# NATURAL RESOURCES CONSERVATION SERVICE
# CONSERVATION PRACTICE STANDARD

## IRRIGATION WATER CONVEYANCE

## LOW PRESSURE, UNDERGROUND, PLASTIC PIPELINE
**(Ft)**

**CODE 430EE**

### DEFINITION

A pipeline and appurtenances installed in an irrigation system.

### SCOPE

This standard applies to underground thermoplastic pipelines from 4 to 18 in. in diameter ***which are closed to the atmosphere*** and are subject to internal pressures up to 50 lb/in.$^2$.

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

The purpose of this practices is

- to prevent erosion or loss of water quality or damage to the land,
- to make possible the proper management of irrigation water ***including wastewater***
- 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.

### PLANNING CONSIDERATIONS

#### *Water Quantity*

The following water quantity items should be considered for planning.

1. Effects on the water budget, especially on infiltration and evaporation.
2. Effects on downstream flows or aquifers that would affect other water uses or users.
3. Potential use for irrigation water management.
4. Effects of installing a pipeline on vegetation that may have been located next to the original conveyance.

#### *Water Quality*

The following water quality items should be considered during planning.

1. Effects of installing the pipeline (replacing other types of conveyances) on channel

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erosion or the movement of sediment and soluble and sediment-attached substances carried by water.

2. Effects on the movement of dissolved substances into the soil, percolation below the root zone or to ground water recharge.
3. Effects of controlled water delivery on the temperatures of water resources that could cause undesirable effects on aquatic and wildlife communities.
4. Effects on wetlands or water-related wildlife habitats.
5. Effects on the visual quality of water resources.

**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 or head or 22 lb\in.$^2$.

Pipelines constructed of 50-lb/in.$^2$ plastic irrigation pipe or the IPS pipe covered by this standard shall have a working pressure no greater than 50 lb\in.$^2$.

Plastic pipeline requiring a working pressure greater than 50 lb/in.$^2$ 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 temperature ***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.

***Mainlines and submains. Mainlines and submains (including manifolds) are generally buried PVC plastic pipe. Laterals or feeder lines need to be installed as nearly level as possible. On sloping fields submains and mainlines should be installed up and down the slope. Typically water is dispensed thru emitters to the plant under low pressure (5 to 20 lb./in^2) in a predetermined pattern. Therefore, a 5 foot elevation change represents over 2.1 lb./in^2 pressure change, which can change emitter discharge more than the allowable 10 percent in low pressure systems. To maintain uniform pressure at outlets to laterals consider***

- ***Dividing submains into shorter lengths or off balance the outlets so less than a 10 foot drop is present between the inlet from the mainline and lowest outlet to a lateral pipeline.***

- ***Install pressure regulators at each outlet to laterals.***
- ***Use pressure compensating emitters where needed.***
- ***Provide adequate pressure to operate pressure and flow regulators at design discharge.***

**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 in 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 free-board 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 of 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-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 discharge 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 a least 1 ft. above the highest part of the pump discharge pipe.

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

1. Construct the dogleg section of the pump discharge pipe with the same nominal diameters as that of the pipeline.
2. Install the pressure-relief valve and the air- and vacuum valve on top 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)* |
| ¾ | | 4 |
| 1¼ | | 6 |
| 1¾ | | 8 |
| 2¼ | | 10 |
| 2¾ | | 12 |
| 3¼ | | 14 |
| 3½ | | 15 |
| 3¾ | | 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 of 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 manufacture 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 alignment, 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.

***Thrust blocks shall be installed for***

- ***all rubber gasket joints regardless of pipe diameter or operating pressures.***
- ***solvent welded pipelines less than 6 inches in diameter and where the operating pressure is equal or greater than 50% of the pressure rating of the pipe.***
- ***all solvent welded pipelines with a diameter of 6 inch or greater.***

***Thrust blocks shall be installed where the pipeline***

- ***changes direction of water flow (i.e., elbows, crosses, wyes and tees).***
- ***size changes (i.e., reducers, reducing tees and crosses).***
- ***ends (i.e., caps and plugs).***
- ***has an in-line control valve.***

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

Table 2.—Allowable soil bearing pressure

***Refer to American Standards of Agricultural Engineers (ASAE) S376.1 Design, Installation and Performance of Underground Thermoplastic Irrigation Pipelines for additional guidance.***

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:

$A = ((98\ HD^2)/B)\sin(a/2)$

Where:

A = Area of thrust block required
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 90º 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 purpose.

