NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

IRRIGATION WATER CONVEYANCE ASBESTOS-CEMENT PIPELINE

(Ft.)

CODE 430BB

DEFINITION

A pipeline and appurtenances installed in an irrigation system.

PURPOSE

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

CONDITIONS WHERE PRACTICE APPLIES

This standard applies to buried asbestos-cement pipelines with rubber gasket joints.

All pipelines shall be planned and located to serve as integral parts of an irrigation water distribution or conveyance system designed to facilitate the conservation use and management of 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 pipeline shall be sufficient to make irrigation practical for the crops to be grown and the irrigation water application methods to be used.

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

The maximum design working pressure shall be based on a safety factor of no less than 3 applied to the certified applied hydrostatic proof pressure as determined by the Hydrostatic Proof Test Procedure in ASTM C 500. Hydrostatic proof test pressures and associated maximum working pressures for standard pipe classifications shall be as specified in ASTM C 500, Table 1.

For pipelines to be used principally for conveyance where adequate hydraulic analysis of surge, water hammer, or other pressure change is made on the basis of anticipated operating conditions and where combined loading stresses are determined, a safety factor of not less than 2 may be applied to the hydrostatic proof pressure and 1.5 to the crushing strength to determine the maximum design working pressure. The minimum acceptable working pressure classification shall be 25 lb/in^2.

External load limit. A safety factor of at least 1.5 shall be applied to the certified 3-edge bearing test in computing allowable heights of fill over the pipe. The earth loads shall be computed by the method outlined in Technical Release No. 5.

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service.

Capacity. The design capacity of the pipeline shall be based on whichever of the following criteria is greater:

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

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" equals 140.

Flow velocity. The full pipe design water velocity in the pipeline when operating at system capacity shall not exceed 5 ft/s. If this limit is exceeded, special considerations must be given to the flow conditions and measures needed to adequately protect the pipeline against surge.

Outlets. Appurtenances to deliver water from the pipe system to the land, to a ditch or reservoir, or to any surface pipe system are 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 inches 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 where backflow may occur.

Stands open to the atmosphere. Stands shall be placed at each inlet to the irrigation pipe system and at such other points as required. In addition to their other functions, all stands shall serve as vents. Stands shall be constructed of steel pipe or other approved material and shall 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 foot 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 nor the design working head plus freeboard shall exceed the allowable working pressure of the pipe.
2. The top of each stand shall extend at least 4 feet above the ground surface except for surface gravity inlets or where visibility is not a factor. Gravity inlets or stands shall be equipped with a trash guard.
3. Downward water velocities 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 3 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 foot above the top of the upper inlet or outlet pipe but not so much 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 ensure that vibration from pump discharge is not transmitted to stands.

A sand trap that also serves as a stand shall have a minimum inside dimension of 30 inches and shall be constructed so that the bottom is at least 24 inches 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-vent and vacuum-relief valves are used instead of open stands, all requirements detailed 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 foot above the top of the uppermost inlet or outlet pipe. To facilitate attaching the pressure-relief valve and the air-vent and vacuum-relief 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 at least 1 foot 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 3 times that of the outletting pipeline) shall be to:

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-vent and vacuum-relief valve on top of the upper horizontal section of the "dogleg."

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

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 foot 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 1/2 the cross-sectional area of the pipeline (both inside measurements) for a distance of at least 1 pipeline diameter up from the centerline of the pipeline. Above this elevation, the vent may be reduced to 2 inches in diameter.

   These cross-sectional requirements shall apply when an air-vent and vacuum-relief valve is used instead of a vent, but the reduced section shall be increased to the nominal size pipe required to fit the threaded inlet of the valve. An acceptable alternative is to install this valve in the side of a service outlet riser, provided that the riser is properly located and adequately sized. If both an air-vent and vacuum-relief valve and a pressure-relief valve are required at the location, the 10-ft/s velocity criterion given under "Stands closed 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-release valve. The three basic types of air-release valves available for use on irrigation pipelines are described below.

An air-release valve is a continuous-acting valve that has a small venting orifice generally ranging between 3/8 inch and 1 1/16 inches 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 operations and allows air to reenter the line. It prevents a vacuum from forming during emptying operations. It is not continuous-acting because it does not allow further escape of air at working pressure once the valve closes.

Air-vent and vacuum-relief valves may be used at any or all the locations listed under "Vents" instead of the vents. An air-vent and vacuum-relief valve also may be used in conjunction with a pressure-relief valve as an alternative to open pump stands. A pipeline is considered open to the atmosphere if at least 1 stand, vent, or service outlet is unclosed and located so that it cannot be isolated from the system by line gates or valves.

On asbestos-cement pipelines not open to the atmosphere, air-vent and vacuum-relief valves shall be installed at all locations specified under "Vents," on all pump stands, and at in-line control devices where there is a need for air removal and entry during filling and emptying operations.

