NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

PIPELINE

(Ft.)

CODE 516

DEFINITION

Pipeline having an inside diameter of 8 inches or less.

PURPOSE

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

- Convey water from a source of supply to points of use for livestock, wildlife, or recreation.
- Reduce energy use.
- Develop renewable energy systems (i.e., in-pipe hydropower).

CONDITIONS WHERE PRACTICE APPLIES

Where it is desirable or necessary to convey water in a closed conduit from one point to another, to conserve the water supply, or for beneficial use of the resource (water or range).

CRITERIA

Laws and Regulations. This practice must conform to all federal, state, and local laws and regulations. Laws and regulations of particular concern include those involving water rights and use, water health and delivery, pollution control, property easements, wetlands, preservation of cultural resources, and endangered species.

General Criteria Applicable to All Purposes

Capacity. For livestock water, the installation shall have a capacity to provide seasonal high daily water requirements for the number and species of animals to be supplied. When providing livestock water, this practice is to be part of a proper grazing plan to facilitate improved grazing distribution.

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

Additional water capacity will be provided for wildlife when applicable. Specific amounts shall be based on target species.

Sanitary protection. If water from the pipeline is to be used for human consumption, applicable state and local regulations shall be met.

Friction Loss. For design purpose, friction head losses shall be computed using Mannings, Hazen-Williams, or Darcy-Weisbach equations. The appropriate equation and roughness coefficient to be used shall be determined for the given flow condition, pipe size, and pipe material in accordance with the procedure described in NEH Part 650, Engineering Field Handbook. See Nebraska Stockwater Pipeline Handbook (NSPH) Chapter 5 for additional design information and friction loss values.

Pipe. All pipe must withstand the pressure it will be subjected to, including hydraulic transients, internal pressures and external pressures. As a safety factor against surge or water hammer, the working pressure for plastic pipe should not exceed 72% of the pressure rating of the pipe and the design flow velocity at system capacity should not exceed 5 ft/sec. If either of these limits is exceeded, special consideration must be given to flow conditions and measures must be taken to adequately protect the pipeline against surge. See NSPH Chapter 5.2 for additional design information for plastic pipe.

For steel pipe the maximum allowable working pressure should not exceed the pressures shown in Table 1 and the design flow velocity at system capacity shall not exceed 8 ft/sec.

Table 1

Maximum allowable working pressure in psi for steel pipe (Schedule 40, ASTM A53) when surge pressures are not known.

VELOCITY (Ft/Sec)	PIPE DIAMETER (inches)		
	¾ - 1	1 ¼ - 3	3 ½ - 4
2	580	880	1,080
4	450	760	960
6	330	630	840
8	210	510	720

The maximum static pressure shall not be more than:

Steel Pipe – 700 psi for ¾ to 1-inch diameter pipe; 1000 psi for 1 ¼ to 3-inch diameter pipe; 1200 psi for 3 ½ to 4-inch diameter pipe.

Thermoplastic pipe – Certified pressure stamped on the pipe.

The minimum nominal pipe diameter shall be three quarter (3/4) inch. In areas where clogging hazards can occur in the pipeline from chemical or biological precipitates, or other solids such as sand, the minimum nominal pipeline diameter shall be 1 ¼ inch.

Steel pipe shall meet the requirements of AWWA Specification C-200 or ASTM Specification A53.

Plastic pipe shall conform to the requirements of the following ASTM specifications, as applicable:

D 1527 Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe, Schedules 40 and 80

D 1785 Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

D 2104 Polyethylene (PE) Plastic Pipe, Schedule 40

D 2239 Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter

D 2241 Poly (Vinyl Chloride) (PVC), Pressure-Rated Pipe (SDR)

D 2282 Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe (SDR-PR)

D 2447 Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter

D 2513 Thermoplastic Gas Pressure Pipe, Tubing and Fittings

D 2737 Polyethylene (PE) Plastic Tubing

D 2672 Joints for IPS PVC Using Solvent Cement

D 3035 Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter

AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe, 4 inches through 12 inches

AWWA C901 Polyethylene (PE) Pressure Pipe and Tubing, ½ inch through 3 inches

Plastic pressure pipe fittings shall conform to the following ASTM specifications, as applicable:

D 2464 Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

D 2466 Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40

D 2467 Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

D 2468 Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe Fittings, Schedule 40

D 2609 Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe

D 2683 Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing

D 3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

D 3261 Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing

Solvents for solvent-welded plastic pipe joints shall conform to the following ASTM specifications, as applicable:

D 2235 Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings

D 2564 Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings

D 2855 Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings

Rubber gaskets for pipe joints shall conform to the requirements of ASTM F477, Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

HDPE pipe material used shall be PE 3408 as per ASTM D3350 and pipe shall be manufactured in accordance with ASTM D2239 Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter or, ASTM D3035 Polyethylene (PE) Plastic Pipe (SDR-DR) Based on Controlled Outside Diameter. The pipe shall be Class C Polyethylene pipe compound as described in ASTM D2239 or D3035.

Thrust Control and Restraints for above ground installation. When above ground installation is required because of shallow soils, rock or for other reasons, the pipe and installation shall meet the following requirements:

The pipe shall be steel or HDPE plastic pipe.

Thrust blocks or anchors shall be required on above ground pipelines at all points of abrupt changes in grade, horizontal alignment, or reduction in size. The blocks shall be of sufficient size to withstand momentum, working pressure, and expansion and contraction forces that might cause pipe movement. 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.

For above ground steel 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 pipe length between expansion joints shall be 500 feet.

Above ground steel pipelines with rubber gasket-type joints shall have movement limited by steel hold down straps at pipe supports or by uniformly spaced anchor blocks.

Thermal Effects. For plastic pipe, thermal effects must be properly factored into system design. Pressure ratings for pipes are normally based on a pipe temperature of 73.4ºF. When operating temperature is higher the effective pressure rating of the pipe shall be reduced accordingly.

Values and procedures for pressure rating reduction shall follow information described in the NEH Part 636, Chapter 52. Also, see NSPH Table 5.1 for PVC Plastic Pipe Rating Reduction Due to Temperature values.

Piping shall be joined in accordance with the manufacturer's recommendations for the particular pipe to be installed. Piping can be joined either mechanically or thermally. Insert fittings used for mechanical joints shall be galvanized steel, brass, stainless steel or plastic meeting ASTM D2609 requirements.

Thermal expansion shall be considered in the design of high-density polyethylene pipe systems laid on the ground surface. The pipe shall be restrained in areas where pipe movement is likely to cause damage to the pipe itself. When the pipe is to be connected to water facilities such as troughs or tanks, it shall be anchored to the ground near the trough. Anchors may be earth berms or embankment, pipe burial, or concrete or timber blocks.

The pipe shall be anchored and "snaked" at intervals along its length. The pipe shall be allowed to deflect laterally between the anchors.

Drainage. Valves or unions shall be installed at low points in the pipeline for systems installed above the frost line so that the line can be drained as needed. Check valves shall be installed as needed to protect groundwater quality or maintain a full pipeline.

Vents and Valves**.** Design shall provide for entry and removal of air along the pipeline, as needed, to prevent air locking or pipe collapse. If parts of the line are above the hydraulic gradient, periodic use of an air pump may be required. Provisions shall be made for pressure relief, air relief and vacuum relief as needed to protect the pipeline.

A continuous acting air release or combination valve shall be located on the first summit from the water source. Additional air release valves should be considered at all summits in the line where an accumulation of air could cause a reduction in flow. Additional venting is normally required for artesian systems, which contain gas, summits with extremely low operating heads (less than 20 psi), and summits collecting air from multiple laterals or long reaches. Special care shall be taken in the pipeline layout to eliminate undulating grade changes.

Manually operated air release cocks, hydrants, globe valves, ball valves or brass stop and drain valves may be used to release air on filling. The minimum size of valve shall be ½ inch.

Vacuum relief valves should be installed as needed for the relief of vacuum pressures (i.e., negative pressures) due to sudden gate or valve closure, pump shutoff, or drainage of the pipeline.

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 installed downstream of pressure-reducing valves in pressurized pipelines to prevent the pressure rating of the pipe being exceeded should erratic operation of the pressure-reducing valve occur.

