

CHAPTER 4 - CULINARY WATER

4.1 GENERAL

This Division covers furnishing and installing pressure pipe to the lines and grades shown on the drawings and/or established in the field, and all flushing, testing, repairing, as required to ensure adequate and safe operation of the water system.

Ductile iron pipe shall be used in all areas east of 400 West unless otherwise specified by the City Engineer. PVC pipe will be used in all areas west of 400 West

4.2 DUCTILE IRON PIPE

4.2.1 Materials:

Ductile iron pipe shall conform to all requirements of ANSI/AWWA C151/A21.51. Minimum pressure class of pipes of 12-inch diameter and smaller shall be pressure Class 350. Minimum pressure Class will be 250 for pipes larger than 12-inch diameter. If thickness class pipe is used, pipes of diameters from 4 inches through 10 inches shall be minimum Class 51 and pipe from 12-inch diameter and larger shall be minimum Class 50. All pipe shall be gauged pipe.

4.2.2 Joints:

- 1) Mechanical Joints: All mechanical joint fittings with accessories shall meet all applicable requirements of ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11 (current revisions). All gasket surfaces shall be smooth and free from imperfections. Gaskets shall conform to tests in accordance with specifications and shall be less than one year old. All buried fittings having steel bolts shall be coated with food-grade grease and wrapped with polyethylene.
- 2) Push-on Joints: Joints shall be push on rubber gasket type. Lubrication shall be water soluble, non-toxic, non-objectionable in taste and odor imparted to the water, non-supporting of bacteria growth, and have no deteriorating effect on the pipe or rubber gaskets. All push-on joints shall meet the requirements of ANSI/AWWA C111/A21.11. Gaskets shall be free from defects and not over one year old.

Lubricants shall be non-toxic and have no deteriorating effects on gasket materials. It shall not impart taste to water in a pipe. It shall conform in every way to ANSI 21.1

- 3) Flanged Joints: Flange joints on fittings shall meet the requirements of ANSI/AWWA C110/A21.10 or ANSI B16.1. Flanges on pipe shall meet the requirements of AWWA C115. Flanged joints shall be bolted firmly with machine, stud or cap bolts of proper size. Flange maybe cast integrally with the pipe or may be screwed on threaded pipe. Flanges shall be faced and drilled and of proper dimensions for size and pressure required. Bolts and nuts, unless otherwise specified, shall be made of the best quality refined iron or metal steel and have clean, well-fitting threads. Bolts will be provided with standard hexagonal nuts and standard hexagonal heads. Bolts shall be of the diameter required for each flange and when installed shall be of length so that no more than 3/8-inch nor less than 1/8-inch extends past face of nut. All buried fittings having steel bolts shall be coated with food-grade grease and wrapped with polyethylene.

4.2.3 Coatings and Linings for Ductile Iron Pipe:

All exterior surfaces of pipe and fittings shall be coated with hot coal tar approximately 1 mil thick. All interior surfaces shall be cement mortar lined with a standard thickness according to ANSI/AWWA C104/A21.4-80.

4.2.4 Corrosion Protection and Soil Tests:

When the City Engineer / Public Works Representative determines that a potential for corrosive conditions exists such as poor drainage or reactive soils, PVC pipe shall be used rather than ductile iron.

4.2.5 Fittings:

All fittings to be used with the ductile iron pipe shall conform to the provisions of ANSI/AWWA C110/A21.10-82 or C153/A21.53-58. Pipe fittings shall be Mechanical-Joint-(MJ)-type with retainer gland (Megalug or equivalent) approved by the manufacturer for the specific pipe material unless otherwise specified by the City Engineer / Public Works Representative. All fittings shall be greased with FM NLGI 2 grease and encased in 8 mil protective plastic.

A megalug-type retainer gland system shall be used on all mechanical joints and shall meet Uni-B-13 for PVC and be UL/FM approved through twelve (12) inch diameter for both ductile iron and PVC pipe. The restraint mechanism shall consist of individually activated gripping surfaces to maximize restraint capability. Twist-off nuts, sized the same as the tee-head bolts, and shall be used to ensure proper activating of restraining devices. The gland shall be manufactured of ductile iron conforming to ASTM A-536-80. The retainer-gland shall have a pressure rating equal to that of the pipe on which it is used (through fourteen inches) with a minimum safety factor of 2:1. Gland shall be Megalug by EBAA Iron, Inc. or approved equal. The type and model of retainer and amount for each connector is shown on standard drawings.