The diameter of the orifice (opening that controls air flow during filling and emptying operations) of an air-vent and vacuum-relief valve shall equal or exceed that specified in Figure 1 for the appropriate diameter of the pipeline.

A combination air valve may be used instead of an air-vent and vacuum-relief valve, provided that the large venting orifice is properly sized.

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.

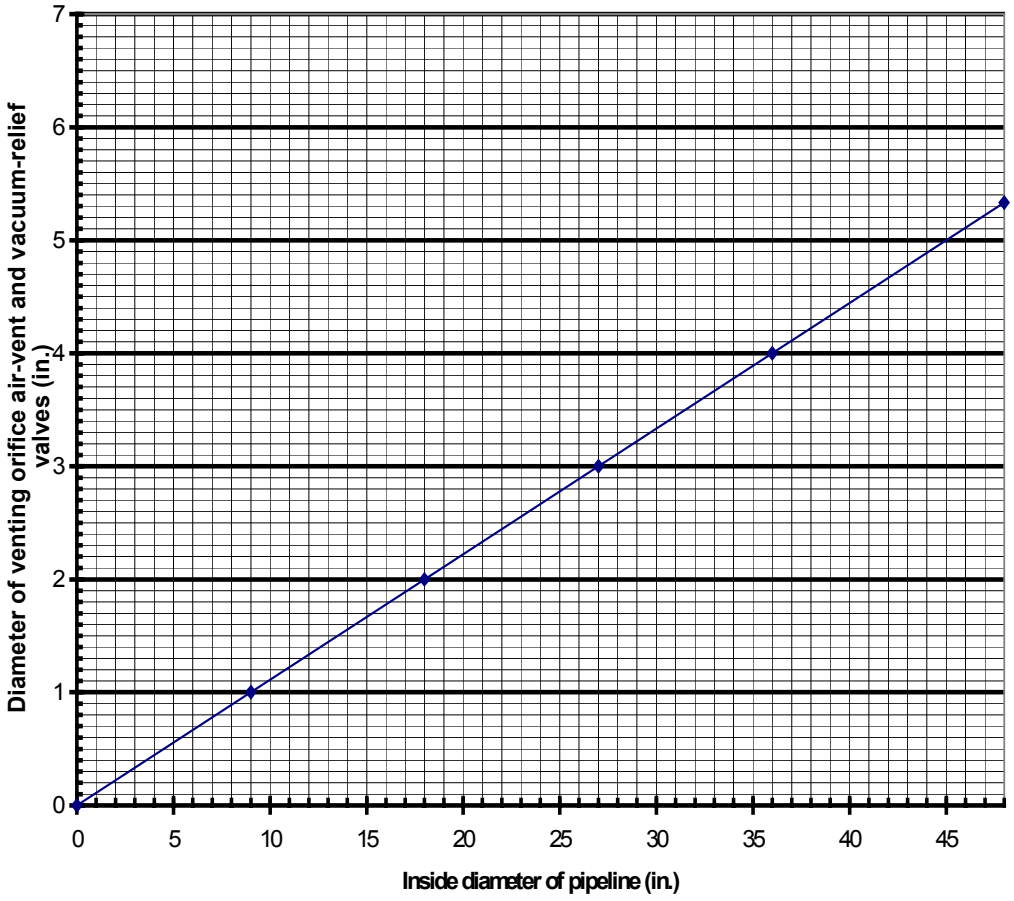

Figure 1 - Sizing of air-vent and vacuum-relief valves

Pressure-relief valves. Pressure-relief valves may be used on asbestos-cement 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 or entry of air is required. A pressure-relief valve shall be installed between the pump discharge and the pipeline if excessive pressures are likely to build up when all valves are closed. A pressure-relief valve shall be installed on the discharge side of

the check valve if a reversal of flow occurs and at the end of the pipeline if it is needed to relieve surge at the end of the line.

Pressure-relief valves for all classes of asbestos-cement pipe shall be no smaller than ¼ inch 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 valve starts to open shall be marked on pressure-relief valves. 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 design and acceptance of these valves.

Drainage. Provisions shall be made for completely draining the pipeline if a hazard is imposed by freezing temperatures or if 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 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, changes in horizontal alignment, or reduction in pipe size normally require an anchor or thrust blocks to absorb any axial thrust of the pipeline. Thrust blocks may also be needed at the end of the pipeline and at in-line control valves.

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

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

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 deflection angle of pipe bend.

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

Materials. All materials described and required in this standard shall meet or exceed the minimum requirements indicated in the construction specifications.

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/ft^2			
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

PLANS AND SPECIFICATIONS

Plans and specifications for constructing asbestos-cement irrigation pipelines shall be in keeping with this standard and shall describe the requirements necessary for installing the practice to achieve its intended purpose.