

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD**

PIPELINE

(feet)

CODE 516

DEFINITION

Pipeline installed for conveying water for livestock or for recreation.

PURPOSE

- Convey water from a source of supply to points of use

CONDITIONS WHERE PRACTICE APPLIES

Where conveyance of water in a closed conduit is desirable or necessary to conduct water from one point to another, to conserve the supply, or for reasons of sanitation. This standard applies to pipelines having an inside diameter of less than four inches, that are installed for livestock watering or for recreation areas.

DESIGN CRITERIA

Capacity. For supplying livestock water, the installation shall have a capacity to provide at least 30 gallons per day for each 1,000 pound liveweight. This is for dairy and beef cattle, chickens, hogs, sheep, and goats. Other rates may be used as approved by NRCS.

For recreation areas, the capacity shall be adequate for all planned uses of the water, such as drinking, fire protection, showers, flush toilets, and irrigation of landscaped areas.

Low Pressure Systems. These systems are operating under low pressures without a pump. The pressure is normally less than 15 pounds per square inch, and the length of the pipe is less than 1,500 feet. Flow for spring development may need a larger pipe size.

See Chapter 12, Engineering Field Handbook (EFH), Part 650 of National Engineering Handbook. Pipe capacities for gravity systems are given in Chapter 12, EFH. Pipe capacity is based on Manning's equation. Low pressure systems may also be designed based on the Hazen-Williams equation like pump pressure systems, as shown below. Low pressure pumping systems such as nose pumps and solar pumps will be considered gravity systems if pressure does not exceed 15 pounds per square inch.

Pump Pressure Systems. A pump pressure system is any system that has a working pressure greater than 15 pounds per square inch. Pump pressure systems shall be designed by an engineer, approved engineering procedure, or a reputable pump pressure system dealer. The design shall meet site conditions. Pipe friction loss shall be based on Hazen-Williams equation as shown in the Missouri Livestock Watering Systems Handbook (MLWSH), Chapter 5.

Sanitary Protection. If water from the pipeline is likely to be used for human consumption, the requirements (for materials and installation) of the state health department must be met. Reasonable caution shall be used to ensure the livestock have a safe source of water.

When a pipeline serving livestock is supplied from a utility that provides for human consumption, an approved method for eliminating backflow shall be installed. Contact the water supplier for appropriate installation recommendations.

Pipe Materials. In corrosive soils or waters use plastic pipe. Plastic pipe shall meet the

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requirements specified in Table 1. Equivalent plastic pipe conforming to other ASTM or AWWA Specifications as shown in the MLWSH may be used, as approved by NRCS.

The minimum pipe size used in gravity systems shall be 1-1/4 inch inside diameter. Pipe size is controlled by design, velocity, pressure and capacity criteria under "Design Criteria".

Galvanized steel pipe is occasionally used for special installations where high strength is required. Steel pipe shall be galvanized and meet the requirements in ASTM A53 or in AWWA Specification C 202.

Plastic Pipe Strength. To ensure adequate strength, pipe with a minimum pressure rating of 150 pounds per square inch shall be used when burying the pipe or working with systems that operate at over 50 pounds per square inch. Use a minimum 100 pounds per square inch rated pipe for above ground installations. Working pressure of the system shall not exceed 72 percent of the pressure rating of the pipe.

Pipe Protection. Polyethylene (PE) pipe for use in above ground systems will be made of materials with a minimum of 2 percent carbon black to provide ultraviolet resistance. Pipe of this type is suitable for seasonal use. Protect pipe designed for above ground use (freeze resistant pipe) by placement outside perimeter fences and under cross fences or by shallow burying where soils (less than 12 inches deep) are suitable. Install pipe in a larger rigid pipe or protect by other means where animal or vehicular traffic may damage the pipe material. Vegetation should be allowed to grow over the pipe to shade it from the sun. This will keep the water cooler and protect it from the sun. Where fire is to be used as management tool, specific provisions must be made to protect the pipe from fire.

If cold weather operation is planned, bury the pipe below frost depth or make provisions to drain the pipe. Frost depths are shown in the MLWSH. Freeze resistant pipe is manufactured to allow expansion of the pipe during periods of cold weather. However,

parts of the pipeline, such as float valves, connectors, may not be freeze proof. Install shutoff valves in various locations along the pipeline to allow easy repair of broken appurtenances and damaged pipe.

When burying plastic pipe in rocky conditions, precautions may be needed during backfilling. To prevent damage from contact with large or sharp edged rock fragments, the pipe may need to be laid on top or covered with a layer of gravel, sand, agricultural lime, or topsoil or similar nonthreatening material.

Drainage. Valves or unions can be installed at low points in the pipeline so that the line can be drained as needed. Drainage shall be provided on above ground installations.

