NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

IRRIGATION WATER CONVEYANCE

STEEL PIPELINE
(feet)
CODE 430FF

DEFINITION

A pipeline and appurtenances installed in an irrigation system.

Scope

This standard applies to the design and installation of buried steel irrigation pipelines and steel irrigation pipelines permanently installed above ground. If soil conditions do not permit below ground installation, on ground installation is restricted to pipelines not greater than 6 in. in diameter. Pipelines greater than 6 in. installed under those conditions shall be placed on aboveground supports. This standard is restricted to pipelines not greater than 48 in. in diameter and does not apply to short pipes used in structures such as siphons, outlets from canals, and culverts under roadways.

PURPOSES

To prevent erosion of 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

The pipeline shall be planned and located to serve as an integral part of an irrigation water distribution or conveyance system that has been designed to facilitate the conservation use of soil and water resources on a farm or group of farms.

All areas served by the pipeline shall be suitable for use as irrigated land.

Water supplies and irrigation deliveries to the area shall be sufficient to make irrigation practical for the crops to be grown and the irrigation water application methods to be used.

CRITERIA

Working pressure

The pipeline shall be designed to meet all service requirements using a design stress equal to 50 percent of yield-point stress. Design stresses for commonly used steel and steel pipe classes are shown in column two below:

Specification and grade of steel **Fabricated Pipe**	Design stress (50 pct yield point) psi (lb/in.^{2})
ASTM A36	18,000
ASTM A283	
Grade C	15,000
Grade D	16,500
ASTM A570	15,000
Grade 30	15,000
Grade 33	16,500
Grade 36	18,000
Grade 40	20,000
Grade 45	22,500
Grade 50	25,000
ASTM A572	
Grade 42	21,000
Grade 50	25,000
Grade 60	60,000

Specification and grade of steel **Manufactured Pipe**	Design stress (50 pct yield point) psi (lb/in.^{2})
ASTM-A53/A53M, A135, A 139	
Grade A	15,000
Grade B	17,500
ASTM-A-139	
Grade C	21,000
Grade D	23,000
Grade E	26,000

In computing tensile stresses in steel pipe, the following items must be considered:

1. The pressure to be delivered at the end of the pipeline.

2. The friction head loss,

3. The elevation differential between the outlet and the inlet of the pipe, and

4. Any pressure due to water hammer or surge that may be created by the closure of a valve in the pipeline.

Flow capacity

The design capacity shall be based on whichever of the following is greater:

1. Capacity to deliver sufficient water to meet the weighted peak consumptive use rate of the crops to be grown, or

2. Capacity sufficient to provide an adequate irrigation stream for the methods of irrigation to be used.

Minimum wall thickness

Minimum pipe wall thickness shall be as follows:

Nominal diameter (in.)	Wall thickness
4-12	14 gage less 12.5 pct
14-18	12 gage less 12.5 pct
20-24	10 gage less 12.5 pct
26-36	3/16 in. less 12.5 pct
38-48	1/2 in. less 12.5 pct

Friction loss

For design purposes, the pipeline friction loss shall be based on that computed with Manning's Formula with n equal to no less than 0.012 for unlined and no less than 0.010 for lined pipe.

Check, pressure-relief, vacuum-release, and air-release valves

If detrimental backflow may occur, a check valve shall be installed between the pump discharge and the pipeline.

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 pressure can build up, a surge chamber or a pressure-relief valve shall be installed close to the check valve on the side from the pump.

Pressure-relief valves shall be no smaller than 1/4 in. nominal size for each diameter inch of the pipeline and shall be set at a maximum of 5 lb/sq.in.above the safe working pressure of the pipeline. A pressure-relief valve or surge chamber shall be installed at the end of the pipeline if needed to relieve surge.

Air-release and vacuum-release valves or combination air-release and vacuum-release valves shall be placed at all summits in the pipeline, at the end of the line, and between the pump and check valve if needed to provide a positive means of air entrance or escape.

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

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

Drainage and flushing

Provisions shall be made for completely draining the pipeline if a hazard is imposed by freezing temperatures or if 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 at all low places in the line. If drainage cannot be provided by gravity, provisions shall be made to empty the line by pumping

Outlets

Appurtenances for delivering water from a pipe system to the land, to a ditch or to a surface pipe system shall be known, as outlets. Outlets shall have capacity to deliver the required flow:

1. To a point at least 6 in. above the field surface,

2. To the hydraulic gradeline of a pipe or ditch,

3. To an individual sprinkler, lateral line, or other sprinkler line at the design operating pressure of the sprinkler or line.

Pipe supports

Irrigation pipelines placed above ground shall be supported by suitably built concrete, steel, or timber saddles shaped to support the pipe throughout the arc of contact, which shall be not less than 90 degrees nor more than 120 degrees as measured at the central angle of the pipe. If needed to prevent overstressing, ring girder-type supports shall be used. Support spacing shall insure that neither the maximum beam stresses in the pipe span or the maximum stress at the saddle exceed the design stress values.

Thrust control

For aboveground pipelines with welded joints, anchor blocks and expansion joints shall be installed at spacings that limit pipe movement due to expansion or contraction to a maximum of 40 percent of the sleeve length of the expansion coupling to be used. The maximum length of pipeline without expansion joints shall be 500 ft. Aboveground pipelines with rubber gasket-type joints shall have the movement of each pipe length restrained by steel holddown straps at the pipe supports or by anchor blocks instead of normal pipe supports.

Anchor blocks usually are not required on buried pipelines. Expansion joints shall be installed, as needed, to limit stresses in the pipeline to the design values.

Thrust blocks shall be required on both buried and aboveground pipelines at all points of abrupt changes in grade, horizontal alignment, or reduction in size. The blocks must be of sufficient size to withstand the forces tending to move the pipe, including those of momentum and pressure, as well as forces due to expansion and contraction.