***OPERATION AND MAINTENANCE***

***An O&M plan shall be provided to the landowner. The plan shall include, but not limited to, the following provisions:***

- ***Inspecting for breaks and leaks;***
- ***Inspecting and testing of pressure relief and air release valves, pressure regulators, pumps, switches and other appurtenances for proper funcitoning;***
- ***Checking for debris, minerals, algae and other materials which may restrict system flow; and***
- ***Draining and/or providing for cold weather operation of the system.***
- ***Prompt repair of leaks and breaks to prevent water loss and possible contamination of surface and ground water.***

***REFERENCES***

***NRCS Construction Specifications for High Pressure, Underground plastic Pipeline, Code CS430EE***

***650.15 Engineering Field Handbook, Chapter 15, Irrigation***

# *Construction Specifications*

## *Irrigation Water Conveyance Low-Pressure, Underground, Plastic Pipeline*

## *CODE 430 EE*

***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 cover for pipe susceptible to any of these hazards shall be: _____***

| *Pipe diameter (in.)* | *Cover depth (in.)* |
|---|---|
| *1/2 through 2-1/2* | *24* |
| *3 through 5* | *30* |
| *6 or more* | *30* |

***The minimum depth of cover shall be 24" but in soils subject to excessive freezing temperatures depth of cover shall be a minimum of 30" in the southern area of WV or 40" in northern WV or higher elevations of WV.***

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

***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 sides of the pipe. The maximum trench width should not exceed 2 feet wider than the pipe diameter. The trench bottom shall be uniform and a continuous grade so that the pipe lies on the bottom without bridging. Clods, rocks and uneven spots that can damage the pipe or cause non-uniform support shall be removed.***

***If there are rocks, boulders or other material that might damage the pipe, the trench bottom shall be undercut a minimum of 4" below the 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 pipe during unusually warm or cold weather. The pipe shall be allowed to come within a few degrees of the trench temperature, prior to placing the backfill over the pipe. The pipe shall be uniformly and continuously supported over its entire length on firm stable material. The use of blocking or mounding material shall not be permitted 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 the capacity below design requirements.***

***All fittings, such as couplings, reducers, bends, tees and crosses shall be protected from corrosive soils, if needed, and installed according to the recommendations of the pipe manufacturer.***

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

***Thrust blocks. Thrust blocks must be formed against a solid hand-excavated trench wall undamaged by mechanical equipment. They shall be constructed of concrete and the space between the pipe and trench wall shall be filled to the height of the outside diameter of the pipe plus 6 inches or as specified by the pipe's manufacture.***

***Testing. The pipeline shall be tested for pressure strength, leakage, and proper functioning. The tests may be performed before backfilling or anytime after the pipeline is ready for service.***

***Tests for pressure strength and leaks shall be accomplished by inspecting the pipeline and appurtenances while the maximum working pressure is maintained and all joints and connections are uncovered, or by observing normal operation of the pipeline after it is put into service. Partial backfills needed to hold the pipe in place during testing shall be placed as specified in "Initial Backfill. Any leaks shall be repaired and the system retested.***

***The pipeline shall be tested to insure that it functions 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.***

***Initial Backfill. Hand, mechanical or water packing methods may be used.***

***The initial backfill material shall be soil or sand that is free from rocks or stones larger than one inch in diameter. At the time of placement, the moisture content of the material shall be such that the required degree of compaction can be obtained with the backfill method used. This initial backfill material shall be placed so that the pipe will not be displaced, excessively deformed or damaged.***

***If backfilling is done by hand or mechanical means, the initial fill shall be compacted firmly around and above the pipe as required to provide adequate lateral support to the pipe.***

***If the water packing method is used, the pipeline first shall be filled with water. The initial backfill before wetting, shall be of sufficient depth to insure complete coverage of the pipe after consolidation. Water packing is accomplished by adding water to the diked reaches of the trench in sufficient quantity to thoroughly saturate the initial backfill without excessive pooling of water. After the backfill is saturated, the pipeline shall remain full until after the final backfill is make. The wetted fill shall be allowed to dry until firm before beginning the final backfill.***