Velocities and Vents. Velocities shall not exceed 5 feet per second unless otherwise approved. 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.

Joints. Watertight joints having a strength equal to that of the pipe shall be used. Couplings must be of material compatible with that of the pipe. If they are made of material susceptible to corrosion, provisions must be made to prevent deterioration.

Visual Resources. The visual design of pipelines in areas of high public visibility and those in fragile areas shall be carefully considered.

VEGETATION

All disturbed areas shall be established to vegetation or otherwise stabilized as soon as practicable after construction. Temporary seeding or mulching may be necessary. Seedbed preparation, seeding, fertilizing, and mulching for all areas over three feet wide will comply with the Conservation Practice Standard (342) Critical Area Planting.

CONSIDERATIONS

The pipeline should be buried below frost line or otherwise protected from freezing. If it cannot be protected from freezing, it should be provided valves, properly located, so that the pipe can be drained during periods of freezing weather.

PLANS AND SPECIFICATIONS

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

OPERATION AND MAINTENANCE

An O&M plan shall be prepared for maintaining the pipeline and all appurtenances.

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TABLE 1

PLASTIC PIPE MATERIALS SUITABLE FOR PIPELINE INSTALLATIONS

This applies to pipelines that have an inside diameter of less than 4 inches. Plastic pressure pipe shall be suitable for underground use. The pipe shall conform to the requirements of one of the following ASTM Specifications: The controlling diameter is shown in parenthesis (ID or OD), ID - Inside Diameter and OD - Outside Diameter.

- D1785 Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, 120 (ID)
- D2104 Polyethylene (PE) Plastic Pipe, Schedule 40 (ID > nominal)
- D2241 Polyvinyl Chloride (PVC) Plastic Pipe (SDR-PR) (ID)
- D2239 Polyethylene (PE) Plastic Pipe (SDR-PR) (ID) Based on controlled Inside Diameter (ID > nominal)
- D3035 Polyethylene (PE) Plastic Pipe (SDR_PR) Based on controlled Outside Diameter (OD)
- D2447 Polyethylene (PE) Plastic Pipe Schedule 40 and 80, Based on Outside Diameter (OD)
- D2737 Polyethylene (PE) Plastic Tubing (ID)
- F771 Polyethylene (PE) Thermoplastic High-Pressure Irrigation Pipeline Systems

or AWWA Specifications:

- C901 Polyethylene (PE) Pressure Pipe and Tubing 1/2 through 3 inch for Water Service
(Inside Diameter greater than Nominal)

Pressure pipe fittings shall conform to the requirements of the appropriate ASTM Specification:

- D2466 Polyvinyl Chloride (PVC) Plastic Pipe Fitting, Schedule 40
- D2467 Socket-Type Polyvinyl Chloride (PVC) Plastic Pipe fitting, Schedule 80
- D2464 Threaded Polyvinyl Chloride (PVC) Plastic Pipe Fitting, Schedule 80
- D2609 Plastic Insert Fitting for Polyethylene (PE) Plastic Pipe
- D3261 Butt Hat Fusion Polyethylene (PE) Plastic Fitting, for Polyethylene (PE) Plastic Pipe and Tubing
- D2672 Bell-End Polyvinyl Chloride (PVC) Pipe
- D2683 Socket-Type Polyethylene Fitting for Outside Diameter-Controlled Polyethylene Pipe and Tubing
- D3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

Solvents-welded pipe joints conform to the appropriate ASTM Specifications:

- D2564 Solvent Cements for Polyvinyl Chloride (PVC) Plastic Pipe and Fittings
- D2855 Making Solvent-Cements Joints with Polyvinyl Chloride (PVC) Pipe and Fittings

Rubber gaskets for pipe joints shall conform to the requirements of ASTM Specifications F477, Elastomeric Seals (Gaskets) for joining plastic pipe.

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Much of the plastic pipe that is normally used for water pipe has a pressure class stamped on the pipe. If not, the pressure class can be computed by the following equation:

$$PC = \frac{2 \times HDS}{DR - 1}$$

where PC = Pressure (pounds per square inch)
HDS = Hydrostatic Design Stress at 73° Fahrenheit
DR or SDR = Dimension Ratio or Standard Dimension Ratio

$$DR = \frac{\text{inside diameter}}{\text{wall thickness}}$$

$$SDR = \frac{\text{outside diameter}}{\text{wall thickness}}$$

The hydrostatic design stress for various plastics are:

Cell Class for Polyethylene (PE)	Plastic Designation	Hydrostatic Design Stress (pounds per square inch)
PE 213323C	PE2306 and PE 2406	630
PE 324433C	PE3406	630
PE 334434C	PE3408	800
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for Poly Vinyl chloride (PVC)		
PVC 12454-B	PVC 1120	2000
PVC 12454-C	PVC 1220	2000
PVC 14333-D	PVC 2120	2000
PVC 14333-D	PVC 2116	1600
PVC 14333-D	PVC 2112	1250
PVC 14333-D	PVC 2110	1000

Schedule 40 pipe made of PVC 1120 is a common pipe and would meet the 150 pounds per square inch requirements for plastic pipe 4 inches in diameter or smaller. Further information on pipe diameters and wall thickness can be obtained for the pertinent ASTM or AWWA specification listed.