Joints and connections

All connections shall be designed and constructed to withstand the working pressure of the line without leakage and to leave the inside of the pipeline free of any obstruction that would reduce the line capacity below design requirements. On sloping lines, expansion joints shall be placed adjacent to and downhill from anchors or thrust blocks. If cathodic protection is required, high resistance joints shall be bridged to insure continuous flow of current.

A dielectric connection shall be placed between the pump and the pipeline and between pipes with different coating.

Corrosion protection

Interior protective coatings shall be provided if the pH of the water to be conveyed is 6.5 or lower. Cement mortar coatings may be used if the water to be conveyed has a pH of 5.5 or higher and a sulfate content of 150 ppm or less.

All pipe exteriors for underground lines must be fully protected against corrosion. To meet protection requirements, all pipe must be coated and must be provided with supplementary cathodic protection as specified in item 2 below:

1. A Class A protection coating shall be provided if the soil-resistivity survey shows that either (a) 20 percent or more of the total surface area of the pipeline will be in soil having a resistivity of 1,500 ohm-cm or less or (b) 10 percent or more of the total surface area of the pipeline will be in soil having a resistivity of 750 ohm-cm or less. A Class B coating shall be provided for pipe to be installed in soil having a resistivity greater than 1,500 ohm-cm.

2. Supplementary cathodic protection shall be provided if the soil-resistivity survey shows that any part of the pipeline will be in soil whose resistivity is less than 10,000 ohm-cm unless galvanized pipe is used. Pipe to soil potential shall be not less than is used. Pipe to soil potential shall be not less than 0.85 V negative, referred to as a copper/copper-sulfate reference electrode, with the cathodic protection installed. The initial anode

installation shall be sufficient to provide protection for a minimum of 15 years.

Cathodic protection shall be provided for galvanized pipe if the soil-resistivity survey shows that any part of the galvanized pipe will be in soil whose resistivity is less than 4,000 ohm-cm. Galvanized pipe requiring cathodic protection shall have a Class B coating.

The total current required, the kind and number of anodes needed, and the expected life of the protection may be estimated

3. Preliminary soil-resistivity measurements to determine coating requirements and the approximate amount of cathodic protection needed may be made before the trench is excavated. For this purpose, field resistivity measurements shall be made using the 4-pin method as described in **Design Note 12**, or samples for laboratory analysis shall be taken at least every 400 ft. along the proposed pipeline and at points where there is a visible change in soil characteristics.

If a reading differs markedly from a preceding one, additional measurements shall be taken to locate the point of change.

The four-pin method with standard pin spacing gives average resistivities of the soil profile to a depth of 7 feet. Where either the pipe or the anodes are to be buried over 5 feet deep, additional readings shall be taken in the trench after excavation to confirm soil resistivities used in design.

Steel pipelines placed on the ground shall be limited to sites where the soil resistivity along any part of the pipeline is greater than 4,000 ohm-cm. Pipe at anchor or thrust blocks shall be embedded or attached rigidly with a holddown strap.

All pipe installed above ground shall be galvanized or shall be protected with a suitable protective paint coating, including a primer coat and two or more final

CONSIDERATIONS

Water Quantity

1. Effects on 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 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 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.

Endangered Species Considerations

Determine if installation of this practice with any others proposed will have any effect on any federal or state listed Rare, Threatened or Endangered species or their habitat. NRCS's objective is to benefit these species and others of concern or at least not have any adverse effect on a listed species. If the Environmental Evaluation indicates the action may adversely affect a listed species or result in adverse modification of habitat of listed species which has been determined to be critical habitat, NRCS will advise the land user of the requirements of the Endangered Species Act and recommend alternative conservation treatments that avoid the adverse effects. Further assistance will be provided only if the landowner selects one of the alternative conservation treatments for installation; or at the request of the landowners, NRCS may initiate consultation with the Fish and Wildlife Service, National Marine Fisheries Service and/or California Department of Fish and Game. If the Environmental Evaluation indicates the action will not affect a listed species or result in adverse modification of critical habitat, consultation generally will not apply and usually would not be initiated. Document any special considerations for endangered species in the Practice Requirements Worksheet.

Some species are year-round residents in some streams, such as, freshwater shrimp. Other species, such as steelhead and salmon, utilize streams during various seasons. Be aware that during critical periods, such as spawning, eggs in gravels and rearing of young may preclude activities in the stream that may directly affect the stream habitat during those periods. For example, there should be no disturbance of stream gravel beds that may have eggs in them. That could include any equipment in the stream or even walking in the stream or work upstream that may result in sediment depositing in the gravel beds. Document any special considerations for endangered species in the Practice Requirements Worksheet.

PLANS AND SPECIFICATIONS

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

OPERATION AND MAINTENANCE

An individual Operation and Maintenance plan will be prepared for each installation.

Minimum operation and maintenance requirements for steel pipelines and appurtenance are:

1. Operation spring start up:
   a. Close all drains.
   b. Open all valves and turnouts.
   c. Fill pipeline slowly (1 fps).
   d. Close turnouts when they start to discharge water free of air. Bleed air from hydraulically operated valves. Check for leaks at air-vacuum and pressure control valves.

2. Operation winter shut down:
   a. Close headgate.
   b. Open all drains. Pump where necessary. Open all in-line valves. Drain valves which are operated hydraulically with pilot controls.

3. Maintenance:
   a. Periodically inspect valves for leakage around stem and repack as necessary.
   b. Remove and inspect air-vac and pressure relief valves for corrosion, mineral build up and wear. Repair as necessary.
   c. Clean/replace filters on pilot controls of hydraulically operated valves.