***Final backfill. The final backfill material shall be free of large rocks, frozen clods and other debris greater than 3 inches 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. Rolling equipment shall not be used to consolidate the final backfill until the specified minimum depth of cover has been placed.***

***All special backfilling requirements 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 with respect to the design of the line, the pipe, and pipe marking, the appurtenances, and the minimum installation requirements.***

***Certifications and guarantee. All material shall be certified with supporting test results or markings stating that the pipe meets the requirements specified in ths standard.***

***The installation contractor shall certify and provide a written guarantee that the installation complies with the requirements***

*of this standard. The certification shall identify the manufacturer, material and markings of the pipe used.*

*MATERIALS*

*Quality of plastic pipe. The compound used in manufacturing the pipe shall meet the requirements of the following materials outlined in Table 1,2 or 3.*

*Table 1. Polyvinyl chloride (PVC) as specified in ASTM-D-1784.*

| Material | Designation | Code Classification |
|---|---|---|
| Type I, Grade 1 | PVC 1120 | 12454-B |
| Type II, Grade 2 | PVC 1220 | 12454-C |
| Type II, Grade 1 | PVC 2110 | 14333-D |
| Type II, Grade 1 | PVC2112 | 14333-D |
| Type II, Grade 1 | PVC 2116 | 14333-D |

*Table 2. Acrylonitrile-butadiene-styrene (ABS) as specified in ASTM-D-1788.*

| Material | Designation | Code Classification |
|---|---|---|
| Type I, Grade 2 | ABS 1210 | 5-2-2 |
| Type I, Grade 3 | ABS 1316 | 3-5-5 |
| Type II, Grade 2 | ABS 2112 | 4-4-5 |

*Table 3. Polyethylene (PE) as specified in ASTM-D-1248.*

| Material | Designation | Code Classification |
|---|---|---|
| Grade P23, Class C | PE 2306 | IIC-P23 |
| Grade P33, Class C | PE 3306 | IIC-P33 |
| Grade P34, Class C | PE 3406 | IVC-P34 |

*The pipe shall be homogeneous through out and free of defects such as visible cracks, holes, foreign matter or deformation. 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 1, 2 or 3. The maximum working pressure for this pipe shall be 50 ft. of head or 22 lb. /in$^2$.*
2. *For PE pipe, ASTM-D-282 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-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. and markings shall include*

*1.0 Nominal pipe size (for example, 12 in.)*

*2.0 type of plastic material according to the designation code (for example, PVC 1120).*

*3.0 Maximum allowable working pressure:*

*a. For low-head plastic irrigation pipe (50 ft. head or 22 lb. /in$^2$.*

*b. For 50 lb. /in$^2$. plastic irrigation pipe (50 lb. /in$^2$.)*

*c. For IPS pipe, the appropriate pressure rating (for example, 63 lb. /in$^2$.*

*4.0 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).*

*5.0 Manufactures 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 couples 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., which ever is greater. Sleeves for clamp-type joints shall provide a minimum of 4 inches overlap between the sleeve and the pipe or fitting.*

*Solvent cement joints. Solvent for solvent cement joints shall conform to ASTM specification 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.*
3. *Dimensions of the coupling and spigot end shall be according to the manufacturer's standard design dimensions and tolerances. Such dimensions shall be gauged at sufficiently frequent intervals to insure dimensional control and satisfactory joint assembly. The method for measuring these dimensions shall be according to ASTM 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 affect a positive seal under all combinations of joint and gasket tolerances when tested according to items 12 and 13.*

5. ***Elastomeric compounds must be non-crazing 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 water tightness. 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 within joints 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 alignment shall have laboratory hydrostatic pressure tests on joints. Tests 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***

***0 pressure…….. 5 min.***

***1/4 x working pressure ...5 min.***

***1/2 x working pressure .. 5 min.***

***3/4 x working pressure…..5 min.***

***1.0 x working pressure.10 min.***

***2.5 x working pressure ..60 min.***

***13. Pipes in maximum deflected position are tested 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 pipe sections of a any one pipe size shall pass the tests. Retest of two other sections, three of four shall pass the tests.***