### 153520 PLASTIC BODY BALL VALVES

Except as otherwise specified, plastic body ball valves shall be PVC body Celanese Piping Systems, Inc. "Chemtrol;" Hill-McCanna "McCannaplast;" or equal. The valves shall be furnished with wrench type operator handles, and shall have union type end connections. All PVC ball valves shall be true union unless approved otherwise.

### 153710 PLAIN HOSE VALVES

Hose valves not otherwise designated shall be Jenkins Figure No. 112, Crane No. 58, or equal, angle hose valves. For yard hydrants they shall be mounted on 1-inch IPS risers with concrete splash blocks as detailed on the Plans. Each valve shall be provided with a nozzle type vacuum breaker.

### 153830 NEEDLE VALVES

Wherever required for accurate throttling of small flows, needle valves shall be provided as indicated on the Plans. Needle valves shall be Powell Figure No. 180 or 181, Lunkenheimer Figure No. 906-BS or 907-BS,

Crane No. 88 or 89, or equal, as required. Needle valves in connection with metering shall be as recommended by the meter manufacturer and shall be furnished with the meters.

153843 AIR VALVE-AND-VACUUM VALVE

Air and vacuum valves shall be designed to allow large quantities of air to escape out of the orifice when filling a pipeline and to close water tight when the liquid enters the valve. The air and vacuum shall also permit large quantities of air to enter through the orifice when the pipeline is being drained to break the vacuum. The discharge orifice area shall be equal or greater than the inlet of the valve. The valve shall consist of a body, cover, baffle, float and seat. The baffle will be designed to protect the float from direct contact of the rushing air and water to prevent the float from closing prematurely in the valve. The seat shall be fastened into the valve cover without distortion and shall be easily removed if necessary. The float shall be stainless steel designed to withstand 1000 psi or more. The float shall be center guided for positive seating.

The valve shall be in all respects similar to APCO Models as follows or approved equal.

The valves must be painted with three or more coats of epoxy rate for culinary water service for resistance to corrosion.

All materials of construction shall be certified in writing to conform to A.S.T.M. specifications as follows:

Body, Cover and Baffle	Cast Iron	ASTM A48 Class 30
Float	Stainless Steel	ASTM A240
Seat	Buna-N	

154600 PIPE HANGERS AND SUPPORTS

The Plans do not, in all cases, show where or how pipe is supported; however, it is intended that all pipe and fittings shall be properly supported, suspended, or anchored as required to prevent sagging, overstressing, or longitudinal movement of certain piping, and to prevent thrusts or loads on or against pumps, meters, and other equipment. The pipe support manufacturers shall determine the proper support size where sizes have not been indicated on the Plans.

In addition to supports indicated on the Plans, exposed piping shall be supported at the base of all risers, at intervals not to exceed 3 feet on all horizontal runs of pipe 2 inches and smaller, and at intervals not to exceed 10 feet on all horizontal runs of pipe larger than 2 inches. Piping 4 inches and larger through fill, backfill, or disturbed ground shall be supported at intervals not to exceed 10 feet with supports as detailed on the Plans. Plastic pipe and tubing, copper pipe and tubing, and rubber hose and tubing shall be supported at close enough intervals to prevent noticeable sagging (in no case more than 2.5 feet for diameters of less than 1-1/2 inches and 5 feet for diameters of 1-1/2 inches and larger), or shall be carried in trays.

Plastic pipe, valves, and headers shall be securely anchored to prevent any apparent movement during operation of valves. Plastic pipe shall be anchored between expansion loops and/or direction changes to provide for uniform expansion.

Where concrete supports are used under piping, the supports shall be poured 1 inch low, then the next day or later, the pipe grouted in place with nonshrink grout. Nonshrink grout shall be used under floor flanges to give level bearing. Floor flanges shall be bolted to the floor with at least two bolts, or as shown on the Plans.

Hanger rods shall be sized in accordance with the manufacturer's recommendation, or as shown on the Plans.

Supports, clamps, clevises, brackets, or any devices bearing against copper pipe shall be copper plated, copper throughout, or insulated, except trays which shall be galvanized.

Special details are shown on the Plans for special supports for heavy pipe and specials. Such supports shall be of heavy or sturdy design to carry the loads imposed thereon.

No use shall be made of chains, plumbers' straps, wire, or other such devices for suspending, supporting, or clamping pipe of any size or type.

