

Natural Resources Conservation Service  
Conservation Practice Standard

LIVESTOCK PIPELINE  
(Ft.)  
CODE 516

**DEFINITION**

A pipeline and appurtenances installed for conveying water for livestock or wildlife.

**PURPOSE**

This practice may be applied as part of a resource management system to achieve one or more of the following purposes:

- Convey water to points of use for livestock or wildlife.
- Reduce energy use.
- Develop renewable energy systems.

**CONDITIONS WHERE PRACTICE APPLIES**

This standard applies to the conveyance of water through a closed conduit, from a source of supply to a watering facility, for use by livestock or wildlife.

This practice does not apply to the use of pipelines for irrigation, which are addressed by NRCS Conservation Practice Standard, Irrigation Pipeline (430).

**CRITERIA**

**General Criteria Applicable to All Purposes**

The volume, quality, and rate of delivery by the pipeline shall be sufficient to make use for livestock or wildlife practical and feasible.

Pipelines shall be placed only in or on soils with environmental conditions suitable for the type of material selected.

**Capacity.** Capacity shall be sufficient to convey the design delivery flow rate for the planned conservation practices. For livestock water, the installation shall have a capacity to provide at least 12 gal per head per day for beef cattle and

horses, 25 gal per head per day for dairy cattle, and 1.5 gal per head per day for sheep and goats. In computing the capacity requirements, allowance must be made for reasonable water losses during conveyance and use.

**Friction and Other Losses.** For design purposes, head loss for hydraulic grade line computations shall be based using one of the following equations: Hazen-Williams, Darcy-Weisbach, or Manning's. Equation selection shall be based on the given flow conditions and the pipe materials used. Other head losses (also called minor losses) from change in velocity and direction of flow due to inlet type, valves, bends, enlargements or contractions can be significant and shall be included as appropriate. For closed, pressurized systems, the hydraulic grade line for all pipelines shall be maintained above the top of the pipeline at all locations for all flows, unless specifically designed for negative internal pressures.

**Pipe Design.** Pipelines shall be designed to meet all service requirements such that internal pressure, including hydraulic transients or static pressure at any point is less than the pressure rating of the pipe.

Flexible conduits such as plastic and metal pipe shall be designed using NRCS National Engineering Handbook (NEH), Part 636, Chapter 52, Structural Design of Flexible Conduits, and the following criteria:

*Plastic Pipe:* When operating at design capacity, the full-pipe flow velocity should not exceed 5 feet per second in pipelines with valves or some other flow control appurtenances placed within the pipeline or at the downstream end. As a safety factor against transient pressures, the working pressure at any point should not exceed 72 percent of the pressure rating of the pipe. If either of these limits is exceeded, special design consideration must be given to the flow conditions, and measures must

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be taken to adequately protect the pipeline against transient pressures.

Pressure ratings for pipes are normally based on a pipe temperature of 73.4°F. When operating temperatures are higher, the effective pressure rating of the pipe shall be reduced accordingly.

*Metal Pipe:* The specified maximum allowable pressure shall be determined using the hoop stress formula, limiting the allowable tensile stress to 50 percent of the yield-point stress for the material selected. Design stresses for commonly used metal pipes are shown in NEH, Part 636, Chapter 52.

**Joints and Connections.** All connections shall be designed and constructed to withstand the pipeline working pressure without leakage and leave the inside of the pipeline free of any obstruction that would reduce capacity.

The allowable longitudinal bending for the pipeline shall be based on type of material and the pressure rating, and shall be in accordance with industry standards, or as described in NEH, Part 636, Chapter 52.

Joints and connections for metal pipes should be of similar materials whenever possible. If dissimilar materials are used, the joints or connections shall be protected against galvanic corrosion.

For sloping metal pipe, expansion joints shall be placed adjacent to and downhill from anchors or thrust blocks.

For welded pipe joints, expansion joints shall be installed, as needed, to limit pipeline stresses to the allowable values.

**Depth of Cover.** Buried pipe shall be installed at sufficient depth below the ground surface to provide protection from hazards imposed by traffic loads, farming operations, freezing temperatures, or soil cracking, as applicable.

