

**NATURAL RESOURCES CONSERVATION SERVICE  
CONSERVATION PRACTICE STANDARD**

**IRRIGATION WATER CONVEYANCE**

**HIGH-PRESSURE, UNDERGROUND, PLASTIC PIPELINE**

(ft.)  
CODE 430DD

**DEFINITION**

A pipeline and appurtenances installed in an irrigation system.

**PURPOSE**

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

**CONDITIONS WHERE PRACTICE APPLIES**

Pipelines shall be part of an irrigation water distribution or conveyance system designed to facilitate farm soil and water conservation use and management. All areas served by pipelines shall be suitable for irrigation with available water supplies.

Pipelines shall be placed only in soils where bedding and backfill requirements can be met.

**DESIGN CRITERIA**

**Laws and regulations.** This practice must conform to all federal, state, and local laws and regulations. Laws and regulations of particular concern include those involving water rights, property easements, wetlands, preservation of cultural resources, and endangered species.

Polluted liquids may not be discharged to Waters of the US at any time during start-up, operation, or shut down.

**Working pressure and flow velocity.** Pipe working pressure rating for water shall be at least 80 pounds per square inch.

As a safety factor against hydraulic transients, working pressure should not exceed 72 percent of the pipe pressure rating, and design flow velocity at system capacity should not exceed 5 feet/second. If either of these limits is exceeded, special consideration must be given to flow conditions and measures taken to adequately protect the pipeline.

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**

Degrees F	PVC	PE
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 reduced pipe pressure rating, multiply the normal pipe pressure rating by the appropriate factor from table.

**Capacity.** Pipeline design capacity shall:

1. Meet crop peak-period consumptive uses;
2. Meet applicable irrigation method needs.

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

**Outlets.** Pipes and outlets shall have capacity to deliver the design flow at operating pressure.

**Check valves.** Where backflow may occur, a check valve shall be installed between the pump discharge and pipeline.

**Pressure-relief valves.** Where excessive pressure may occur when valves are closed, install a pressure-relief valve between the pump discharge and the pipeline. Where flow reversal may occur, install pressure-relief valves on the discharge side of the check valve. Where surge may occur, install pressure-relief valves at the end of the pipeline.

Pressure-relief valves shall be no smaller than ¼-inch nominal size for each pipeline diameter inch and shall be set to open at 5 lb/in.<sup>2</sup> or less above the pipe pressure rating.

Conservation practice standards are reviewed periodically and updated if needed. The current version of this standard is posted on our web site at [www.sd.nrcs.usda.gov](http://www.sd.nrcs.usda.gov) or may be obtained at your local Natural Resources Conservation Service.

The pressure at which the valves start to open shall be marked on each pressure-relief valve. Adjustable pressure-relief valves shall be sealed or otherwise altered to prevent changing the adjustment from that marked on the valve.

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

**Air-release valves.** The three basic types of air-release valves for irrigation pipelines are:

1. An **air-release valve**, is a continuously acting valve that has a small venting orifice, generally ranging between 1/16 and 3/8 inch in size. This valve releases pockets of air from the pipeline once the line is filled and under working pressure.
2. An **air-and-vacuum valve**, has a large venting orifice, exhausts large quantities of air from the pipeline during filling and allows air to reenter the line and prevents a vacuum from forming during emptying. This valve is also called an air-vacuum-release 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 after the valve closes.
3. A **combination air valve** is sometimes called a combination air-release and air-vacuum valve or combination air-and-vacuum-relief valve. It is continuous acting and combines the functions of both the air-release valve and the air-and-vacuum valve. Both valves are housed in one valve body.

If needed to provide positive means for air escape during filling and air entry while emptying, air-and-vacuum valves or combination air valves shall be installed at all summits, at the entrance, and at the end(s) of the pipeline.

The ratio of air-release valve diameter to pipe diameter for valves intended to release air when filling the pipe should not be less than 0.1. However, small-diameter valves may be used to limit water hammer pressures by controlling air release where control of filling velocities is questionable. Equivalent valve outlet diameter may

be less than 0.1 for continuously acting air release valves. Provide adequate vacuum relief.

Air-release valve and combination air valve sizes must meet manufacturer's recommendations.

**Drainage.** Provision shall be made for draining the pipeline if a freezing hazard exists.

**Flushing.** Provisions for flushing sediment and debris, shall be installed at the distal end of the pipeline where required.

**Thrust control.** Provide needed thrust control at abrupt changes in pipeline grade, horizontal alignment, reduction in pipe size, pipeline ends, and inline control valves. Thrust blocks and anchors must withstand the forces tending to move the pipe, including momentum, pressure, expansion, and contraction.

Pipe manufacturer's recommendations for thrust control shall be followed. In absence of pipe manufacturer's requirements, use the following:

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

Where:

- A = Area of thrust block required in feet
- H = Maximum working pressure in feet
- D = Inside diameter of pipe in feet
- B = Allowable passive pressure of the soil in lb/ft<sup>2</sup>
- a = Deflection angle of pipe bend

Area of thrust blocks for dead ends and tees shall be 0.7 times the block area for a 90°-pipe angle.

If adequate soil tests are not available, the passive soil pressure may be estimated from Table 2.

**Table 2 – Allowable soil bearing pressure, lb/ft<sup>2</sup>**

Soil	Depth of cover to center of thrust			
	2 feet	3 feet	4 feet	5 feet
Sound bedrock	8,000	10,000	10,000	10,000
Dense sand and gravel Ø=40°	1,200	1,800	2,400	3,000
Dense fine to course sand Ø=35°	800	1,200	1,650	2,100
Silt, clay mix Ø=25°	500	700	950	1,200
Soft clay or organic Ø=10°	200	300	400	500

## **PLANS AND SPECIFICATIONS**

Plans and specifications shall meet this standard and describe requirements achieving the purpose.

## **OPERATION AND MAINTENANCE (O&M)**

An O&M plan must be prepared for use by the owner/operator. Provide specific instructions for proper function, periodic inspection, and repair.