Brackets, supports, hangers, etc. shall be painted as specified in DIVISION 9.

Except as otherwise specified or approved, hangers and supports shall be as follows.

#### 154610 ANCHOR BOLTS AND INSERTS

Anchor bolts and concrete anchors shall be in accordance with DIVISION 5.

Where shown on the Plans, continuous concrete inserts, Unistrut Series P3200, or Elcen "Speed Strut" Figure 1150 of the lengths shown or specified shall be furnished and installed. Where not otherwise shown or specified, inserts in concrete ceilings and beam soffits may be malleable iron inserts, Grinnell Figure 152 or 282; Bergen-Patterson Part 108; Unistrut Series P3200; or equal. Wall and side beam inserts shall be Unistrut Series P3200; Elcen "Speed Strut" Figure 1150, or equal.

Support members shall be Unistrut Series P-1000, Elcen "Speed Strut" Figure 600, or equal. Support members and brackets shall be painted in accordance with the requirements of DIVISION 9, prior to installation of pipe or trays.

Brackets shall be brackets of the model number as called for on the Plans, and made from Unistrut Series P-1000; Elcen "Speed Strut" Figure 600, or equal.

Channel inserts shall be installed in all pipe trenches and pipe galleries below grade even under buildings at not more than 5 feet on centers. Channel inserts shall be installed in ceilings where shown on the Plans at not more than 5 feet on centers. Both wall and ceiling inserts shall be placed so that they are staggered at the midpoint spacing of the opposite wall. Channel inserts shall extend to within 3 inches of top of walls. Vertical channel supports installed opposite inserts shall extend to same height as inserts.

Under no circumstances will the use of Slugin or similar anchors relying on the deformation of a lead alloy or similar element for their holding power be permitted.

With the Engineers written permission, powder driven studs may be used for the securing of conduit and small pipe to structural metal, but their use will not be permitted in concrete, masonry, and similar materials.

#### 154620 SINGLE PIPE HANGERS AND SUPPORTS

Single pipe hangers for pipe over 6-inch shall be adjustable clevis hangers, Bergen-Patterson Part 100; Grinnell Figure 260; or equal.

Single pipe hangers for pipes 6-inch and smaller may be as specified above or may be solid or split malleable iron rings, Bergen-Patterson Part 233 or 240; Grinnell Figure 104 or 101; or equal.

Single rod hangers for steam pipe shall be malleable iron or steel yoke and roller hangers, Elcen Figure 14 or 14A; Grinnell Figure 174 or 181; or equal.

Double rod steam pipe hangers, shall be Elcen Figure 15; Grinnell Figure 171; or equal.

#### 154621 WALL OR CEILING CLAMPS

Pipe fastened against walls or ceiling shall be spaced out from the surface to allow the make up of unions, fittings, etc. For pipe larger than 2-inch, supports shall be offset pipe clamps, Elcen Figure 44; Bergen-Patterson Part 179; or equal. For pipe 2-inch and smaller, supports may be as above, or may be Unistrut standoff pipe clamps.

#### 154630 TRAPEZE HANGERS

Use shall be made of trapeze hangers where shown on the Plans or where several pipes are located at the same elevation in a horizontal plane. Unistrut sections, fittings, etc., or their equal, shall be as called for on the Plans.

#### 154640 WALL BRACKETS

Wall brackets shall be fabricated steel, Bergen-Patterson Part 84; Grinnell Figure 195; Unistrut P2513, 2513A, or 2542; or equal.

#### 154660 FLOOR STANDS AND STANCHIONS

Floor stand or stanchion saddles shall be furnished with U-bolt hold down yokes, Grinnell Figure 259; Bergen-Patterson Figure 125; or equal.

Poured concrete pipe supports shall be cast where indicated on the Plans. Vertical corners shall be neatly chamfered. As a minimum of cradling, the concrete shall extend 1/4 of the pipe diameter above the pipe invert and at least 6 inches along the pipe shell.

154670 RISER SUPPORTS

All elbows to be supported from the floor shall be furnished and installed as base elbows, whether so indicated on the Plans or not. Supports for the base fittings shall be adjustable metal supports or concrete piers as shown on the Plans, or as directed by the Engineer.

Riser clamps shall be Elcen Figure 29, Grinnel Figure 261, or equal.

\*\*\* END OF DIVISION 15 \*\*\*