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

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

This standard applies to underground thermoplastic pipelines ranging from ½ to 27 inches in diameter that are closed to the atmosphere and that are subject to internal pressures of 50 lb/in.^{2} or greater.

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.

Water supplies, pipeline capacity, water 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 method 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.

CRITERIA

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 or a Manning's "N" value of 0.009.

Outlets. Appurtenances required to deliver water from the pipeline to an individual sprinkler or to a lateral line of sprinklers or surface pipe located on the ground surface are known as outlets. Outlets shall have adequate capacity to deliver the design flow to the individual sprinkler, surface lateral line of sprinklers, or surface pipe at the design operating pressure.

Working pressure and flow velocity. The minimum acceptable class of pipe shall be that having a pressure rating for water of 50 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 taken to adequately protect the pipeline against surge.

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 is 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.

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

Any in-line check valves installed in an irrigation pipeline, to prevent pollution to the water source from chemigation injection, shall meet the current regulations of the New Mexico Department of Agriculture. Any inline check valve system for chemigation shall have, as a minimum, the following features:

- An automatic quick closing, spring assisted check valve, located in the main line of the irrigation supply line.
- An automatic low pressure drain valve, located between the check valve and the irrigation supply pump.
- An automatic vacuum relief valve, located between the check valve and the irrigation supply pump.
- An inspection port or a viewing device located in such a manner that the inlet to the low pressure drain can be observed.

All of the above mentioned components shall be installed according to the current or draft regulations of the New Mexico Department of Agriculture. **Table 2** is a current list of mainline check valves which, when installed with all components mentioned above, appear to meet the requirements. The State Conservation Engineer or designee must approve any deviations from this list.

In addition to the inline check system described above, the following components, as described in the regulations of the New Mexico Department of Agriculture, are also required in the chemigation system to prevent pollution of the irrigation water source:

- A spring-loaded check valve in the chemical injection line, located at the point of injection into the irrigation pipeline.
- A functional device, such as a pressure switch, and functional controls which will stop the irrigation supply pump and the chemical injection pump if the pressure in the irrigation system falls below that required for proper operation of the system.

Pressure relief valves. A pressure-relief valve (PRV) shall be installed between the pump discharge and the pipeline if excessive pressure can build up when all valves are closed. PRV's valves shall be installed on the discharge side of the check valve and at any point along the pipeline if needed to relieve surge. Particular attention must be given for the need of a PRV at the end of the line.

PRV's shall be no smaller than ¼-in. 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 PRV's start to open shall be marked on each PRV. Adjustable PRV's shall be sealed or otherwise altered to prevent changing the adjustment from that marked on the valve.

Manufacturers of PRV's 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. For design purposes of PRV capacity, use **Table 3.**

Table 2

APPROVED CHEMIGATION VALVES

MANUFACTURER	SIZE (INCHES)	MODEL NO.
MANUFACTURER	**SIZE (INCHES)**	**MODEL NO.**
Ames Co. Woodland, CA	6, 8, 10, 12	A113-250, A113-251, A113-252, A113-253, A113-254, A113-255
Clemons Sales Corp. Boise, ID	6, 8, 10	- - - - - - - -
Clow Valve Division * Overland Park, KS	6, 8, 10, 12	5340, 5381, 5386
Fresno Valve and Casting * Lubbock, TX	6, 8, 10, 12	36xx000 (xx=06,08,10,12) CT130Cxx (xx=06,08,10,12) CT130Axx (xx=06,08,10,12)
Midwest Irrigation Henderson, NE	6, 8	CH1000A, CH1000B, CH1000C, CH1000D
Northern Pump Henderson, NE	6, 8, 10	NCCVFF, NCCVFC, NCCVTC, NCCVPC, NCCVPC
Pierce Corp. Eugene, OR	6, 8, 10	480-008-00xx (xx=06,08,10)
Reinke Mfg.Co. Deshler, NE	6, 8, 10	CV6, CV8, CV10, CV6PE, CV8PE, CV10PE
T-L Irrigation Co. Hastings, NE	6, 8, 10	IV6295, IV6296, IV6297, IV6298 IV6300, IV6301, IV6302, IV6303
Valmont Irr. Products Valley, NE	6, 8, 10	1KO1819, IKO2017, 1KO2018
Waterman Industries** Garden City, KS	6, 8, 10, 12	PC-30, PC-31, PC-31E, CPC-30, CPC30B, PC-150, PC-150E, CPC-150

* These valves are approved only if they have a separate inspection port, vacuum relief, and low pressure drain.

** Check valves manufactured prior to 1982-83 do not have a spring, but can be retrofitted with a spring that meets the specifications for chemigation.

Air relief valves. The three basic types of air-relief valves (ARV) for use on irrigation pipelines are described below:

- A combination air 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 and prevents a vacuum from forming during emptying. This type of valve is sometimes called air vacuum relief valve, air vacuum air relief valve, or air vent and vacuum relief valve. This valve is not continuous acting because it does not allow further escape of air at working pressure once the valve closes. It will allow air to enter the pipe when it is de-pressurized.
- A continuously acting ARV, has a small venting orifice, generally ranging between 1/16 and 3/8 in. in size. This valve releases pockets of air from the pipeline once the line is filled and under working pressure.
- A continuous acting combination air and vacuum relief valve, housed in one body, combines the functions of both the

continuously acting ARV and the combination air and vacuum relief valve.

Table 3

Pressure Relief Valve Capacity

Pressure relief Valve	Flow Rate – GPM
3	650
4	1,000
6	1,500

If needed to provide positive means for air escape during filling and air entry while emptying, the appropriate air and vacuum relief 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 ARV 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 of less than 0.1 are permitted for continuously acting ARV's. Adequate vacuum relief must always be provided.

Continuous acting ARV's or continuous acting combination air and vacuum relief valves shall be used as needed to permit air to escape from the pipeline while the line is at working pressure. These types of valves shall be sized according to the working pressure and venting requirements recommended by the valve manufacturer.

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

Thrust control. Abrupt changes in pipeline grade, horizontal alignment, or reduction in pipe size normally requires 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 absence of the pipe manufacturer's requirements, the following formula 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 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 90° deflection angle of pipe bend.

If adequate soil tests are not available, the passive soil pressure may be estimated from **Table 4**.

Drainage. Provision shall be made for completely draining the pipeline if:

- Freezing temperatures imposes a hazard,
- Drainage is recommended by the manufacturer of the pipe, or
- Drainage 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.

Table 4

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

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.

CONSIDERATIONS

Effects on components of the water budget, especially infiltration and evaporation.

Effects on downstream flows or aquifers that would affect other water uses or users.

Potential use for irrigation water management.

Effects of installing a pipeline on vegetation that may have been located next to the original conveyance.

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.

Effects on the movement of dissolved substances into the soils and on percolation below the root zone or to ground water recharge.

Effects of controlled water delivery on the temperatures of water resources that could cause undesirable effects on aquatic and wildlife communities.

Effects on wetlands or water-related wildlife habitats.

Effects on the visual quality of water resources.

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 purposes.

OPERATIONS AND MAINTENANCE

Provisions shall be made as necessary for operations and maintenance requirements and may include a formal plan for larger or more complex designs.

Pipe supports will be checked, on an annual basis, for erosion and animal or human activity that may damage or affect the proper operation or integrity of the pipe.

The pipe will be checked for leaks and evidence of leaks on an annual basis. Any damage will be promptly repaired.