

CHAPTER 3 - PRESSURE IRRIGATION

3.1 GENERAL

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

All utilities must have a minimum cover of thirty inches (30") from finished grade of pavement.

3.2 PVC PIPE

3.2.1 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. Pressure Irrigation pipe shall be purple in color for easy identification.

3.2.2 Joints:

Joints shall be the push-on rubber-gasket type. Lubrication shall be water soluble, non-supporting of bacteria growth, and have no deteriorating effect on the PVC pipe or rubber gaskets.

3.2.3 Fittings:

All fittings to be used with the PVC pipe shall be the same as fittings for ductile iron pipe and 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) unless otherwise specified by the City Engineer / Public Works Representative. All fittings shall be greased with FM 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.

3.2.4 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. This tape shall be prepared with white or black printing on a purple field, color Panatone 512C, having the words:

CAUTION: NONPOTABLE WATER - DO NOT DRINK.

3.2.5 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 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.

3.3 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.

3.4 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

3.5 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 eight (8) 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 "IRR" or "DRAIN" cast in the metal depending on the application.

3.5.1 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.

3.6 PIPE INSTALLATION

3.6.1 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.

3.6.2 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.

3.6.3 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.

3.6.4 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.

3.6.5 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 ($22\text{-}1/2^\circ$) 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.

3.6.6 Connections to Existing Irrigation 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.

3.6.7 Pipe Embedment:

Refer to Section 2.5.3 Pipe Embedment Material Placement

3.7 PRESSURE IRRIGATION SERVICE CONNECTION

Pressure irrigation service laterals shall be constructed with materials specified and at the locations and limits shown on the Standard Drawings.

3.7.1 Extent and Locations of Laterals:

New pressure irrigation service laterals shall be installed per the location and limits shown on the utility location standard drawing. Irrigation service boxes 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.

Pressure irrigation services shall not have any joints between the saddle at the main and the meter connection.

Service laterals relocated during construction of new pipelines shall extend from the pressure irrigation main to the service box if the existing service is in poor condition or of a material other than polyethylene. Relocated services shall not have any joints between the saddle and the meter.

3.7.2 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.

All connections of services to main lines shall be through a service saddle. 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.

Connection to polyethylene service line shall be made using a brass compression by MIPT adapter with Q-style (quick joint) nut, Ford style C84-44-Q or Mueller style H-15428 only.

3.7.3 Polyethylene Tubing:

Pipe for service laterals shall be a minimum of one inch (1”) diameter. Sizes larger than 1” shall comply with ASTM Specification B88. Services shall be polyethylene CTS tubing.

Pipe for the transmission of irrigation water from main to utility box shall be **purple** polyethylene CTS tube. 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.

Material designation code: Polyethylene - Purple
PE 3408

Plastic Extrusion Compound: Type III, class C, Grade 34, as defined by ASTM D 2239

Standard pipe dimension ratio CTS (SDR 9) - 160-psi pressure rating.

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

Tubing shall be Cencore HDPE 3408 or equivalent.

3.7.4 Compression Connection:

A rigid liner shall be used inside of all tubing at the compression fitting, regardless of size.

- 1) The interior surface of the coupling nut, including threads, shall have a baked on, fluorocarbon coating to reduce assembly friction and prevent the gasket from turning and twisting during tightening. The nut shall bottom on a cast or machined shoulder on the body when properly assembled. This design will provide a visual check to assure connection is properly assembled.
- 2) The sealing gasket shall be of molded synthetic rubber (ASTM D2000) with molded in place bronze spring (ASTM A134 Alloy #6) to eliminate the possible cold flow of the gasket between the pipe and fitting. A gripper band of hardened stainless steel (ANSI Type 401) shall be fitted into the gasket. When the gasket is compressed it will cause the gripper ring to distort the pipe giving the fitting a high resistance to pull out. The gripper band shall overlap itself to prevent cold flow of the gasket into the cavity under the band.
- 3) When compression fittings are used with P.E. Pipe, Stainless Steel pipe stiffeners are required to eliminate cold flow of plastic pipe.
- 4) All fittings are to be for CTS Polyethylene pipe.
- 5) The Minimum pull out load for the fitting when used with PE plastic pipe shall be as follows for each given size:

<u>SIZE</u>	<u>MINIMUM PULL OUT (FT.LBS.)</u>
1"	400
1½"	500
2"	500

MUELLER H-15428 "STRAIGHT SERVICE FITTING" OR FORD C84-XX-Q STYLE "QUICK JOINT COUPLING" COMPRESSION COUPLINGS AND FITTINGS ARE TO BE USED ON ALL P.E. PLASTIC PIPE INSTALLATIONS.

3.7.5 Service Box:

Service box shall be a standard green irrigation box with cover. The size shall be the appropriate size for the service size and meter as specified and shown on the standard drawings. Service Box shall be installed over the ball valve and meter as shown on the standard drawings. A sign shall be attached or embossed to or on

the cover indicating as follows: "IRRIGATION." Box shall be Brooks 1419 series utility box with lid recessed and shall be provided with Waterworks Pentagon Head locking device or equivalent.

3.7.6 PVC Pipe:

Pipe for the transmission of irrigation water from the PVC MIPT adapter to the homeowner's side of the valve shall be Schedule 80 PVC pipe threaded nipple, twelve (12) inches long. A threaded end cap will be installed on the end of the pipe on the homeowner's side. No joints will be allowed under sidewalks or other paved surfaces.

3.7.7 Service Pipe Installation:

The polyethylene service pipe shall be installed by use of a "Hole Hog" or other similar device under all existing paved surfaces. Where subsurface materials or conditions will not permit installation by this method, open trenching will be permitted with the approval of the City Engineer / Public Works Representative. Open trenching will be used in new streets not yet paved.

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

3.8 PIPELINE TESTING AND FLUSHING

All newly laid pipes or any valved section thereof shall be subjected to a hydrostatic pressure test. A leakage test shall be conducted concurrently with the pressure test. All new lines, and extensions there from, shall be flushed thoroughly before being placed into service. **All service line connections must be installed prior to the pressure test.**

3.8.1 Pressure Test:

If the pipe section being tested includes concrete thrust blocking, the concrete shall be allowed at least twenty-four (24) hours to set before any testing is conducted.

- 1) Test Pressure Restrictions: Test pressures shall,
 - a. Be not less than 200 psi.
 - b. Not exceed the pressure rating of the pipe.
 - c. Be of at least 2 hour duration.
 - d. 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.
 - e. 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 filled slowly with water to the specified test pressure. Pressurization of the pipe shall be based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gage. Pressure 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 during the pressure test shall be repaired or replaced with sound materials and the test shall be repeated. Repairs or replacements to the pipeline and subsequent pressure testing shall be repeated as necessary for the pipeline to pass the pressure test.
- 5) **Length of Pipeline:** The maximum length of pipeline tested at one time shall be 1,000 feet.

3.8.2 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 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 the pipeline manufacture’s specifications, or that determined by the following formula, whichever is less:

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

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 (gage) during the leakage test, in pounds per square inch. See Table 1.

- 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.

3.8.3 Acceptance of Testing:

Acceptance of testing 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.

3.8.4 Flushing:

Flushing shall be accomplished through temporary flushing valves, or end of line blow-off assemblies at a minimum flushing velocity of two and one-half feet per second (2.5 fps). Flow volumes to produce this velocity are shown in the following chart:

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
42	10,800
48	14,100

3.9 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 culinary water use, the valve shall be plumbed out of the vault and behind the closest curb and gutter to vent. The air vent stand pipe shall be centered in the park strip or as directed by the City Engineer.

3.10 PRESSURE IRRIGATION DRAINS

When system drains are necessary to be installed on extensions of the pressure irrigation system they shall be constructed as a system drain to a curb inlet box or a storm drain manhole. As an alternative, the system drain may enter directly to a storm drainage pipe if approved by the City Engineer or his authorized representative. The drain shall be constructed as shown on the Standard Drawings. The materials used shall meet the requirements of Division 3, Pressure Pipe Pressure Irrigation. The connection to the box or pipe shall be by coring a hole and grouting the drainpipe in. A non-shrink grout shall be used.

When a section of pressure irrigation pipeline has to be laid such that there is a belly in it then a local drain sump will need to be constructed. The drain shall be constructed as shown on the Standard Drawings.