Pressure relief valves shall be set to open at a pressure as low as practical, but no greater than 5 pounds per square inch (psi) above the pressure rating or maximum allowable pressure of the pipe. The valves shall have sufficient flow to reduce the excessive pump pressures or pressure caused by erratic pressure-reducing valves that can damage the pipeline.

Surge chambers or other protective devices are required in the line at points where the combination operating pressure and surge exceeds the maximum working pressure of the pipe. Such points are generally associated with check valves or other quick-closing valves.

Care should be taken to eliminate excessive pressures on float valves and hydrants, which leads to erratic valve operation, pipelines surges and premature failure. As a minimum, pressure reducing valves shall be installed upstream of water facilities (tanks and troughs), if the static pressure at that location exceeds 80 psi.

Check valves may be required in pipelines delivering water to points of higher elevation to protect against flow reversal. Check valves shall be used in the pump discharge and pipeline wherever the potential backflow from the pipeline would be excessive or could potentially damage the pump.

Valves smaller than the nominal size of the pipeline may be used to control the flow.

Suitable screens, strainers, or other entrance protection shall be installed on all pipelines.

Joints. Watertight joints that have 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 protect them.

All connections and fittings shall be designed to withstand the maximum pressure of the line without excess leakage and leave the inside of the line free of any obstruction which would reduce the line capacity below design requirements.

All steel accessories used in the line where soil may cause excessive corrosion shall be adequately protected from corrosion by wrapping with plastic tape or coating with high quality corrosion preventatives. When plastic tape is used, all surfaces to be wrapped shall be coated with a primer compatible with the tape, prior to wrapping.

Protection. When steel pipe is used, interior protective coatings shall be provided in accordance with NRCS Conservation Practice

Standard 430 Irrigation Pipeline. If a coal-tar enamel protective coating is needed for corrosion protection, the coating shall meet the requirements of AWWA Specification C-203.

Steel 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 coats.

Plastic pipe installed above ground shall be resistant to ultraviolet light throughout the intended life of the pipe.

All pipes shall be protected from hazards presented by traffic, farm operations, freezing temperatures, fire, thermal expansion and contraction. Reasonable measures should be taken to protect the pipe from potential vandalism.

Vegetation. Disturbed areas shall be established with vegetation or otherwise stabilized as soon as practical after construction. Seedbed preparation, seeding, fertilizing, and mulching shall conform to NRCS Conservation Practice Standard 342, Critical Area Planting.

Visual resources. The visual design of pipelines and appurtenances in areas of high public visibility shall be carefully considered.

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.

Additional Criteria Applicable to Develop Renewable Energy Systems

Renewable energy systems shall meet applicable design criteria in NRCS and/or industry standards, and shall be in accordance with manufacturer's recommendations. Hydropower systems shall be designed, operated, and maintained in accordance with the Microhydropower Handbook, Sections 4 and 5, as appropriate.

CONSIDERATIONS

Consider the effects on livestock distribution due to water quality variations in each stock watering facility within a pasture.

Consider the impacts on stream water quality by reducing sediment yield, reduction in bank erosion and eliminating the direct deposit of manure in water courses by excluding livestock from streams and lakes by providing alternate sources of livestock water.

Reasonable measures such as the selection of pipe and appurtenance location, covers, visual screens etc. should considerd to minimize the potential of vandalism.

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. If the pipeline is a component of a system that includes additional conservation practices, the information necessary to construct these additional practices will also be conveyed on the plans.

OPERATION AND MAINTENANCE

An O&M plan specific to the type of installed pipeline shall be provided to the landowner. The plan shall include, but not be limited to, the following provisions:

- Opening/closing valves to prevent excessive water hammer;
- Filling at the specified rate requirements;
- Inspecting and testing valves, pressure regulators, pumps, switches and other appurtenances;
- Maintaining erosion protection at outlets and where pipelines have been installed;
- Checking for debris, minerals, algae and other materials which may restrict system flow; and
- Draining and/or providing for cold weather operation of the system.

- If manual valves are used, the operation of the valve should be documented in the O&M plan and discussed with the owner.

REFERENCES

McKinney, J.D., et al. Microhydropower Handbook, IDO-10107, Volumes 1 & 2. U.S. Department of Energy, Idaho Operations Office.

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

USDA-NRCS, Nebraska Stockwater Pipeline Handbook.