**NATURAL RESOURCES CONSERVATION SERVICE
OPERATION AND MAINTENANCE**

PIPELINE

An operation and maintenance plan shall be developed and established by the producer to maintain the pipeline capacity and associated vegetative cover. Items to consider are:

1. Protect pipeline from damage by farm equipment, vehicles, and livestock.
2. Check for leaks and improper operation. Repair any damage as soon as possible after being noted.
3. Repair any eroded areas that are hazardous to the pipeline. Reestablish vegetative cover immediately where erosion has removed seeding.
4. Mark pipeline locations in areas where they can be damaged by other activities.
5. Record on a map the location of pipeline and its approximate depth.
6. Check to ensure needed volume of water is being supplied at the designed pressure.

Additional Details: _____

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**NATURAL RESOURCES CONSERVATION SERVICE
MISSOURI CONSTRUCTION SPECIFICATION****PIPELINE****General**

Construction operations shall be carried out in a manner and sequence that erosion and air and water pollution are minimized and held within legal limits.

The completed job shall present a workmanlike appearance and shall conform to the line, grades, and elevations shown on the drawings or as staked in the field.

All operations shall be carried out in a safe and skillful manner. Safety and health regulations shall be observed and appropriate safety measures used. Contractor shall be assured that all state laws concerning buried utilities have been met.

All trees, stumps, roots, brush, weeds, and other objectionable materials shall be removed from designated work area.

Materials

Materials and fabrication shall be as specified on the drawings. Plastic pipe 2 inches or less in diameter meeting ASTM specifications D1785, D2239, D2241 or AWWA C901 may be used. Plastic pipe over 2 inches in diameter shall be polyvinyl chloride (PVC) 1120 or 1220 conforming to ASTM D1785 or D-2241. The ASTM or AWWA designation shall be stamped on the pipe. Steel pipe shall meet ASTM specification A53 or AWWA specification C202. Other plastic pipe meeting MO-NRCS Conservation Practice Standard (516) Pipeline is acceptable.

To ensure adequate strength, pipe with a minimum pressure rating of 150 pounds per square inch shall be used when burying the pipe or working with systems that operate at over 50 pounds per square inch.

Placement

Placement of the pipeline shall be as shown on the plans or as staked. The pipe should be free of dirt and other materials before assembling. Flexible plastic pipe shall be placed in a "snake-like" position to provide expansion and contraction with temperature change.

Other parts of the water system shall be installed and connected to the pipeline as specified.

Pipelines shall be placed so that they are protected against hazards imposed by traffic, farm operations, freezing temperatures, or soil cracking. Minimum depth of burial shall be as shown on drawings. Unless otherwise specified, plastic pipe should be buried at least 24 inches for ordinary field traffic. When crossing under a road, pipeline should be buried deeper or otherwise protected from collapsing by placing it in a steel or concrete conduit.

Other means of protection must be provided if the depth required for protection is impractical because of shallow soils over rock or for other reasons. Abrupt changes in grade must be avoided to prevent damage to the pipe.

The pipeline should be buried below frost line or otherwise protected from freezing. If it cannot be protected from freezing, the pipeline should be provided with valves properly located so that the pipe can be drained during periods of freezing weather.

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

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

All PVC pipe connections designed to be glued will use PVC solvent cement. Allow glue to cure according to manufacturer's guidelines prior to moving pipe and pressure testing. Gluing shall not be done at temperatures below freezing.

Testing

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

1. Before backfilling, the pipe shall be filled with water and tested at design working head or a minimum head of 10 feet., whichever is greater. All leaks shall be repaired and the test shall be repeated before backfilling.
2. Pipelines shall 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 the test exceeds this rate, the defect shall be repaired until retests show that the leakage is within the allowable limits, except that all visible leaks shall be repaired.

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 from 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.

Mound soil over pipe to allow for settlement. Provisions shall be provided for stabilizing disturbed areas and controlling erosion, as necessary.

Vegetation

Topsoil shall be added, if needed, to establish vegetation. Refer to JS-AGRON-25 for seeding and mulching recommendations or equivalent.

Additional Details:
