Irrigation Water Conveyance (ft)

Low-pressure, Underground, Plastic Pipeline

Definition

A pipeline and appurtenances installed in an irrigation system.

Scope

This standard applies to underground thermoplastic pipelines from 4 to 24 in. in diameter that are subject to internal pressures up to 50 lb/in².

The standard includes the design criteria for these irrigation pipelines, the minimum installation requirements, and the specifications for the thermoplastic pipe to be used. It applies to pipelines with stands and vents open to the atmosphere and to pipelines not open to the atmosphere but provided with pressure-relief valves and air-and-vacuum valves.

Purpose

To prevent erosion or loss of water quality or damage to the land, to make possible the proper management of irrigation water, and to reduce water conveyance losses.

Conditions where practice applies

All pipelines shall be planned and located to serve an integral part of an irrigation water distribution or conveyance system designed to facilitate the conservation use and management of the soil and water resources on a farm or group of farms.

The water supply and quality and rate of irrigation delivery for the area served by the pipeline shall be sufficient to make irrigation practical for the crops to be grown and the irrigation water application methods to be used.

Plastic pipelines installed according to this standard shall be placed only in suitable soils where the bedding and backfill requirements can be fully met.

Design criteria

Working pressure. The pipeline shall be designed to meet all service requirements without a static or working pressure, including hydraulic transients, at any point greater than the maximum allowable working pressure of the pipe used at that point. The static or working pressure of pipelines open to the atmosphere shall include freeboard.

Maximum allowable working pressure for low-head plastic irrigation pipe shall be 50 ft of head or 22 lb/in².

Pipelines constructed of 50-lb/in² plastic irrigation pipe or the IPS pipe covered by this standard shall have a working pressure no greater than 50 lb/in².

Plastic pipeline requiring a working pressure greater than 50 lb/in² shall be constructed according to the requirements specified in 430–DD of this standard.

Plastic pipe pressure rating normally is based on a water temperature of 73.4 degrees F. Factors for adjusting allowable working pressure for higher water temperatures are given in table 1.

Table 1.—Pressure rating factors for PVC and PE pipe for water at elevated temperatures

Temperature	PVC	PE
deg F		
73.4	1.00	1.00
80	.88	.92
90	.75	.81
100	.62	.70
110	.50	—
120	.40	—
130	.30	—
140	.22	—

NOTE: To obtain the pipe's reduced pressure rating because of a water temperature greater than 73.4 deg F, multiply the normal pressure rating by the appropriate factor from table.

Friction losses. For design purposes, friction head losses shall be no less than those computed by the Hazen-Williams equation, using a roughness coefficient, c, equal to 150.

Flow velocity. The full-pipe design water velocity in the pipeline when operating at system capacity should not exceed 5 ft/s.

Capacity. The design capacity of the pipeline shall be based on whichever of the following criteria requires the larger amount of water:

1. The capacity shall be sufficient to deliver the volume of water required to meet the peak-period consumptive use of the crop or crops to be irrigated.
2. The capacity shall be sufficient to provide an adequate irrigation stream for all methods of irrigation planned.

Outlets. Appurtenances to deliver water from the pipe system to the land, to a ditch or a reservoir, or to any surface pipe system shall be known as outlets. Outlets shall have adequate capacity at design working pressure to deliver the required flow to (1) the hydraulic gradeline of a pipe or ditch, (2) a point at least 6 in above the field surface, or (3) the design surface elevation in a reservoir.

Check valves. A check valve shall be installed between the pump discharge and the pipeline if backflow may occur.

Stands open to the atmosphere. Stands shall be used wherever water enters the pipeline system to avoid entrapment of air, to prevent surge pressures, to avoid collapse because of negative pressures, and to prevent the pressure from exceeding the maximum allowable working pressure of the pipe. Open stands may be required at other locations in low-head systems to perform other functions. Stands shall be constructed of steel pipe or other approved material and be supported on a base adequate to support the stand and prevent movement or undue stress on the pipeline. Open stands shall be designed to meet or exceed the following criteria:

1. Each stand shall allow at least 1 ft of freeboard above design working head. The stand height above the centerline of the pipeline shall be such that neither the static head nor the design working head plus freeboard exceeds the allowable working pressure of the pipe.
2. The top of each stand shall extend at least 4 ft above the ground surface except for surface gravity inlets or where visibility is not a factor. Gravity inlets shall be equipped with a trash guard.
3. The downward water velocity in stands shall not exceed 2 ft/s. The inside diameter of the stand shall not be less than the inside diameter of the pipeline. This downward velocity criterion applies only to stands having vertical offset inlets and outlets.
4. If the water velocity in the inlet (from the pump or other water source) equals or exceeds three times the velocity in the outlet pipeline, the centerline of the inlet shall have a minimum vertical offset from the centerline of the outlet at least equal to the sum of the diameters of the inlet and outlet pipes.
5. The cross-sectional area of stands may be reduced above a point 1 ft above the top of the upper inlet or outlet pipe, but the reduced cross section shall not be such that it would produce an average velocity of more than 10 ft/s if the entire flow were discharging through it.
6. Vibration-control measures, such as special couplers or flexible pipe, shall be provided as needed to insure that vibration from pump discharge pipes is not transmitted to stands.

Sand traps, when combined with a stand, shall have a minimum inside dimension of 30 in and shall be constructed so that the bottom is at least 24 in below the invert of the outlet to the pipeline. The downward velocity of flow of the water in a sand trap shall not exceed 0.25 ft/s.

Gate stands shall be of sufficient dimension to accommodate the gate or gates and shall be large enough to make the gates accessible for repair.

Float valve stands shall be large enough to provide accessibility for maintenance and to dampen surge.

Stands closed to the atmosphere. If pressure-relief valves and air-and-vacuum valves are used instead of open stands, all requirements under "Stands Open to the Atmosphere" shall apply except as modified below.

The inside diameter of the closed stand shall be equal to or greater than that of the pipeline for at least 1 ft above the top of the uppermost inlet or outlet pipe. To facilitate attaching the pressure-relief valve and the air-and-vacuum valve, the stand may be capped at this point or, if additional height is required, the stand may be extended to the desired elevation by using the same inside diameter or a reduced cross section. If a reduced section is used, the cross-sectional area shall be such that it would produce an average velocity of no more than 10 ft/s if the entire flow were discharged through it. If no vertical offset is required between the pump discharge pipe and the outlet pipeline and the discharge pipe is "doglegged" below ground, the stand shall extend to at least 1 ft above the highest part of the pump discharge pipe.

An acceptable alternative design for stands requiring no vertical inlet offset (when inlet velocity is less than three times that of the outletting pipeline) shall be:

1. Construct the dogleg section of the pump discharge pipe with the same nominal diameter as that of the pipeline.
2. Install the pressure-relief valve and the air-and-vacuum valve on top of the upper horizontal section of the dogleg.

Pressure-relief and air-and-vacuum valves shall be installed on stands with nominal size pipe required to fit the valves' threaded inlets.

Vents. Vents must be designed into systems open to the atmosphere to provide for the removal and entry of air and protection from surge. They shall:

1. Have a minimum freeboard of 1 ft above the hydraulic gradeline. The maximum height of the vent above the centerline of the pipeline must not exceed the maximum allowable working pressure of the pipe.
2. Have a cross-sectional area at least one-half the cross-sectional area of the pipeline (both inside measurements) for a distance of at least one pipeline diameter up from the centerline of the pipeline. Above this elevation the vent may be reduced to 2 in. in diameter.

   These cross-sectional requirements shall apply when an air-and-vacuum valve is used instead of a vent, but the reduced section shall be increased to the nominal size pipe required to fit the valve's threaded inlet. An acceptable alternative is to install this valve in the side of a service outlet, provided that the riser is properly located and adequately sized. If both an air-and-vacuum valve and a pressure-relief valve are required at the location, the 10-ft/s velocity criterion given under "Stands Open to the Atmosphere" shall apply to the reduced section.
3. Be located at the downstream end of each lateral, at summits in the line, and at points where there are changes in grade in a downward direction of flow of more than 10 degrees.

Air-and-vacuum valves. An air-and-vacuum valve, which has a large venting orifice, exhausts large quantities of air from the pipeline during filling operations and allows air to reenter the line and prevents a vacuum from forming during emptying operations. This type of valve is sometimes called air-vacuum valve or air vent and vacuum-relief valve. It is not continuous acting because it does not allow further escape of air at working pressure once the valve closes.

Air-and-vacuum valves installed according to the standards for "Vents" can be used instead of open vents at any or all the locations listed in (3) under "Vents."

Air-and-vacuum valves installed according to the standards for "Stands Closed to the Atmosphere" can be used in conjunction with pressure-relief valves as an alternative to open pump stands. A pipeline is considered open to the atmosphere if at least one stand, vent, or service outlet is unclosed and located so that it cannot be isolated from the system by line gates or valves.

The diameter of the orifice (opening that controls air flow during filling and emptying operations) of an air-and-vacuum valve shall equal or exceed that specified below for the appropriate diameter of pipeline.

Diameter of orifice	Diameter of pipeline
(in)	(in)
3/4	4
1 1/4	6
1 3/4	8
2 1/4	10
2 3/4	12
3 1/4	14
3 1/2	15
3 3/4	16
4	18

Manufacturers of air-and-vacuum valves marketed for use under this standard shall provide dimensional data, which shall be the basis for selecting and accepting these valves.

Pressure-relief valves. Pressure-relief valves can be used on low-pressure plastic pipelines as an alternative to stands open to the atmosphere. A pressure-relief valve shall serve the pressure-relief function of the open stand or vent for which it is an alternative.

Pressure-relief valves do not function as air-release valves and shall not be used as substitutes for such valves if release of entrapped air is required. Pressure-relief valves shall be used in conjunction with air-and-vacuum valves at all pump stands and at the end of pipelines if needed to relieve surge at the end of the lines.

The flow capacity of pressure-release valves shall be the pipeline design flow rate with a pipeline pressure no greater than 50 percent more than the permissible working pressure for the pipe.

The pressure at which the valve starts to open shall be marked on each pressure-relief valve. Adjustable pressure-relief valves shall be sealed or otherwise altered to insure that the adjustment marked on the valve is not changed.

Manufacturers of pressure-relief valves marketed for use under this standard shall provide capacity tables, based on performance tests, that give the discharge capacity of the valves at the maximum permissible pressure and differential pressure settings. Such tables shall be the basis for design of pressure setting and for acceptance of these valves.

Drainage. Provisions shall be made for completely draining the pipeline if a hazard is imposed by freezing temperatures, drainage is recommended by the manufacturer of the pipe, or drainage of the line is specified for the job. If provisions for drainage are required, drainage outlets shall be located at all low places in the line. These outlets can drain into dry wells or to points of lower elevation. If drainage cannot be thus provided by gravity, provisions shall be made for emptying the line by pumping or by other means.

Flushing. If provisions are needed for flushing the line free of sediment or other foreign material, a suitable valve shall be installed at the distal end of the pipeline.

Thrust control. Anchors or thrust blocks shall be provided on pipelines having a working pressure of 25 lb/in^2 or greater at abrupt changes in pipeline grade, changes in horizontal alinement, or reduction in pipe size to absorb any axial thrust of the pipeline. Thrust blocks may also be needed at the end of the pipeline and at inline control valves.

The pipe manufacturer's recommendations for thrust control shall be followed. In absence of such recommendations, the following formula should be used to design thrust blocks:

$$A = \frac{98\,HD^2}{B} \sin\frac{a}{2}$$

Where:

- A = Bearing area of thrust block required in ft^2
- H = Maximum working pressure in ft
- D = Inside diameter of pipe in ft
- B = Allowable passive pressure of the soil in lb/ft^2
- a = Deflection angle of pipe bend

Area of thrust blocks for dead ends and tees shall be 0.7 times the area of block required for a 90 degree deflection angle of pipe bend.

If adequate soil tests are not available, the allowable bearing soil pressure can be estimated from table 2.

Materials. All materials described and required in this standard shall meet or exceed the minimum requirements listed for materials under "Specifications."

Plans and specifications

Plans and specifications for constructing low-pressure, underground, plastic irrigation pipelines shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purposes.

Table 2.—Allowable soil bearing pressure

Natural soil material	Depth of cover to center of thrust block			
	2 ft	3 ft	4 ft	5 ft
	lb/ft²			
Sound bedrock	8,000	10,000	10,000	10,000
Dense sand and gravel mixture (assumed θ = 40°)	1,200	1,800	2,400	3,000
Dense fine to coarse sand (assumed θ = 35°)	800	1,200	1,650	2,100
Silt and clay mixture (assumed θ = 25°)	500	700	950	1,200
Soft clay and organic soils (assumed θ = 10°)	200	300	400	500

Irrigation Water Conveyance

Low-Pressure, Underground, Plastic Pipeline Specifications

Installation

Minimum depth of cover. Pipe shall be installed at sufficient depth below the ground surface to provide protection from hazards imposed by traffic crossing, farming operations, freezing temperatures, or soil cracking. The minimum depth of the cover shall be 30 in, but in soils subject to deep cracking, the cover shall be a minimum of 36 in. The maximum depth of cover for all pipe sizes shall be 4 ft.

In areas where the pipe will not be susceptible to freezing and vehicular or cultivation hazards and the soils do not crack appreciably when dry, the minimum depth of cover may be reduced to 18 in for pipes 4 in through 6 in. in diameter and 24 in for pipes more than 6 in. in diameter.

At low places on the ground surface, extra fill may be placed over the pipeline to provide the minimum depth of cover. The top width of the fill shall be no less than 10 ft and the side slopes no steeper than 6 horizontal to 1 vertical. The fill material shall be placed and compacted before the trench is excavated. If extra protection is needed at vehicular crossings, encasement pipe or other approved methods may be used.

Trench construction. The trench at any point below the top of the pipe shall be only wide enough to permit the pipe to be easily placed and joined and to allow the initial backfill material to be uniformly placed under the haunches and along the side of the pipe. The maximum trench width shall be 30 in greater than the diameter of the pipe. If the trench is precision excavated and has a semicircular bottom that closely fits the pipe, the width shall not exceed the outside diameter of the pipe by more that 10 percent.

The trench bottom shall be uniform so that the pipe lies on the bottom without bridging. Clods, rocks, and uneven spots that can damage the pipe or cause nonuniform support shall be removed.

If there are rocks, boulders, or any other material that might damage the pipe, the trench bottom shall be undercut a minimum of 4 in below final grade and filled with bedding material consisting of sand or compacted fine-grained soils.

Provisions shall be made to insure safe working conditions if unstable soil, trench depth, or other conditions can be hazardous to personnel working in the trench.

Placement. Care shall be taken to prevent permanent distortion and damage when handling the pipe during unusually warm or cold weather. The pipe shall be allowed to come within a few degrees of the temperature it will have after it is completely covered before placing the backfill, other than that needed for shading, or before connecting the pipe to other facilities. The pipe shall be uniformly and continuously supported over its entire length on firm stable material. Blocking or mounding shall not be used to bring the pipe to final grade.

For pipe with belled ends, bell holes shall be excavated in the bedding material, as needed, to allow for unobstructed assembly of the joint and to permit the body of the pipe to be in contact with the bedding material throughout its length.

Joints and connections. All joints and connections shall be capable of withstanding the design maximum working pressure for the pipeline without leakage and shall leave the inside of the line free of any obstruction that can reduce its capacity below design requirements.

All fittings, such as couplings, reducers, bends, tees, and crosses, shall be installed according to the recommendations of the pipe manufacturer.

Fittings and appurtenances made of steel or other metals susceptible to corrosion shall be adequately protected by wrapping them with plastic tape or applying a coating having high corrosion-preventative qualities. If plastic tape is used, all surfaces shall be thoroughly cleaned and then coated with a primer compatible with the tape before wrapping them.

Thrust blocks. Thrust blocks must be formed against solid unexcavated earth undamaged by mechanical equipment. They shall be constructed of concrete, and the space between the pipe and the trench wall shall be filled to the height of the outside diameter of the pipe or as specified by the manufacturer.

Testing. The pipeline shall be thoroughly and completely tested at the design pressure for pressure strength and leakage while uncovered or only partly backfilled. If it is necessary to partly backfill the line before testing to hold the pipeline in place, backfilling shall be according to the specifications under "Initial Backfill." All joints and connections shall be left uncovered for inspection; only the body of the pipe sections shall be covered.

The line shall be slowly filled with water. Adequate provision shall be made for air release during filling operations, taking care to bleed all entrapped air. The pressure shall be slowly built up to the maximum design working pressure of the system. While this pressure is maintained, all exposed pipe, fittings, valves, hydrants, joints, appurtenances, and covered parts of the line shall be examined for leaks. Any leaks shall be repaired and the system retested.

It shall be demonstrated by testing that the pipeline will function properly at design capacity. At or below design capacity there shall be no objectionable flow conditions such as water hammer, continuing unsteady delivery of water, damage to the pipeline, or detrimental discharge from control valves, vents, or stands.

Initial backfill. The pipeline shall be filled with water and maintained near design working pressure during backfilling.

The initial backfill material shall be selected soil or sand free from rocks or stones larger than 1 in. in diameter and earth clods greater than about 2 in. in diameter. The material shall be placed so that the pipe will not be displaced, excessively deformed, or damaged.

Water packing shall be used when possible to consolidate the initial backfill around the pipe. The initial backfill, before wetting, shall be of sufficient depth to insure complete coverage of the pipe after consolidation occurs. Water packing is accomplished by adding enough water to diked reaches of the trench to saturate the initial backfill thoroughly without excessive pooling. After the initial fill is saturated, the pipeline shall remain full until after final backfilling. The waterpacked backfill shall be allowed to dry until firm enough to walk on before final backfill is begun.

If conditions do not permit water packing, the initial backfill shall be placed in layers and compacted around and about 6 in above the pipe by hand or mechanical methods to the soil density required to provide adequate lateral support to the pipe.

An exception to water packing or to compacting the initial backfill completely is permitted if the trench is precision excavated and has a semicircular bottom that closely fits the pipe and the width does not exceed the outside diameter of the pipe by more than 10 percent. With this type of trench construction, all other initial and final backfill requirements shall apply, including having the pipe under water pressure during backfilling.

Final backfill. Final backfill material shall be free of large rocks, frozen clods, and other debris greater than 3 in. in diameter. The material shall be placed and spread in approximately uniform layers so that there will be no unfilled spaces in the backfill and the backfill will be level with the natural ground or at the design grade required to provide the minimum depth of cover after settlement takes place. Rolling equipment shall not be used to consolidate the final backfill.

All special backfilling recommendations of the pipe manufacturer shall be met.

Basis of acceptance. The acceptability of the pipeline shall be determined by inspections to check compliance with all the provisions of this standard, including the design of the line, the pipe and pipe markings, the appurtenances, and the minimum installation requirements.

Certification and guarantee. If requested by the state conservation engineer, the manufacturer shall certify that the pipe meets the requirements specified in this standard.

The installing contractor shall certify that the installation complies with the requirements of this standard and shall furnish a written guarantee that protects the owner against defective workmanship and materials for not less than 1 year and that identifies the manufacturer and markings of the pipe used.

Materials

Quality of plastic pipe. The compound used in manufacturing low-pressure plastic irrigation pipe shall meet the requirements of one of the following materials and have an established long-term hydrostatic design stress rating as listed:

Polyvinyl chloride (PVC) as specified in ASTM-D-1784

Material	Code classification	Hydrostatic design stress	Designation
		lb/in²	
Type I, Grade 1	12454-B	2,000	PVC 1120
Type I, Grade 2	12454-C	2,000	PVC 1220
Type II, Grade 1......................	14333-D	1,000	PVC 2110
Type II, Grade 1......................	14333-D	1,250	PVC 2112
Type II, Grade 1......................	14333-D	1,600	PVC 2116

Acrylonitrile-butadiene-styrene (ABS) as specified in ASTM-D-1788

Material	Code classification	Hydrostatic design stress	Designation
		lb/in²	
Type I, Grade 2	5-2-2	1,000	ABS 1210
Type I, Grade 3	3-5-5	1,600	ABS 1316
Type II, Grade 1......................	4-4-5	1,250	ABS 2112

Polyethylene (PE) as specified in ASTM-D-1248

Material	Code classification	Hydrostatic design stress	Designation
		lb/in²	
Grade P23, Class C	IIC-P23	630	PE 2306
Grade P33, Class C	IIC-P33	630	PE 3306
Grade P34, Class C	IVC-P34	630	PE 3406

Clean rework material, generated from the manufacturer's own pipe production, may be used by the same manufacturer if the pipe produced meets all requirements of this standard.

The pipe shall be homogeneous throughout and free from visible cracks, holes, foreign matter, or other defects. The pipe shall be as uniform in color, opacity, density, and other physical properties as is commercially practicable.

Pipe requirements. Plastic irrigation pipe (PIP) installed under this standard shall be classified in one of the following categories:

1. Low-head irrigation pipe shall meet the applicable dimensional requirements listed in table 3. The maximum working pressure for this pipe shall be 50 ft of head or 22 lb/in².
2. 50-lb/in² plastic irrigation pipe shall meet the dimensional requirements listed in table 4 for the appropriate PVC and ABS plastic materials. The maximum allowable working pressure for this pipe shall be 50 lb/in².

In addition, the pipe shall meet the requirements specified in the sections of the ASTM designations listed below, except that the dimensions and tolerances in tables 3 and 4 of this standard shall apply.

1. For PVC pipe, ASTM-D-2241 sections pertaining to dimensions and tolerances, flattening, extrusion quality, conditioning, test conditions, and sampling.
2. For ABS pipe, ASTM-D-2282 sections pertaining to dimensions and tolerances, conditioning, test conditions, and sampling.
3. For PE pipe, ASTM-D-2239 sections pertaining to dimensions and tolerances, bond, carbon black, density, conditioning, test conditions, and sampling.

IPS-size pipe (outside diameter same as that for iron pipe sizes) manufactured, tested, and marked according to one of the following ASTM specifications and having a pressure rating for water of at least 50 lb/in^2 but less than 80 lb/in^2 shall be acceptable under this standard. However, the maximum operating pressure for such pipe shall be 50 lb/in^2.

ASTM—	Standard specification for—
D-1785	Polyvinyl chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120.
D-2241	Polyvinyl chloride (PVC) Plastic Pipe, (SDR-PR).
D-2672	Bell-End Polyvinyl chloride (PVC) Plastic Pipe.
D-1527	Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe, Schedules 40 and 80.
D-2104	Polyethylene (PE) Plastic Pipe, Schedule 40.
D-2447	Polyethylene (PE) Plastic Pipe, Schedules 40 and 80. Based on outside diameter.

Markings. Markings on the pipe shall include the following, which shall be spaced at intervals of not more than 5 ft:

1. Nominal pipe size (for example, 10 in).
2. Type of plastic material according to the designation code (for example, PVC 1120).
3. Maximum allowable working pressure:
   a. For low-head plastic irrigation pipe (50-ft head or 22 lb/in^2).
   b. For the 50-lb/in^2 plastic irrigation pipe (50 lb/in^2).
   c. For IPS pipe, the appropriate pressure rating (for example, 63 lb/in^2).
4. Specification designation with which pipe complies
   a. For plastic irrigation pipe, the designation PIP.
   b. For IPS-size pipe, the ASTM designation (for example, D-2241).
5. Manufacturer's name (or trademark) and code.

Fittings and couplers. All fittings and couplers shall equal or exceed the same pressure rating of the pipe with which they are used. They shall be made of material that is recommended for use with the pipe.

The pipe shall be furnished with belled ends or separate couplers and fittings that are suitable for joining the pipe and appurtenances by means of a solvent cement joint, rubber gasket-type joint, or other methods recommended by the pipe manufacturer. Belled ends, sleeves, or plastic fittings shall be made of the same type of plastic material as the pipe.

Fittings or belled ends for solvent cement joints shall have tapered sockets with socket lengths of at least 40 percent of the inside diameter of the pipe or 3 in, whichever is greater. Sleeves for clamp-type joints shall provide a minimum of 4 in overlap between the sleeve and the pipe or fitting.

Solvent cement joints. Solvent for solvent cement joints shall conform to ASTM specifications D-2564 for PVC pipe and fittings and D-2235 for ABS pipe and fittings.

Rubber gasket joints. Rubber gasket joints shall conform to the following:

1. Push-on type—A joint in which an elastomeric ring gasket is compressed in the annular space between a belled end or socket and spigot end of pipe.
2. Mechanical joint—A joint in which a seal or gasket is compressed by application of pressure through a mechanical device. The pipe spigot shall have a wall thickness sufficient to withstand, without deformation or collapse, the compressive force exerted when the fitting is tightened.

Table 3.—Dimensions of low-head plastic irrigation pipe (PIP)

Nominal size	PVC and ABS materials				PE materials			
	Outside diameter		Wall thickness		Inside diameter		Wall thickness	
	Average	Tolerance	Minimum	Tolerance	Average	Tolerance	Minimum	Tolerance
in	in				in		in	
4	4.13	±0.009	0.065	+0.020	4.00	±0.020	0.065	+0.020
6	6.14	±.011	.070	+.020	7.00	±.025	.095	+.020
8	8.16	±.015	.080	+.020	8.00	±.040	.120	+.020
10	10.20	±.015	.100	+.020	10.00	±.040	.135	+.020
12	12.24	±.015	.120	+.020	12.00	±.040	.155	+.020
14	14.28	±.015	.140	+.020	14.00	±.040	.185	+.022
15	15.30	±.015	.150	+.020	15.00	±.040	.200	+.024
18	18.70	±.028	.200	+.024				
21	22.04	±.033	.236	+.028				
24	24.80	±.037	.268	+.032				

Table 4.—Dimensions of 50-lb/in² PVC and ABS plastic irrigation pipe (PIP)

Nominal size	Outside diameter		Wall thickness				
	Average	Tolerance	Allowance	PVC 1120 PVC 1220	PVC 2116 ABS 1316	PVC 2112 ABS 2112	PVC 2110 ABS 1210
in	in	in		in	in	in	in
4	4.13	±0.009	Minimum	0.065	0.065	0.081	0.101
			tolerance	+.020	+.020	+.020	
6	6.14	±.011	Minimum	.078	.096	.120	.150
			tolerance	+.020	+.020	+.020	+.020
8	8.16	±.015	Minimum	.101	.128	.160	.199
			tolerance	+.020	+.020	+.020	+.024
10	10.20	±.015	Minimum	.126	.159	.200	.249
			tolerance	+.020	+.020	+.024	+.030
12	12.24	±.015	Minimum	.151	.191	.240	.299
			tolerance	+.020	+.023	+.029	+.036
14	14.28	±.015	Minimum	.176	.223	.280	.348
			tolerance	+.021	+.027	+.034	+.042
15	15.30	±.015	Minimum	.189	.239	.300	.373
			tolerance	+.023	+.029	+.036	+.045
18	18.70	±.028	Minimum	.230	.292	.367	.456
			tolerance	+.027	+.033	+.042	+.054

3. Dimensions of the coupling and spigot end shall be according to the manufacturer's standard design dimensions and tolerances. Such dimensions shall be gaged at sufficiently frequent intervals to insure dimensional control and satisfactory joint assembly. The method for measuring these dimensions shall be according to Method D–2122.
4. Gasket dimensions shall be according to the manufacturer's standard design dimensions and tolerances. The size and shape of the gasket must insure an adequate compressive force against the spigot and socket after assembly to effect a positive seal under all combinations of joint and gasket tolerances when tested according to Items 12 and 13.
5. Elastomeric compounds must be noncrazing to pipe. The gasket in the cured state shall not cause craze marks, pits, or blisters when in contact with the plastic pipe. The plastic pipe can be stained in the area of gasket contact.
6. Lubricant, if required, shall be suitable for lubricating the parts of the joints in the assembly. The lubricant shall have no deteriorating effects on the gasket and pipe materials.
7. The joint shall be designed to provide a permanent seal.
8. The gasket shall be the sole element depended upon to make the joint flexible and watertight. The gasket shall be a continuous elastomeric ring.
9. The joint design may provide for the axial deflection of a pipe joint by permitting one side of the outside perimeter of the joint to open wider than the compressed position without reducing its watertightness. If greater deflections than provided by the joint design are required, suitable fittings must be provided.
10. The joint components shall be of such design that they will withstand the forces caused by the compression of the gasket when joined without cracking or fracturing when tested according to Items 12 and 13.
11. All surfaces of the joint upon or against which the gasket may bear shall be smooth, free of cracks, fractures, or imperfections that could adversely affect the performance of the joint.
12. Pipes in straight alinement—Laboratory hydrostatic pressure tests on joints shall be made on an assembly of two sections of pipe properly connected according to the joint design. After the pipe sections are fitted together with the gasket or gaskets in place, the assembly shall be subjected for the minutes shown to an internal hydrostatic pressure of:

	min.
0 pressure	5
1/4 working pressure	5
1/2 working pressure	5
3/4 working pressure	5
1.0 working pressure	10
2-1/2 working pressure	60

13. Pipes in maximum deflected position—Using a pipe and joint system, similar to that described in 12, deflect the test sections axially to the maximum deflection specified by the manufacturer and subjected to the pressures indicated under 12.
14. Two specimens of any one size shall pass the tests. Retest of two other specimens shall be required if one of the first two fails. Three of the four shall pass the tests.