NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

IRRIGATION WATER CONVEYANCE
REINFORCED PLASTIC MORTAR PIPELINE

(ft)
CODE 430GG

DEFINITION

A pipeline and appurtenances installed in an irrigation system.

SCOPE

This standard applies to underground reinforced plastic mortar pipelines 8 to 54 in. in diameter. Pipelines more than 54 in. in diameter shall be installed under special design and specification requirements.

The standard includes the design criteria for irrigation pipelines, the minimum installation requirements, and the specifications for the reinforced plastic mortar 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.

Water supplies, quality, and rates 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 methods to be used.

Reinforced plastic mortar pipelines installed under this standard shall be placed only in suitable soils where the bedding and backfill requirements can be fully met.

PLANNING CONSIDERATIONS

Water Quantity

1. Effects on the components of 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

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

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 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 free board.

The minimum acceptable work pressure class shall be pipe having a rated operating head of 50 ft of water.

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 145.

Flow velocity. The 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 to adequately protect the pipelines against surge.

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 or irrigation planned.

Outlets. Appurtenances to deliver water from the pipe system to the land, to a ditch or 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; (3) the design surface elevation in a reservoir; or (4) and individual sprinkler, lateral line, or other sprinkler line.

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

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 due to negative pressures, and to prevent 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 materials and shall be supported on a base adequate to support the stand and to 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 will exceed 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, which shall be equipped with trash racks and covers.
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 sources) 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 reduction shall not be such that it would produce and average velocity of more than 10 ft/s if the entire flow were discharging through it.

6. Vibration-control measures, such as special couplers of 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. Suitable provisions for cleaning sand traps shall be provided.

Gate stands shall be of sufficient dimensions 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 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 ft above the top of the uppermost inlet or outlet pipe. To facilitate attracting the pressure-relief valve and the air-and-vacuum valve, the stand may be capped at this point, or if additional height is require, 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 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 the 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 a 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 riser, provided that the riser is properly located and adequately sized. If an air-and-vacuum valve and a pressure-relief valve are required at the location, the 10-ft/s velocity criterion given under “Stands” 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 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-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 once the valve closes.

Air-and-vacuum valves may be used instead of vents at any or all the locations listed under "Vents". An air-and-vacuum 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 one stand, vent, or service outlet is unclosed and located so that it can not be isolated from the system by line gates or valves.

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

Air-release and vacuum-release valve outlets shall be at least 1 in. in diameter when specified for lines 5 to 8 in. in diameter, at least 2-in. for lines 10 to 16 in. in diameter, at least 4 in. for lines 18 to 28 in. in diameter, at least 6-in. for lines 30 to 36 in. in diameter, and least 8-in. for lines 38 to 48 in. in diameter.

For pipelines larger than 16 in. in diameter, 2-in. air-release valves may be used instead of the sizes indicated if they are supplemented with vacuum-release valves that provide a vacuum-release capacity equal to the sizes shown.

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

Pressure-relief valves. Pressure-relief valves may be used on low-pressure pipelines as an alternative to stands open to the atmosphere.

A pressure-relief valve shall be installed at the pump location if excessive pressure can build up when all valves are closed. Also, in closed systems where the line is protected from reversal of flow by a check valve and excessive surge pressures are likely to build up, a surge chamber or pressure-relief valve shall be installed close to the check valve on the side away from the pump.

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

A pressure-relief valve or surge chamber shall be installed at the end of the pipeline if needed to relieve surge.

The flow capacity of pressure-release valves shall be the pipeline design flow rate within a pipeline pressure no greater than 50 percent above the permissible working pressure for 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 the 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 of pressure setting and of acceptance of these valves.

Drainage. Provisions shall be made for completely draining the pipeline if freezing temperatures are a hazard, the pipe manufacturer recommends it, or it 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 provided by gravity, provisions shall be made to empty the line by pumping or 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 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 the absence of such recommendations, the following formula shall be used in designing 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.