Pipelines shall have sufficient strength to withstand all external loads on the pipe for the given installation conditions. Appropriate live loads shall be used for the anticipated traffic conditions.

Where it is not possible to achieve sufficient cover or sufficient strength, a carrier (encasement) pipe or other mechanical measures shall be used.

**Valves and Other Appurtenances.** Pressure ratings of valves and other appurtenances shall equal or exceed the design working pressure.

When lever operated valves are used, an analysis shall be performed to evaluate potential transient pressures, assuming rapid valve closure.

*Check Valves and Backflow Prevention.* A Check Valve shall be installed between the pump discharge and the pipeline if detrimental backflow may occur.

Approved backflow prevention devices shall be used on all pipelines where back flow may contaminate the source water supply or groundwater.

*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 set to open at a pressure as low as practical, but no greater than 5 pounds per square inch above the design working pressure rating or maximum allowable pressure of the pipe. Adjustable Pressure Relief Valves shall be sealed or otherwise altered to prevent changing the adjustment from that marked on the valve.

*Air Vents.* For design velocities lower than 8 ft/s, some provision shall be included in the design for removing air. If parts of the line are above the hydraulic gradient, periodic use of an air pump may be required.

*Outlets and Water Level Control.* Appurtenances to deliver water from the pipe to the watering facility shall have adequate capacity to deliver the required flow. Where water is supplied continuously to the watering facility, use automatic water level controls (such as Float Valves) to control the flow of water and to prevent unnecessary overflows.

Design outlets and water level controls to withstand or be protected from damage by livestock, wildlife, freezing and ice damage. Outlets shall be designed to minimize erosion, physical damage, or deterioration due to exposure.

**Thrust Control.** Abrupt changes in pipeline grade, horizontal alignment, or size reductions, may require an anchor or thrust blocks to absorb pipeline axial thrust. Thrust control is typically 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 absence of manufacturer's data, thrust blocks shall be designed using NEH, Part 636, Chapter 52.

**Filling.** The pipeline system shall have a means of controlling the filling of the pipeline to prevent entrapment of air or excessive transient pressures.

Filling velocities greater than 1 foot per second in a closed to the atmosphere pipe system (i.e., all outlets closed), requires special evaluation and provisions to remove entrapped air and prevent excessive transient pressures.

If filling at a low flow rate is not possible, the system shall be open to the atmosphere (outlets open) prior to pressurizing. The system shall be designed for air removal and excessive transient pressures that may develop at higher filling rates.

**Flushing.** If the sediment load in the water is significant, the pipeline shall have adequate velocity to ensure that sediment is moved through and flushed out of the pipeline.

If provisions are needed for flushing sediment or other foreign material, a suitable valve shall be installed at the distant end or low point of the pipeline.

**Draining.** Provisions shall be made for the complete removal of water from the pipeline by gravity or other means when freezing temperatures are a hazard or when draining is otherwise specified by manufacturer or design.

**Safe Discharge of Water.** Provisions shall be made for water being discharged from valves, especially air valves and pressure relief valves. These valves shall be located such that flows are directed away from system operators, livestock, electrical equipment, or other control valves.

**Vegetation.** Re-establish vegetation or otherwise stabilize disturbed areas as soon as practical after construction. Seedbed preparation, seeding, fertilizing, and mulching shall meet applicable criteria in NRCS Conservation Practice Standard, Critical Area Planting (342).

#### **Additional Criteria Applicable to Reduce Energy Use**

Provide analysis to demonstrate reduction of energy use from practice implementation.

Reduction of energy use is calculated as average annual or seasonal energy reduction compared to previous operating conditions.

#### **CONSIDERATIONS**

**Safety.** Pipeline systems may present a hazard

to the safety of people, during installation and operation. Consider safety as follows:

- Address trench safety in design and during construction.
- Provide protection for people from high pressure water blowing from Pressure Relief, Air Release, and other valves.
- Determine the existence or non-existence of underground utilities prior to construction.

**Economics.** Consider economics in pipeline design, as follows:

- Select pipe sizes based on lifetime energy requirements, versus initial costs of materials.
- Select pipe material based upon the expected service life of practice.
- Consider hydropower applications as alternatives to the use of Pressure Reducing valves or reduced pipe diameters to induce friction loss.