4.2.6 Detectable Caution Tape:

All pipe shall include a three-inch (3") wide detectable caution tape installed in the pipeline trench approximately twelve inches (12") above the top of pipeline. Caution tape shall be furnished with white or black printing on a blue colored field having the words:

CAUTION: POTABLE WATER - BELOW.

4.2.7 Tracer Wire:

All pipes shall include a 12 gauge solid THHN tracer wire installed according to NESC standards. The tracer wire shall be installed and secured to the top center of the pipe. The tracer wire shall be brought up and connected to a fire hydrant flange bolt at each hydrant for pipe line location. The tracer wire shall also be installed on all service lines per the standard drawings. The tracer wire shall also be brought up along the outside of, and then through, the top of the valve box through a drilled hole (as specified on the standard drawings), unless directed otherwise by the City Engineer or his designee. All connections shall be made with waterproof grease nut connectors to help ensure continuity. A continuity test shall be conducted by the City to verify the integrity of the tracer wire installed by the Contractor. It is the responsibility of the Contractor to ensure that the continuity test is performed by the City prior to any paving operations. Failures in the continuity are the responsibility of the Contractor and shall be repaired by the Contractor and verified by the City prior to any paving operations.

4.3 PVC PIPE

4.3.1 Materials:

Pipe for the transmission and distribution of water shall be manufactured in accordance with AWWA C900 standards latest revision, "AWWA Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4-inch through 12-inch, for Water:" PVC pipe fourteen inches (14") and larger shall be manufactured in accordance with AWWA C905 standards latest revision, "AWWA Standard for Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14-inch through 36-inch." All PVC pipe four-inch (4") and larger

shall be dimension ratio (DR) 18 with a working pressure of 150 psi. The PVC pipe shall have a cast-iron-pipe-equivalent outside diameter.

4.3.2 Joints:

- 1) Mechanical Joints: All mechanical joint fittings with accessories shall meet all applicable requirements of ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11 (current revisions). All gasket surfaces shall be smooth and free from imperfections. Gaskets shall conform to tests in accordance with specifications and shall be less than one year old. All buried fittings having steel bolts shall be coated with food-grade grease and wrapped with polyethylene.
- 2) Push-on Joints: Joints shall be push on rubber gasket type. Lubrication shall be water soluble, non-toxic, non-objectionable in taste and odor imparted to the water, non-supporting of bacteria growth, and have no deteriorating effect on the pipe or rubber gaskets. All push-on joints shall meet the requirements of ANSI/AWWA C111/A21.11. Gaskets shall be free from defects and not over one year old.

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A megalug-type retainer gland system shall be used on all mechanical joints and shall meet Uni-B-13 for PVC and be UL/FM approved through twelve (12) inch diameter for both ductile iron and PVC pipe. The restraint mechanism shall consist of individually activated gripping surfaces to maximize restraint capability. Twist-off nuts, sized the same as the tee-head bolts, and shall be used to ensure proper activating of restraining devices. The gland shall be manufactured of ductile iron conforming to ASTM A-536-80. The retainer-gland shall have a pressure rating equal to that of the pipe on which it is used (through fourteen inches) with a minimum safety factor of 2:1. Gland shall be Megalug by EBAA Iron, Inc. or approved equal. The type and model of retainer and amount for each connector is shown on standard drawings.

4.3.4 Detectable Caution Tape:

All pipe shall include a three-inch (3") detectable caution tape installed in the pipeline trench approximately twelve inches (12") below the ground surface. Caution tape shall be furnished with white or black printing on a colored field having the words:

CAUTION: POTABLE WATER - BELOW.

4.3.5 Tracer Wire:

All pipes shall include a 12 gauge solid THHN tracer wire installed according to NESC standards. The tracer wire shall be installed and secured to the top center of the pipe. The tracer wire shall be brought up and connected to a fire hydrant flange bolt at each hydrant for pipe line location. The tracer wire shall also be installed on all service lines per the standard drawings. The tracer wire shall also be brought up along the outside of, and then through, the top of the valve box through a drilled hole (as specified on the standard drawings), unless directed otherwise by the City Engineer or his designee. All connections shall be made with waterproof grease nut connectors to help ensure continuity. A continuity test shall be conducted by the City to verify the integrity of the tracer wire installed by the Contractor. It is the responsibility of the Contractor to ensure that the continuity test is performed by the City prior to any paving operations. Failures in the continuity are the responsibility of the Contractor and shall be repaired by the Contractor and verified by the City prior to any paving operations.

4.4 PIPE INSTALLATION

4.4.1 Cutting:

When required, cutting of pipe shall be done in a neat and workmanlike manner by a method recommended by the manufacturer. All cuts shall be cut square to the longitudinal axis of the pipe. If needed after cutting, the pipe shall be beveled and filed to prevent gasket damage in joint assembly. All beveled ends of pipe must be removed before connecting to MJ fittings, in accordance with manufacturer's recommendations.

4.4.2 Dewatering of Trench:

Where water is encountered in the trench, it shall be removed during pipe-laying operations and until the ends of the pipe are sealed. See Section 2.3 Control of Groundwater.

4.4.3 Laying of Pipe:

The pipe and pipe coating (where applicable) shall be inspected for defects or UV light damage before installation. Any defects shall be repaired or the pipe shall be replaced, whichever is deemed necessary by the City Engineer / Public Works Representative.

All pipe shall be laid and maintained to the required lines with fittings and valves at the required locations, as shown on the Drawings.

All pipe, fittings, and valves shall be moved carefully, either when lowering from the truck, or when placing in the trench. Under no circumstances shall materials be dropped or dumped from the truck or into the trench.

The Developer/Contractor shall take the necessary precautions to ensure that foreign materials do not enter the pipe. No debris, tools, or other materials shall be placed in the pipe during laying operations. When laying of pipe is not in progress, the pipe shall be closed with a water tight plug.

Maximum deflections at pipe joints shall not exceed the joint specifications of AWWA C900 (latest revision), or the recommendations of the pipe manufacturer.

Deflections in PVC pipe shall be made by defecting pipe joints and may not be made by longitudinal bending of the barrel of the pipe.

4.4.4 Joint Restraints:

Concrete thrust blocks shall not be used as a restraining system for waterline mains or laterals without prior approval of the City Engineer / Public Works Representative. Reaction restraints shall be applied at all bends and tees, and at all points of reduction or at fittings where changes in pipe diameter occur in accordance with Standard Pipe Restraint Detail Drawings.

Mechanical restraints for pipes larger than twelve (12) inches in diameter must be designed by a registered professional engineer and approved by the City Engineer prior to installation.

4.4.5 Thrust Blocking:

With approval of the City Engineer / Public Works Representative thrust blocking may be applied in addition to required joint restraints at all tees, valves, plugs, caps, and at bends that deflect twenty-two and one-half (22-1/2°) degrees or more. The fitting shall be encased in a 8 mil protective plastic wrap before the thrust block is poured. Reaction blocking shall be concrete, having a compressive strength of not less than three-thousand (3000) psi at twenty-eight (28) days. Blocking shall be placed between undisturbed soil and the fitting to be anchored. The area of bearing on the pipe and on the ground shall be as shown in the Drawings. The blocking shall be placed so that the pipe and the fittings will be accessible for repair.

4.4.6 Connections to Existing Water Lines:

Information on the Drawings regarding existing pipelines is taken from "record" drawings from the City or utility company files and may or may not be accurate as to size, type of material, or location of those lines. The Developer/Contractor will be responsible to determine the proper fittings and materials required, obtain the City Engineer / Public Works Representative's approval of the planned connection, and perform the construction in a suitable fashion.

4.4.7 Pipe Embedment:

Refer to Section 2.5.3 Pipe Embedment Material Placement

4.5 WATER SERVICE LATERALS

Water service laterals shall be constructed with materials specified and at the locations shown on the Standard Drawings or at the actual location established during construction.