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

If adequate soil tests are not available, the allowable bearing 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/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

Maximum depth of cover. If the pipe is installed in a trench, the earth cover over the top of the pipe shall not exceed that given in table 2.

Table 2. —Maximum cover for pipes installed in trenches

Pipe diameter	Type 4 bedding	Type 7 bedding	Type 10 bedding
in.	*ft*	*ft*	*ft*
8	35	35	35
10	23	35	35
12	18	35	35
14	15	35	35
15-16	13	35	35
18-20	12	35	35
21	11	35	35
24	11	28	35
27	10	25	35
30	10	24	35
33	10	23	35
36	10	22	35
39	10	21	35
42	9	20	35
45-54	9	19	35

If the pipe is installed in an embankment, the external load shall not exceed a load equivalent to the height of earth cover over the top of the pipe given in table 3.

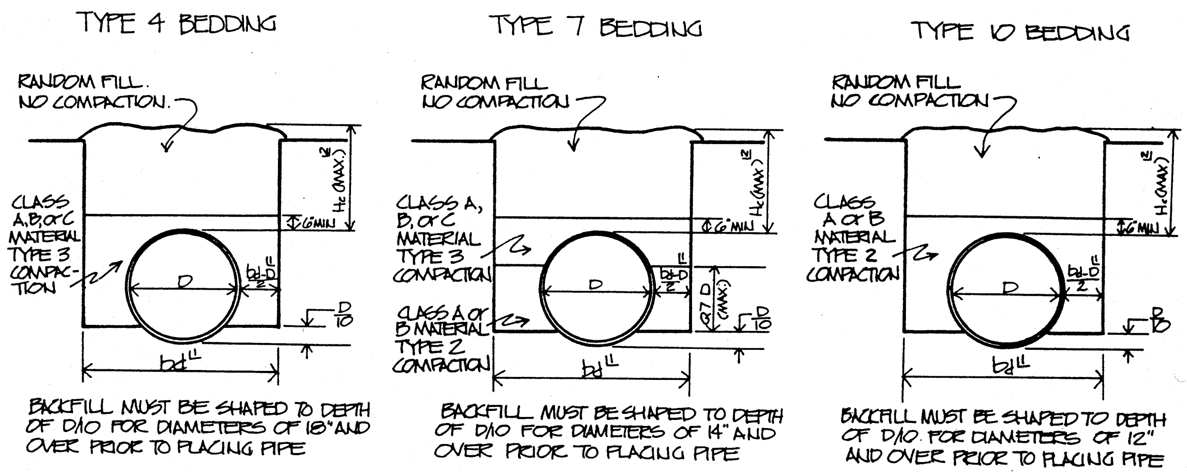
Table 3. —Maximum cover for pipes installed in embankments

Pipe diameter	Type 4 bedding	Type 7 bedding	Type 10 bedding
in.	*ft*	*ft*	*ft*
8	12	18	24
10	10	15	21
12	9	14	20
14	9	13	19
15-39	8	13	19
45-54	7	13	19

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

PLANS AND SPECIFICATIONS

Plans and specifications for constructing reinforced plastic mortar irrigation pipelines shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purposes.



Shape natural subgrade to fit the pipe to depth of D/10 by using a template or properly shaped excavating equipment. At the contractor's option, the subgrade may be excavated to 4 in. below the bottom of the pipe and backfilled with Class A material, Type 3 compaction. If the subgrade is rock, contains rocks larger than 1 in. in diameter, or is unstable, excavate to a depth of 6 in. below the bottom of the pipe, backfill with Class A material, Type 3 compaction, and shape backfill as instructed above. Pipe must be in contact with the subgrade at all locations along the pipe (no high or low spots except as needed for bell ends, rings, or fittings).

NOTES—Show appropriate value on drawings:
1. bd = D + 18 in. for compaction by water saturation; bd = D + 36 in. for mechanical compaction.
2. H_c = Height of fill used in design calculations.

Figure 1.—Bedding conditions for pipe.