**Other Resources.** Consider potential impacts to other resources as follows:

- Address rare plant species and cultural resources during the installation of buried pipelines. When possible, avoid these resources, as well as wetlands and other habitats that are highly sensitive to disturbance, or include measures to minimize impacts.
- Consider the visual design of pipelines and appurtenances, especially in areas of high public visibility.

#### **PLANS AND SPECIFICATIONS**

Prepare plans and specifications for Livestock Pipelines that describe the requirements for applying the practice according to this standard. As a minimum, the plans and specifications shall include:

- A plan view of the layout of the pipeline.
- Profile view of the pipeline.
- Pipe sizes and materials.
- Pipe joint requirements.
- Site specific construction specifications that describe in writing the installation of the pipeline. Include requirements for pressure testing of the pipeline.
- Depth of cover and backfill requirements.

- Vegetative establishment requirements

## **OPERATION AND MAINTENANCE**

An Operation and Maintenance (O&M) Plan shall be developed for each Livestock 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 written statements in the plans and specifications, the conservation plan narrative, or as a separate O&M Plan.

Other aspects of O&M, such as filling and draining procedures, marking crossing locations, valve operation to prevent pipe or appurtenant damage, appurtenance or pipe maintenance, and recommended operating procedures, should be described as needed within the O&M plan.

## **REFERENCES**

USDA-NRCS, National Engineering Handbook, Part 636, Chapter 52, Structural Design of Flexible Conduits.

NRCS Conservation Practice Standards:

342 – Critical Area Planting

430 – Irrigation Pipeline

## Natural Resources Conservation Service Construction Specification

### LIVESTOCK PIPELINE (516)

#### 1. SCOPE

Work shall consist of furnishing and installing the pipeline, fittings, and appurtenances as specified on the drawings. The pipeline shall be located as shown on the drawings or as staked in the field.

filled with water and tested at the design working head or at a head of 10 feet, whichever is greater. All leaks must be repaired. The test must be successfully repeated without leaks before backfilling.

#### 2. SITE PREPRATION

The pipeline location shall be cleared as needed for trenching and installation of the pipeline. Cleared material shall be disposed of by burning, burying, or other approved method.

- (2) The pipe should be pressure tested at the working pressure for 2 hours. The allowable leakage shall not be greater than 1 gallon per diameter inch per mile. If leakage exceeds this rate, the defect must be repaired until retests show that the leakage is within the allowable limits. However, all visible leaks must be repaired.

#### 3. INSTALLATION

##### a. Placement

Pipelines shall be placed so that they are protected against hazards imposed by traffic, farm operations, freezing temperatures, or soil cracking. Other means of protection must be provided if the depth required for protection is impracticable because of shallow soils over rock or for other reasons. The minimum cover over the pipeline shall be 30 inches. Low areas may be filled to provide minimum cover. Abrupt changes in grade must be avoided to prevent rupture of the pipe.

Trenches for plastic pipelines all be free of rocks and other sharp-edged materials, and the pipe shall be carefully placed to prevent damage.

Plastic pipelines may be placed by plow-in equipment if soils are suitable and rocks and boulders will not damage the pipe.

All fittings and connections shall be installed and sealed in accordance with manufacturer's recommendations.

##### b. Testing

Pipelines shall be pressure tested by one of the following methods:

- (1) Before backfilling, the pipe should be

##### c. Backfilling

All backfilling shall be completed before the line is placed in service. For plastic or copper pipe, the initial backfill shall be of selected material that is free of rocks or other sharp-edged material that can damage the pipe. Deformation or displacement of the pipe must not occur during backfilling.

Plastic pipelines installed by the plow-in method require surface compaction and shaping in addition to the normal plow-in operations.

Installation and backfilling shall be done in a workmanlike manner. Provisions shall be made for stabilizing disturbed areas and controlling erosion, as necessary.

#### 4. VEGETATION

All disturbed areas shall be shaped and graded to blend with the surrounding area. Fertilizers and lime shall be applied as necessary to the disturbed area, incorporated by disking as necessary, and the area seeded in accordance with requirements of Critical Area Planting (342).