NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

IRRIGATION WATER CONVEYANCE

ASBESTOS-CEMENT PIPELINE

(ft)
CODE 430BB

DEFINITION

A pipeline and appurtenances installed in an irrigation system.

SCOPE

This standard applies to buried asbestos-cement pipelines with rubber gasket joints.

PURPOSE

To prevent erosion or 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

All pipelines shall be planned and located to serve as integral parts of an irrigation water distribution or conveyance system designed to facilitate the conservation use and management of soil and water resources on a farm or group of farms.

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.

DESIGN CRITERIA

Working pressure. The pipelines shall be designed to meet all service requirements without a static or working pressure at any point greater than the minimum allowable working pressure of the pipe used at that point. The static or working pressure of pipelines open to the atmosphere shall include freeboard.

The maximum design working pressure shall be based on a safety factor of no less than 3.0 applied to the certified applied hydrostatic proof pressure as determined by the Hydrostatic Proof Test Procedure in ASTM-C-500. Hydrostatic proof test pressures and associated maximum working pressures for standard pipe classifications shall be as specified in ASTM-C-500, table 1.

For pipelines to be used principally for conveyance, where adequate hydraulic analysis of surge, water hammer, or other pressure change is made on the basis of anticipated operating conditions and where combined loading stresses are determined, a safety factor of not less than 2.0 may be applied to the hydrostatic proof pressure and 1.5 to the crushing strength to determine the maximum design working pressure. The minimum acceptable working pressure classification shall be 25 lb/in^2.

External load limit. A safety factor of at least 1.50 shall be applied to the certified three-edge bearing test in computing allowable heights of fill over the pipe. The earth loads shall be computed by the method outlined in SCS TR-5.

Capacity. The design capacity of the pipeline shall be based on whichever of the following criteria is greater:

1. The capacity shall be sufficient to deliver the volume of water required to meet the peak-period consumptive use of the crop or crops to be irrigated.
2. The capacity shall be sufficient to provide an adequate irrigation stream for all methods of irrigation planned.

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 140.

Flow velocity. The full-pipe design water velocity in the pipeline when operating at system capacity shall not exceed 5 ft/s. If this limit is exceeded, special considerations must be given to the flow conditions and measures needed to adequately protect the pipeline against surge.

Outlets. Appurtenances to deliver water from the pipe system to the land, to a ditch or reservoir, or to any surface pipe system shall be known as outlets. Outlets shall have adequate capacity at design working pressure to deliver the required flow to: (1) the hydraulic gradeline of a pipe or ditch, (2) a point at least 6 in. above the field surface, or (3) the design surface elevation in a reservoir.

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

Stands open to the atmosphere. Stands shall be placed at each inlet to the irrigation pipe system and at such other points as required. In addition to their other functions, all stands shall serve as vents. Stands shall be constructed of steel pipe or other approved material and shall be supported on a base adequate to support the stand and prevent movement or undue stress on the pipeline. Open stands shall be designed to meet or exceed the following criteria:

1. Each stand shall allow at least 1 ft of freeboard above design working head. The stand height above the centerline of the pipeline shall be such that neither the static head nor the design working head nor the design working head plus freeboard shall exceed the allowable working pressure of the pipe.
2. The top of each stand shall extend at least 4 ft above the ground surface except for surface gravity inlets or where visibility is not a factor. Gravity inlets or stands shall be equipped with a trash guard.
3. Downward water velocities in stands shall not exceed 2 ft/s. The inside diameter of the stand shall not be less than the inside diameter of the pipeline. This downward velocity criterion applies only to stands having vertical offset inlets and outlets.
4. If the water velocity in the inlet (from the pump or other water source) equals or exceeds three times the velocity in the outlet pipeline, the centerline of the inlet shall have a minimum vertical offset from the centerline of the outlet at least equal to the sum of the diameters of the inlet and outlet pipes.
5. The cross-sectional area of stands may be reduced above a point 1 ft above the top of the upper inlet or outlet pipe, but not so much that it would produce an average velocity of more than 10 ft/s if the entire flow were discharging through it.
6. Vibration-control measures such as special couplers or flexible pipe, shall be provided as needed to insure that vibration from pump discharge is not transmitted to stands.

Sand traps that also serve as a stand shall have a minimum inside dimension of 30 in. and shall be constructed so that the bottom is at least 24 in. below the invert of the outlet to the pipeline. The downward velocity of flow of the water in a sand trap shall not exceed 0.25 ft/s.

Gate stands shall be of sufficient dimension to accommodate the gate or gates and shall be large enough to make the gates accessible for repair.

Float valves stands shall be large enough to provide accessibility for maintenance and to dampen surge.

Stands closed to the atmosphere. If pressure-relief valves and air-and-vacuum valves are used instead of open stands, all requirements detailed under “Stands Open to the Atmosphere” shall apply except as modified below.

The inside diameter of the closed stand shall be equal to or greater than that of the pipeline for at least 1 ft above the top of the uppermost inlet or outlet pipe. To facilitate attaching the pressure-relief valve and the air-and-vacuum valve, the stand may be capped at this point, or if additional height is required, the stand may be extended to the desired elevation by using the same inside diameter or a reduced cross section. If a reduced section is used, the cross-sectional area shall be such that it would produce an average velocity of no more than 10 ft/s if the entire flow were discharged though it. If no vertical offset is required between the pump discharge pipe and the outlet pipeline and the discharge pipe is “doglegged” below ground, the stand shall extend at least 1 ft above the highest part of the pump discharge pipe.

An acceptable alternative design for stands requiring no vertical inlet offset (when inlet velocity is less than three times that of the outletting pipeline) shall be to:

1. Construct the “dogleg” section of the pump discharge pipe with the same nominal diameter as that of the pipeline.
2. Install the pressure-relief valve and the air-and-vacuum valve on top of the upper horizontal section of the “dogleg.”

Pressure-relief and air-and-vacuum valves shall be installed on stands with the nominal size pipe required to fit the valves’ threaded inlets.

Vents. Vents must be designed into systems open to the atmosphere to provide for the removal and entry of air and protection from surge. They shall:

1. Have a minimum freeboard of 1 ft above the hydraulic gradeline. The maximum height of the vent above the centerline of the pipeline must not exceed the maximum allowable working pressure of the pipe.
2. Have a cross-sectional area at least one-half the cross-sectional area of the pipeline (both inside measurements) for a distance of at least one pipe-line diameter up from the centerline of the pipeline. Above this elevation the vent may be reduced to 2-in. in diameter.

   These cross-sectional requirements shall apply when an air-and-vacuum valve is used instead of a vent, but the reduced section shall be increased to the nominal size pipe required to fit the valve’s threaded inlet. An acceptable alternative is to install this valve in the side of a service outlet riser, provided that the riser is properly located and adequately sized. If both an air-and-vacuum valve and a pressure-relief valve are required at the location, the 10-ft/s velocity criterion given under “Stands” shall apply to the reduced section.
3. Be located at the downstream end of each lateral at summits in the line, and at points where there are changes in grade in a downward direction of flow of more than 10 degrees.

Air-release valve. The three basic types of air-release valves available for use on irrigation pipelines are described below:

An air-release valve, a continuous acting valve that has a small venting orifice generally ranging between 1 1/16 in. and 3/8 in. in size. This valve releases pockets of air from the pipeline once the line is filled and under working pressure.

An air-and-vacuum valve, which has a large venting orifice, exhaust large quantities of air from the pipeline during filling operations and allows air to reenter the line and prevents a vacuum from forming during emptying operations. This type of valve is sometimes called air-vacuum-release valve or air-vent-and-vacuum-relief valve. It is not continuous acting because it does not allow further escape of air at working pressure once the valve closes.

A combination air valve, sometimes called combination air-release-and-air-vacuum valve or combination air-and-vacuum-relief valve. It is continuous acting and combines the functions of both the air-release valve and the air-and-vacuum valve. Both valves are housed in one valve body.

Air-and-vacuum valves may be used at any or all the locations listed under “Vents” instead of the vents. An air-and-vacuum valve also may be used in conjunction with a pressure-relief valve as an alternative to open pump stands. A pipeline is considered open to the atmosphere if at least one stand, vent, or service outlet is unclosed and located so that it cannot be isolated from the system by line gates or valves.

On asbestos-cement pipelines not open to the atmosphere, air-and-vacuum valves shall be installed at all locations specified under “Vents,” on all pump stands, and at inline control devices where there is a need for air removal and entry during filling and emptying operations.

The diameter of the orifice (opening that controls air-flow during filling and emptying operations) of an air-and -vacuum valve shall equal or exceed that specified in figure 1 for the appropriate diameter of the pipeline.

A combination air valve may be used instead of an air-and-vacuum valve, provided that the large venting orifice is properly sized.

Air-release valves or combination air-valves shall be used as needed to permit air to escape from the pipeline while the line is at working pressure. Small orifices of these types shall be sized according to the working pressure and venting requirements recommended by the valve manufacturer.

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

Pressure-relief valves. Pressure-relief valves may be used on asbestos-cement pipelines as an alternative to stands open to the atmosphere. A pressure-relief valve shall serve the pressure-relief function of the open stand or vent for which it is an alternative.

Pressure-relief valves do not function as air-release valves and shall not be used as substitutes for such valves if release or entry of air is required. A pressure-relief valve shall be installed between the pump discharge and the pipeline if excessive pressures are likely to build up when all valves are closed. A pressure-relief valve shall be installed on the discharge side of the check valve if a reversal of flow occurs and at the end of the pipeline if it is needed to relieve surge at the end of the line.

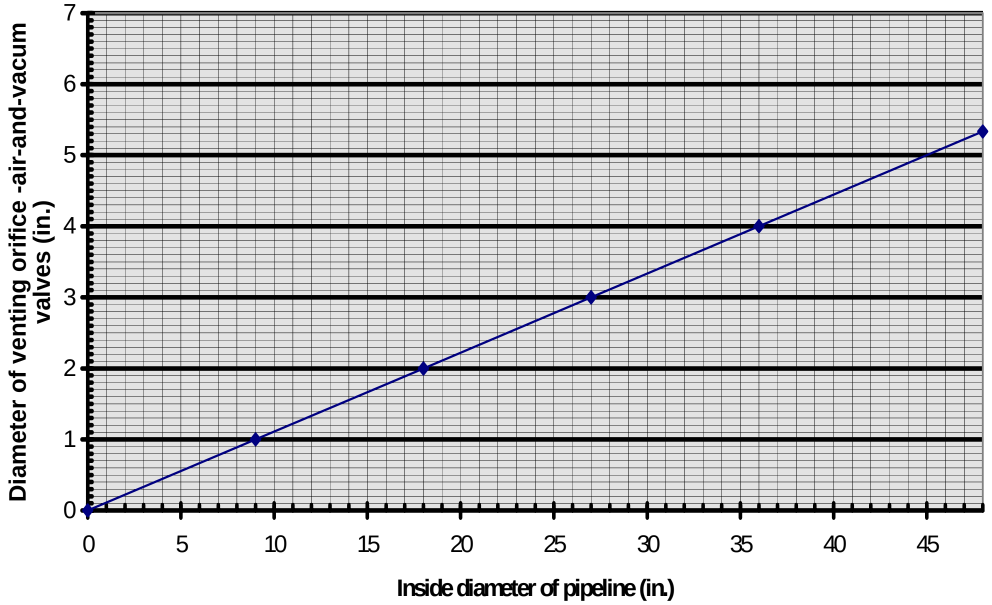
Pressure-relief valves for all classes of asbestos-cement pipe shall be no smaller than ¼-in. for each inch of the pipeline diameter and shall be set to open at a pressure no greater than 5 $lb/in.^2$ above the pressure rating of the pipe.

The pressure at which the valve starts to open shall be marked on pressure-relief valves. Adjustable pressure-relief valves shall be sealed or otherwise altered to prevent changing the adjustment from that marked on the valve.

Manufacturers of pressure-relief valves 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.

Drainage. Provisions shall be made for completely draining the pipeline if a hazard is imposed by freezing temperatures or if a drainage of the line 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 can drain into dry wells or to points or lower elevation. If drainage cannot be thus provided by gravity, provisions shall be made to empty the line by pumping or by other means.

Figure 1. Sizing of air-and-vacuum valves



Flushing. If provision 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.

Thrust control. Abrupt changes in pipeline grade, changes in horizontal alinement, or reduction in pipe size normally require an anchor or thrust blocks to absorb any axial thrust of the pipeline. Thrust blocks may also be needed at the end of the pipeline and at inline control valves.

The pipe manufacture's recommendations for thrust control shall be followed. In the absence of such recommendations, the following formula shall be used to design thrust blocks:

$$A = ((98\ HD^2)/B)\sin(a/2)$$

Where:

- A = Area of thrust block required
- 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 90º deflection angle of pipe bend.

If adequate soil tests are not available, the passive soil pressure may be estimated from the following:

Table 1.—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 = 40º)	1,200	1,800	2,400	3,000
Dense fine to coarse sand (assumed Ø = 35º)	800	1,200	1,650	2,100
Silt and clay mixture (assumed Ø = 25º)	500	700	950	1,200
Soft clay and organic soils (assumed Ø = 10º)	200	300	400	500

Materials. All materials described and required in this standard shall meet or exceed the minimum requirements indicated in "Specification for Materials."

PLANS AND SPECIFICATIONS

Plans and specifications for constructing asbestos-cement irrigation pipelines shall be in keeping with this standard and shall describe the requirements necessary for installing the practice to achieve its intended purpose.

ASBESTOS-CEMENT PIPELINE SPECIFICATIONS

INSTALLATION

Minimum depth of cover. Pipe shall be installed deep enough to insure protection from hazards imposed by traffic crossings, farming operations, freezing temperatures, or soil cracking. The minimum depth of cover shall be 2 ft; but in soils susceptible to deep cracking, the minimum cover shall be 3 ft.

At low places on the ground surface, extra fill may be placed over the pipeline to provide the minimum depth of cover. The fill shall be no less than 10 ft wide and the side slopes no steeper than 6:1. If extra protection is needed at vehicle crossings, encasement pipe or other approved methods may be used.

Trench construction. The trench at any point below the top of the pipe shall be only wide enough to permit the pipe to be easily placed and joined and to allow the backfill material to be uniformly placed under the haunches and along the sides of the pipe.

The trench bottom shall be uniform so that the pipe lays on the bottom without bridging. Clods, rocks, and uneven spots that can damage the pipe or cause nonuniform support shall be removed.

If trenches are excavated in soils containing rock or other hard materials, if the soils are susceptible to appreciable swelling and shrinking on wetting and drying, or if the trench bottom is unstable, the trenches shall be overexcavated and backfilled with selected materials, as needed, to provide a suitable base. If water is in the trench, it shall be drained away, and laying of the pipe shall be postponed until a suitable base is obtained.

The trench alinement shall be such that the pipe can be laid without excessive deflections at the joints.

Placement. The pipe shall be uniformly and continuously supported over its entire length of firm stable material. Blocking or mounding shall not be used to bring the pipe to final grade.

The pipe shall be placed so that the maximum deflection in any one coupling does not exceed 5 degrees for pipe sizes 12 in. and less and 3 degrees for larger sizes. Short radius curves may be introduced into the alinement by using short sections of pipe and giving each coupling no more than the maximum allowable deflection.

Joints and connections. All joints and connections shall be designed and constructed to withstand the design maximum working pressure for the pipeline without leakage and to leave the inside of the line free of any obstruction that can reduce its capacity below design requirements.

All fittings, such as couplings, reducers, bends, tees, and crosses, shall be installed according to the recommendations of the pipe manufacturer.

Fittings made of steel or other metals susceptible to corrosion shall be adequately protected by wrapping them with plastic tape or by applying a coating having high corrosion-preventative qualities. If plastic tape is used, all surfaces shall be thoroughly cleaned and then coated with a primer compatible with the tape before wrapping them.

Thrust blocks. Thrust blocks must be formed against a solid hand-excavated trench wall that is undamaged by mechanical equipment. They shall be constructed of concrete; the space between the pipe and the trench wall shall be filled to the height of the outside diameter of the pipe or as specified by the manufacturer.

Backfill. Backfill material shall be free of large rocks or stones, frozen clods, and other debris that can damage the pipe.

The material shall be placed so that (1) the pipe will not be displaced or damaged, (2) there will be no unfilled spaces in the backfill, and (3) the backfill will be level with the natural ground or at the design grade required to provide the minimum depth of cover after settlement.

Testing. Pipelines shall be tested for leaks by observing their normal operation any time after the contractor has installed all appurtenances on the pipeline and indicated the pipeline is ready for testing.

The line shall be inspected in its entirety while the maximum working pressure is maintained. All visible leaks shall be promptly repaired and the line retested.

It shall be demonstrated by testing that the pipeline will function properly at design capacity. At or below design capacity there shall be no objectionable flow conditions. Objectionable flow conditions shall include water hammer, continuing unsteady delivery of water, damage to the pipeline, or detrimental discharge from control valves.

Basis of acceptance. The acceptability of the pipeline shall be determined by inspections to check compliance with all the provisions of this standard with respect to the design of the line, the pipe and pipe markings, the appurtenances used, and the minimum installation requirements.

Certification and guarantee. If requested by the state conservation engineer, the pipe manufacturer must certify that the pipe meets the requirements specified in this standard.

The installing contractor shall certify that the installation complies with the requirements of this standard. He shall furnish a written guarantee that protects the owner against defective workmanship and materials for a period not less than 1 year. The certification identifies the manufacturer and markings of the pipe used.

MATERIALS

Quality of asbestos-cement pipe. Asbestos-cement irrigation pipe and coupling sleeves shall be made of an intimate mixture of Portland cement (ASTM-C-150) or of Portland blast furnace slag Cement (ASTM-C-595) or of Portland-Pozzolan cement (ASTM-C-595), silica and asbestos fiber and shall be free of organic substances. The material shall be formed under pressure and thoroughly cured to produce pipe meeting the requirements of these specifications.

The pipe shall be Types I, II, and III, corresponding to the chemical requirements given below:

Type I—For use on sites where moderately aggressive water and soil of moderate sulfate content are expected to come in contact with the pipe. When tested according to the Uncombined Calcium Hydroxide Test Procedure provided in ASTM-C-500, the amount of uncombined calcium hydroxide in the pipe shall not exceed 3 percent.

Type II—For general use on sites where either moderately or highly aggressive water or water and soil of both moderate and high sulfate content are expected to come in contact with the pipe. When tested according to the Uncombined Calcium Hydroxide Test Procedure provided in ASTM-C-500, the uncombined calcium hydroxide in the pipe shall not exceed 1 percent.

Type III—For use only on sites where contact with aggressive waters and sulfates are not expected. There are no chemical requirements for Type III pipe.

Pipe requirements. Asbestos-cement irrigation pipe shall meet all the requirements of these specifications (430-BB) and shall be classified according to its allowable maximum operating pressure: 25, 75, 90 and 125.

Asbestos-cement pressure pipe shall meet all the requirements of ASTM-C-296 and shall be classified according to its pressure class: 100, 150, and 200.

Asbestos-cement transmission pipe shall meet all requirements of ASTM-C-668 and shall be in classifications representing numerically one-tenth of the minimum hydrostatic strength. Such classifications are 30, 35, 40, 45, 50, 60, 70, 80, and 90.

Each standard, random, or short length of pipe and coupling sleeve shall be hydrostatically tested by the manufacturer before shipment. They shall have sufficient strength to withstand the applied hydrostatic proof pressure prescribed in table 1 when tested according to the hydrostatic Proof Test Procedure provided in ASTM-C-500.

The maximum allowable working pressure for the various types and classification of asbestos-cement pipe are listed in table 1.

Each length of pipe shall have sufficient flexural strength to withstand, without failure, the total load prescribed in tables 2 and 3 for the classes and sizes listed when tested according to the Flexure Proof Test Procedure in ASTM-C-500.

Asbestos-cement pipe shall have the minimum crushing strength indicated in tables 4 and 5 when tested according to the Crushing Test Procedure in ASTM-C-500.

Fittings and couplers. All fittings and couplers shall meet or exceed the pressure rating of the pipe with which they are used.

Coupling sleeves shall be made of asbestos-cement and shall be machined with rubber ring retaining grooves so that a watertight seal is provided when the joint is assembled. Assembly of pipe and coupling shall provide necessary and separation.

Markings. Each standard or random length of pipe shall bear the name or trademark of the manufacturer, nominal size, pipe classification, and date of manufacture. The type of pipe (Types I, II, or III, corresponding to the chemical requirements) shall be marked on the pipe or stated in the manufacturer's literature pertaining to the pipe.

Each asbestos-cement coupling sleeve shall bear the name or trademark of the manufacturer, nominal size, classification, and the letter T to indicate that it has been hydrostatically tested.

Gaskets. Rubber ring gaskets required for proper assembly of pipe and coupling shall conform to the manufacturer's dimensions and tolerances. They shall equal or exceed the specifications for gaskets indicated in ASTM-D-1869.

Table 1.—Applied hydrostatic proof pressure

Specification No.	Pipe Classification	Working Pressure	Applied proof pressure	Size range
		--------------*lb/in.*^{2}	--------------	*in*
SCS 430-BB irrigation pipe	25 lb	25	75	3 - 36
	75 lb	75	225	3 - 36
	90 lb	90	270	3 - 36
	125	125	375	3 - 36
ASTM-C-296 pressure pipe	Class 100	100	350	3 - 36
	Class 150	150	525	3 - 36
	Class 200	200	700	3 - 36
ASTM-C-668 transmission pipe	30	75	225	6 - 42
	35	87	262	—
	40	100	300	—
	45	112	337	—
	50	125	375	—
	60	150	450	—
	70	175	525	—
	80	200	600	—
	90	225	675	—

Table 2.—Minimum flexural strength
(Total applied load in lb)

Nominal size	Working pressure classification: SCS 430-BB irrigation pipe				ASTM-C-296 pressure pipe		
	25 lb	75 lb	90 lb	125 lb	Class 100	Class 150	Class 200
in							
3	300	500	—	750	755	853	915
4	600	1,000	—	1,300	1,200	1,470	1,870,
5	900	1,500	—	2,000	—	—	—
6	1,300	2,000	2,000	3,300	2,800	3,700	4,900
8	2,500	3,700	4,000	6,000	5,330	7,600	10,130

NOTE: Based on a 9-ft span for all sizes. See ASTM-C-500, Flexure Proof Test

Table 3.—Minimum flexural strength
(Total applied load in lb)

Nominal size	Pipe classification ASTM-C-668 transmission pipe								
	30	35	40	45	50	60	70	80	90
in									
6	—	—	2,300	2,500	2,800	3,200	3,700	4,000	4,900
8	3,700	4,400	5,100	5,700	6,400	6,900	7,600	8,800	10,100

NOTE: Based on a 9-ft span for all sizes. See ASTM-C-500, Flexure Proof Test

Table 4.—Minimum crushing strength for asbestos-cement pipe
(lb/lineal ft)

Nominal size	Working pressure classification: SCS 430-BB irrigation pipe				ASTM-C-296 pressure pipe		
	25 lb	75 lb	90 lb	125 lb	Class 100	Class 150	Class 200
in							
3	1,500	2,300	—	4,400	4,600	6,700	8,800
4	1,100	1,900	—	4,200	4,100	5,400	8,700
5	1,000	1,650	—	4,000	—	—	—
6	1,000	1,400	1,600	3,700	4,000	5,400	9,000
8	1,300	1,650	2,000	4,000	4,000	5,500	9,300
10	1,500	1,900	2,100	4,300	4,400	7,000	11,000
12	1,500	2,200	2,300	4,600	5,200	7,600	11,800
14	1,500	2,600	—	5,000	5,200	8,600	13,500
16	1,500	2,750	—	5,400	5,800	9,200	15,400
18	1,800	2,900	—	5,800	6,500	10,100	17,400
20	2,000	3,100	—	6,400	7,100	10,900	19,400
24	2,400	3,500	—	7,500	8,100	12,700	22,600
30	3,000	4,100	—	9,000	9,700	15,900	28,400
36	3,600	5,000	—	10,500	11,200	19,600	33,800

Table 5.—Minimum crushing strength for asbestos-cement pipe
(lb/lineal ft)

Nominal size	Pipe classification ASTM-C-668 transmission pipe								
	30	35	40	45	50	60	70	80	90
in									
6	—	—	2,400	3,200	4,000	4,700	5,700	6,700	9,000
8	2,000	2,400	2,800	3,400	4,000	4,800	5,500	7,400	9,300
10	2,000	2,500	3,000	3,500	4,500	5,500	7,000	9,000	11,000
12	2,000	2,500	3,000	4,000	5,200	6,400	7,800	10,000	12,500
14	2,000	2,500	3,000	4,000	5,200	7,000	8,800	11,000	13,500
15	2,300	2,800	3,300	4,300	5,500	7.,400	9,300	12,000	14,500
16	2,500	3,000	3,500	4,500	5,800	7,500	9,500	12,400	15,400
18	2,500	3,000	4,000	5,000	6,500	8,500	11,000	14,000	18,000
20	2,500	3,500	4,500	5,500	7,100	9,500	12,000	15,000	20,000
21	2,500	3,500	4,500	5,800	7,300	9,700	12,500	16,000	21,000
24	2,800	3,800	5,000	6,200	8,100	11,000	15,000	19,000	24,000
27	3,500	4,200	5,500	7,000	8,800	12,500	16,500	20,500	27,000
30	3,500	4,500	6,000	7,500	9,700	13,500	18,000	22,500	30,000
33	3,500	5,000	6,500	8,000	10,500	14,500	19,500	24,500	33,000
36	4,000	5,000	7,000	9,000	11,200	16,000	21,000	26,000	36,000
39	4,200	5,300	7,500	9,700	12,000	17,200	22,500	28,000	39,000
42	4,300	5,700	8,000	10,500	13,000	18,500	24,000	30,000	42,000

PLANNING CONSIDERATIONS FOR WATER QUANTITY AND QUALITY

Quantity

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

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

3. Potential use for irrigation water management.

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

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.