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

This standard applies to underground thermoplastic pipelines ranging from ½ inch to 27 inches in diameter that are closed to the atmosphere and that are subject to internal pressures of 80 lb/in^2 or greater.

The standard includes the design criteria and minimum installation requirements for high-pressure, plastic irrigation pipelines.

All pipelines shall be planned and located to serve as 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.

CRITERIA

General Criteria Applicable to All Purposes

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

Plastic pipelines shall be placed only in suitable soils where the bedding and backfill requirements can be fully met.

Laws, rules, and regulations. This practice shall conform to all federal, state, and local laws, rules, and regulations. Laws, rules, and regulations of particular concern include those involving water rights, land use, pollution control, property easements, wetlands, preservation of cultural resources, and endangered species.

Working pressure and flow velocity. The minimum acceptable class of pipe shall be that having a pressure rating for water of 80 lb/in^2.

The pipeline shall be designed to meet all service requirements without an operating pressure, including hydraulic transients, or static pressure at any point greater than the pressure rating of the pipe used at that point. As a safety factor against surge or water hammer, the working pressure should not exceed 72 percent of the pressure rating of the pipe, nor should the design flow velocity at system capacity exceed 5 ft/s. If either of these limits is exceeded, special consideration must be given to the flow conditions; and measures must be taken to adequately protect the pipeline against surge.

Capacity. Capacity shall be sufficient to provide an adequate irrigation stream for the irrigation application methods or planned storage.

Design capacity of the pipeline conveyance or distribution system shall be based on one of the following:

1. Adequate to meet the moisture demands of all crops to be irrigated in the design area.
2. Sufficient to meet the requirements of selected irrigation events during critical crop

growth periods when less than full irrigation is planned.

3. For special-purpose irrigation systems, sufficient to apply a stated amount of water to the design area in a specified net operating period.
4. Sufficient to meet the requirements for efficient application with the distribution system.

In computing the above capacity requirements, allowance must be made for reasonable water losses during application or use.

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.

Outlets. Appurtenances to deliver water from the pipe system to the field, ditch, reservoir, storage, or surface pipe system are known as outlets. Outlets shall have adequate capacity to deliver the required flow to:

1. The hydraulic gradeline of a pipe or ditch.
2. A point at least 6 inches above the field surface.
3. The design surface elevation in a reservoir.
4. An individual sprinkler, lateral line, hydrant, or other device at the required operating pressure.

Outlets shall be designed to minimize erosion, physical damage, or deterioration caused by exposure.

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

Pressure-relief valves. A pressure-relief valve shall be installed between the pump discharge and the pipeline if excessive pressure can build up when all valves are closed. Pressure-relief valves shall be installed on the discharge side of the check valve where a reversal of flow may occur and at the end of the pipeline, if needed, to relieve surge at the end of the line.

Pressure-relief valves shall be no smaller than ¼ inch nominal size for each inch of the pipeline diameter and shall be set to open at a pressure no greater than 5 lb/in^2 above the pressure rating of the pipe.

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 the discharge capacities of the valves at the maximum permissible pressure and differential pressure settings. Such tables shall be the basis for the design and acceptance of these valves.

Air-release valves. The three basic types of air-release valves for use on irrigation pipelines are described below:

- An air-release valve, 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.
- An air-vent and vacuum-relief valve, which has a large venting orifice, exhausts large quantities of air from the pipeline during filling and allows air to reenter the line, preventing a vacuum from forming during emptying. It is not continuous-acting because it does not allow further escape of air at working pressure once the valve closes.
- A combination air valve is sometimes called a combination air-release and air-vacuum valve or combination air-vent and vacuum-relief valve. It is continuous-acting and combines the functions of both the air-release valve and the air-vent and vacuum-relief 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-vent and vacuum-relief valves or combination air valves shall be installed at all summits, at the entrance, and at the end(s) of the pipeline. Such valves generally are needed at these locations if the line is truly closed to the atmosphere. However, they may not be needed if other features of the pipe system, such as permanently located sprinkler nozzles or other unclosed service outlets, adequately vent the

particular location during filling and emptying operations.

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 diameters of less than 0.1 are permitted for continuously acting air-release valves. Adequate vacuum relief must be provided.

Air-release valves or combination air valves shall be used as needed to permit air to escape from the pipeline while the line is at working pressure. Small orifices of these types shall be sized according to the working pressure and venting requirements recommended by the valve manufacturer.

Manufacturers of air valves marketed for use under this standard shall provide dimensional data, which shall be the basis for selection and 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 may drain into dry wells or to points of lower elevation. If drainage cannot be provided by gravity, provisions shall be made to empty 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. Abrupt changes in pipeline grade, horizontal alignment, or reduction in pipe size normally require an anchor or thrust blocks to absorb any axial thrust of the pipeline. Thrust control may also be needed at the end of the pipeline and at in-line control valves.

Thrust blocks and anchors must be large enough to withstand the forces tending to move the pipe, including those of momentum and pressure as well as forces due to expansion and contraction.

The pipe manufacturer's recommendations for thrust control shall be followed. In the absence of the pipe manufacturer's requirements, the following equation must be used in designing thrust blocks:

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

Where:

A = Area of thrust block required in ft^2
H = Maximum working pressure in feet
D = Inside diameter of pipe in feet
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 pipe bend.

If adequate soil tests are not available, the passive soil pressure may be estimated from Table 1.

Table 1 - 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 Ø = 40°)	1,200	1,800	2,400	3,000
Dense fine to coarse sand (assumed Ø = 35°)	800	1,200	1,650	2,100
Silt and clay mixture (assumed Ø = 25°)	500	700	950	1,200
Soft clay and organic soils (assumed Ø = 10°)	200	300	400	500

Materials. All materials shall meet or exceed the minimum requirements indicated in “Plans and Specifications.”

CONSIDERATIONS

If irrigation application methods (for example, trickle irrigation) have limiting working pressures, pressure-relief valves should be considered to ensure the pressure created in the pipeline does not exceed the allowable pressure.

Chemigation valves (that is, double-seated check valves with air relief valve and low pressure drain) should be used on all pipelines in which fertilizer, pesticides, acids, or other chemicals are added to the water supply and where drainage may contaminate the mainline, water supply, or ground water.

Where pipelines are to be drained, consideration should be given to disposal of drained water.

Consideration should be given to the direction of water leaving an air valve or pressure-relief valve. If possible, the flow should be directed away from electrical equipment and hook-ups.

Design processes should consider safety elements when installations are effected by utilities.

PLANS AND SPECIFICATIONS

Plans and specifications for constructing high-pressure underground plastic pipeline 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 operation and maintenance (O&M) plan shall be developed for each pipeline system installed. The plan should document needed actions to ensure that practices perform adequately throughout their expected life.

O&M requirements shall be included as an identifiable part of the design. Depending on the scope of the project, this may be accomplished by brief statements in the plans and specifications, the conservation plan narrative, or as a separate O&M plan.

Other aspects of O&M such as drainage procedures, defining crossing location, valve(s) operation to prevent pipe or appurtenant damage, other appurtenance or pipe maintenance, and recommended operating procedures should be described as needed within the O&M plan.