Pipe for water service laterals shall be a minimum of 1" in diameter. Sizes larger than 1" shall comply with ASTM Specification B88. Services shall be either Type K-soft copper tubing or polyethylene CTS tubing.

Polyethylene CTS tube shall be manufactured in accordance with the standard specification for Polyethylene (PEP) plastic tubing as issued by the American Standard for Testing and Materials under ASTM D 2239 and AWWA C901. Standard pipe dimension ratio CTS (SDR 9) - 160-psi pressure rating. Tubing shall be Cencore HDPE 3408 or equivalent.

All tubing for service lines shall be cut and installed in a neat and workmanlike manner by a method recommended by the manufacturer.

4.5.1 Extent and Locations of Laterals:

New water service laterals shall be installed at the centerline of the lot. Meter cans shall be installed in the center of the park strip (where applicable) or one foot behind sidewalk where park strip does not exist or as approved by the City Engineer / Public Works Representative.

The service lateral shall extend from the water main to the meter can and from the meter can to fifteen feet (15') beyond the back of walk. Water services shall not have any joints between the corporation stop at the main and the meter setter.

Water service laterals relocated during construction of new pipelines shall extend from the water main to the water meter if the existing service is in poor condition or of a material other than copper or polyethylene. Relocated water services shall not have any joints between the corporation stop and the meter.

4.5.2 Connection to Main:

A 24-inch gooseneck shall be formed with the tubing for all connection types. No connections shall be made to the main within 24" of the end of the pipe joint. On existing services the existing connection to main will be used unless damaged or leaking.

Connection to Ductile Iron Main

All connections of services to ductile iron main lines shall be direct tap with a corporation type stop. The corporation stop shall be a FORD FB1000-X-Q STYLE or MUELLER 300 B-25008 for one-inch (1") through two-inch (2"). All with "CC" thread for direct tap.

Connection to PVC Main

All connections of services to PVC main lines shall be through a service saddle with a corporation type stop. All service saddles shall be of a "Full encirclement design," and shall be I.D. controlled, which design will eliminate the possibility of pipe crushing due to the over-torquing of the nuts upon installation.

All service saddles shall be manufactured of stainless steel in conformance to AWWA C800, General Section - 1, Paragraph 1.2 (ASTM B62). All service saddles shall be nylon coated ductile iron service saddle with dual stainless steel straps, Romac 202NS or equivalent.

The corporation stop shall be a FORD FB1100 XX Q STYLE or MUELLER 300 B 25028 for one inch (1") through two inch (2").

Ball valve curb stop shall be FORD B84-444-W-Q-NL Style or MUELLER equivalent.

Size	FORD Ball Valve Curb Stop
1"	B84-444-W-Q-NL
1 1/2"	B84-666-W-Q-NL
2"	B84-777-W-Q-NL

4.5.3 Meter Setter, Box and Cover:

All meter setters shall be 18" dual check type.

Size	FORD 70 Series Coppersetter
1"	VBHC74-18W-11-44-NL
1 1/2"	VBHH76-18W-11-66-NL
2"	VBHH77-18W-11-77-NL

The meter box shall be 21-inch (21") diameter for a one-inch (1") service or thirty-six-inch (36") diameter for the larger service lines. Meter box to be thirty-six inches (36") in height, corrugated white HDPE, with grooves to fit over the inlet and outlet line. The meter cover to be D&L Supply L-2244 for a 21-inch (21") diameter box or L-2326 for a thirty-six-inch (36") diameter box, with recessed standard waterworks pentagon head locking device and raised cast center rim. Cover to be one inch (1") above the top back of curb.

4.5.4 Special Joints and Fittings:

Copper Tubing / Poly Tubing to Screw Pipe Joints: Joints from copper tubing or poly tubing to threaded pipe shall be made by the use of brass adapter compression fittings after receiving approval from the City Engineer / Public Works Representative.

4.5.5 Flushing, Testing and Disinfecting:

Flushing, testing and disinfecting shall be done at the time the water main is flushed, tested and disinfected. The end of the trench where the stub out past the meter is located shall be left open to allow for discharging water out of the service line for proper flushing and to insure that the line has been adequately disinfected. The line shall be flushed thoroughly following installation. Flushing, testing and disinfecting shall conform to the applicable paragraphs of this division.

On existing services the Developer/Contractor shall take precautions to prevent contamination of the pipe and connections during installation. The line shall be flushed thoroughly following installation.

4.5.6 Damage and Repair of Water Mains and Appurtenances:

The Developer/Contractor shall be responsible for any damage to water mains and water facilities caused by his operations. The Developer/Contractor may be relieved of the responsibility under the following conditions:

- 1) He has not excavated below or beyond the required excavation lines, and
- 2) He has given proper and timely notice of his work plans, and
- 3) He has used reasonable care, and cooperated, minimizing the damage.

Any damage to water gates, hydrants, valve chambers, meter boxes, and other surface appurtenances that result from the Developer/Contractor's operation shall be its sole responsibility.

The Developer/Contractor shall install a brass pin, 1/2” in diameter, stamped with the letter “W” in the top back of curb at the location where the lateral crosses the curb.

4.6 FLUSHING, DISINFECTING, AND TESTING OF WATER MAINS

4.6.1 Disinfection:

All culinary water lines shall be disinfected by chlorination. Chlorination shall provide a minimum of 25 ppm residual after 24 hours contact in the pipeline. This may be expected with an application of 50 ppm, although some conditions may require more. Chlorine in the form of a 1% slurry of high-test calcium hypochlorite (HTH, Perchloron, Pitchlor, etc. which are 70% available chlorine by weight) shall be fed into the pipeline in such a manner as to mix with the water flowing in the pipeline. (A 1% slurry - 10,000 ppm - results from mixing one pound of calcium hypochlorite with 8.40 gallons of water.)

The following table provides information as to the required quantity of slurry to be used per 100 feet of pipe to provide a chlorine concentration of 50 ppm:

Pipe Size (in.)	Vol. of 100 ft. Length (gal)	Required Amount of 1 % Chlorine Slurry (gal)
1 ½	9.18	0.07
2	16.32	0.12

2 ½	25.50	0.18
3	36.73	0.26
4	65.28	0.47
6	146.90	1.05
8	261.10	1.87
10	408.10	2.92
12	587.60	4.20

During the process of chlorinating the pipeline, operate all valves and other pipeline appurtenances several times to provide sufficient contact with the chlorinating agent. Following chlorination, drain and thoroughly flush the water line as per the Flushing section of these specifications.

Disinfection shall conform to the requirements of AWWA C651 latest edition.

4.6.2 Bacteria Test

The Public Works Representative shall obtain two (2) water samples, 24 hours apart, upon which the City will have bacteriological tests performed.

If the line does not pass the bacteria test, the water main shall be flushed and/or rechlorinated and the water line shall be retested until the results of the bacteriological test are satisfactory.

4.6.3 Flushing:

All new water systems or extensions to existing systems shall be thoroughly flushed before being placed in service. Flushing shall be accomplished through hydrants, or end of line blow-off assemblies at a minimum flushing velocity of 2.5-feet per second. See chart below.

FLOW RATE AND OPENINGS TO FLUSH PIPELINES
(40- psi Residual Pressure)

Pipe Size (inches)	Flow Required to Produce 2.5 fps velocity (gpm)
2	26
4	100
6	220
8	390
10	610
12	880
14	1,200
16	1,565
18	1,980
20	2,450
24	3,525
30	5,507

4.6.4 Pressure Test:

All newly laid pipes or any valved section thereof shall be subjected to a hydrostatic pressure. A leakage test shall be conducted concurrently with the pressure test.

- 1) Test Pressure Restrictions: Test pressures shall:
 - a. Not be less than 150 psi or 1.5 times the static pressure at the highest point along the test section, whichever is greater.

- b. Not exceed pipe or thrust restraint design pressures.
 - c. Be of at least 2-hour duration.
 - d. Not vary by more than plus or minus five (± 5) psi for the duration of the test.
 - e. Not exceed twice the rated pressure of the valves or hydrants when the pressure boundary of the test section includes closed gate valves or hydrants.
 - f. Not exceed the rated pressure of the valves when the test boundary of the test section includes closed, resilient-seated gate valves or butterfly valves.
- 2) **Pressurization:** Each valved section of pipe shall be slowly filled with water and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gage, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the City Engineer / Public Works Representative.
 - 3) **Air Removal:** Before applying the specified test pressure, air shall be expelled completely from the pipe, valves, and hydrants. If permanent air vents are not located at all high points, the Developer/Contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged.
 - 4) **Examination:** All exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, valves, or hydrants that are discovered following the pressure test shall be repaired or replaced with sound materials and the test shall be repeated until it is satisfactory to the Owner.

4.6.5 Leakage Test:

A leakage test shall be conducted concurrently with the pressure test.

- 1) **Leakage Defined:** Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof, to maintain pressure within 5 psi of the specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water.
- 2) **Allowable Leakage:** No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{SD(P)^{0.5}}{133,200}$$

In which L is the allowable leakage, in gallons per hour; S is the length of pipeline tested in feet; D is the nominal diameter of the pipe, in inches; and P is the average test pressure during the leakage test, in pounds per square inch gage.

- a. Allowable leakage at various pressures is shown in Table 1.
- b. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gal/hr/in. of nominal valve size shall be allowed.
- c. When hydrants are in the test section, the test shall be made against the closed hydrant .

TABLE 1
Allowable Leakage per 1000 ft of Pipeline - gph

Average Test Pressure psi (Bar)	Nominal Pipe Diameter—in.																
	3	4	6	8	10	12	14	16	18	20	24	30	36	42	48	54	

450 (31)	0.48	0.64	0.95	1.27	1.59	1.91	2.23	2.55	2.87	3.18	3.82	4.78	5.73	6.69	7.64	8.60
400 (28)	0.45	0.60	0.90	1.20	1.50	1.80	2.10	2.40	2.70	3.00	3.60	4.50	5.41	6.31	7.21	8.11
350 (24)	0.42	0.56	0.84	1.12	1.40	1.69	1.97	2.25	2.53	2.81	3.37	4.21	5.06	5.90	6.74	7.58
300 (21)	0.39	0.52	0.78	1.04	1.30	1.56	1.82	2.08	2.34	2.60	3.12	3.90	4.68	5.46	6.24	7.02
275 (19)	0.37	0.50	0.75	1.00	1.24	1.49	1.74	1.99	2.24	2.49	2.99	3.73	4.48	5.23	5.98	6.72
250 (17)	0.36	0.47	0.71	0.95	1.19	1.42	1.66	1.90	2.14	2.37	2.85	3.56	4.27	4.99	5.70	6.41
225 (16)	0.34	0.45	0.68	0.90	1.13	1.35	1.58	1.80	2.03	2.25	2.70	3.38	4.05	4.73	5.41	6.03
200 (14)	0.32	0.43	0.64	0.85	1.06	1.28	1.48	1.70	1.91	2.12	2.55	3.19	3.82	4.46	5.09	5.73
175 (12)	0.30	0.40	0.59	0.80	0.99	1.19	1.39	1.59	1.79	1.98	2.38	2.98	3.58	4.17	4.77	5.36
150 (10)	0.28	0.37	0.55	0.74	0.92	1.10	1.29	1.47	1.66	1.84	2.21	2.76	3.31	3.86	4.41	4.97
125 (9)	0.25	0.34	0.50	0.67	0.84	1.01	1.18	1.34	1.51	1.68	2.01	2.52	3.02	3.53	4.03	4.53
100 (7)	0.23	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50	1.80	2.25	2.70	3.15	3.60	4.05

*If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.
 **To obtain leakage in liters/hour, multiply the values in the table by 3.785.

- 3) **Examination:** All exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, valves, or hydrants that are discovered during the leakage test shall be repaired or replaced with sound materials and the test shall be repeated. Repairs or replacements to the pipeline and subsequent leakage testing shall be performed as necessary for the pipeline to pass the leakage test.
- 4) **Acceptance of Installation:** Acceptance shall be determined on the basis of allowable leakage. If any test of pipe laid discloses leakage greater than specified, the Developer/Contractor shall, at its own expense, locate and repair the defective material until the leakage is within the specified allowance.

All visible leaks are to be repaired regardless of the amount of leakage.

4.7 RESILIENT SEATED GATE VALVE

Valves in sizes 4" through 10" shall be of the iron body, non-rising bronze stem, resilient seated type, manufactured to equal or exceed all applicable AWWA standards latest revision and all specific requirements outlined in these specifications.

All gate valves shall be WATEROUS Series 2500 or MUELLER A-2361.

4.8 BUTTERFLY VALVE

Valves in sizes 12" and larger shall be butterfly valves manufactured to equal or exceed all applicable AWWA standards latest revision and all specific requirements outlined in these specifications.

All butterfly valves shall be M&H 4500 or MUELLER LINESEAL III or approved equal.

4.9 VALVE BOXES

Valves and valve boxes shall be installed as required in these Specifications and Standard Drawings. Valves and valve boxes shall be set plumb. Valve boxes shall be centered directly over the valve. If the top of the valve nut is greater than five (5) feet below finished grade a valve nut extension shall be required. Earth fill shall be carefully tamped around the valve box to a distance of four (4) feet on all sides of the box, or to the undisturbed trench face if less than four (4) feet. Valves shall have the interiors cleaned of all foreign matter before installation.

All buried valves shall be installed complete with two-piece, cast iron, 5-1/4-inch shaft valve box with lid. The lid shall have the words "WATER" or "FIRE" cast in the metal depending on the application.

4.9.1 Placement of Concrete Collars

Valve boxes shall be set to the finished grade and contour of the street. Valve boxes shall be protected during backfilling and compaction of the road base and during the placing or replacing of road surfaces. Any valve boxes damaged or broken shall be replaced by the Developer/Contractor at its expense. Prior to paving, the valve box shall be GPS-located by the Developer / Contractor (shot at the center of the valve

box) and set six (6) inches below the finished grade. After paving the asphalt shall be removed, and the valve box shall be raised to match the grade and slope of the finished road surface.

Road base around the valve box shall be re-compacted, and the concrete collar placed. Valve boxes placed in asphalt surfacing shall be constructed such that the cast iron ring is one-quarter inch (1/4") lower than the pavement. Valve boxes must be cleaned of all debris after setting of collars.

4.10 FIRE HYDRANTS

Fire hydrants shall be "traffic model" type designed to conform to AWWA Specifications. Hydrants shall be Mueller "Super Centurion 250" or Waterous "Pacer".

4.11 AIR RELEASE and VACUUM RELIEF VALVE

Air release and vacuum relief valves shall fulfill functions of air release (permit escape of air accumulated in line at high point of elevation while line is under pressure) and vacuum relief (allow air to enter the pipe and prevent its potential collapse due to the formation of a vacuum condition caused by rapid withdrawal of water) . Air and vacuum relief valves shall be placed at high points or uphill end points in the system. The need for air relief valves should be minimized through the engineering design of the line.

Air release and vacuum relief valves shall be single-body, standard combination valves rated for a minimum working pressure of 150 psi, unless otherwise indicated. (APCO Model 145C or approved equal as indicated on Standard Drawings). Bodies shall be of high strength cast iron. The float, seat, and all moving parts shall be constructed of Type 316 stainless steel. Seat washers and gaskets shall be of a material insuring water tightness with a minimum of maintenance. The valve exterior shall be painted with shop-applied primer suitable for contact with potable water. The connection to the main for the air release and vacuum relief valve shall be service clamp, Ford FS202 or approved equal. Tapping the main through the service clamp will be accomplished with standard tapping equipment before the system is put into service. Typical small distribution mains (4" to 12") shall have the typical 2-inch combination air-vacuum valves per the Standard Drawings. Larger water main pipelines shall have valves which are engineered and sized to compensate for the size of pipe and the length of run.

Valves shall be installed in a 5-foot diameter precast manhole base with a standard manhole frame and lid (D&L 1180 or approved equal) per Standard Drawing. The manhole lid shall read "WATER" or "PRESSURIZED IRRIGATION" as appropriate. Set the manhole base and lid plumb and as detailed. Center the manhole over valve. For pressurized irrigation use, the valve shall vent directly into the vault.