

ANSI/ASAE S261.7 FEB1989 (R2015)

Design and Installation of Nonreinforced Concrete Irrigation Pipe Systems



American Society of Agricultural and Biological Engineers

STANDARD

ASABE is a professional and technical organization, of members worldwide, who are dedicated to advancement of engineering applicable to agricultural, food, and biological systems. ASABE Standards are consensus documents developed and adopted by the American Society of Agricultural and Biological Engineers to meet standardization needs within the scope of the Society; principally agricultural field equipment, farmstead equipment, structures, soil and water resource management, turf and landscape equipment, forest engineering, food and process engineering, electric power applications, plant and animal environment, and waste management.

NOTE: ASABE Standards, Engineering Practices, and Data are informational and advisory only. Their use by anyone engaged in industry or trade is entirely voluntary. The ASABE assumes no responsibility for results attributable to the application of ASABE Standards, Engineering Practices, and Data. Conformity does not ensure compliance with applicable ordinances, laws and regulations. Prospective users are responsible for protecting themselves against liability for infringement of patents.

ASABE Standards, Engineering Practices, and Data initially approved prior to the society name change in July of 2005 are designated as "ASAE", regardless of the revision approval date. Newly developed Standards, Engineering Practices and Data approved after July of 2005 are designated as "ASABE".

Standards designated as "ANSI" are American National Standards as are all ISO adoptions published by ASABE. Adoption as an American National Standard requires verification by ANSI that the requirements for due process, consensus, and other criteria for approval have been met by ASABE.

Consensus is established when, in the judgment of the ANSI Board of Standards Review, substantial agreement has been reached by directly and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that a concerted effort be made toward their resolution.

CAUTION NOTICE: ASABE and ANSI standards may be revised or withdrawn at any time. Additionally, procedures of ASABE require that action be taken periodically to reaffirm, revise, or withdraw each standard.

Copyright American Society of Agricultural and Biological Engineers. All rights reserved.

ASABE, 2950 Niles Road, St. Joseph, MI 49085-9659, USA, phone 269-429-0300, fax 269-429-3852, hq@asabe.org

ANSI/ASAE S261.7 FEB1989 (R2015)

Approved September 1989; reaffirmed December 2015 as an American National Standard

Design and Installation of Nonreinforced Concrete Irrigation Pipe Systems

Developed by the Concrete Irrigation Pipe System Committee; approved by the Soil and Water Division Standards Committee; adopted by ASAE 1957; revised 1960, 1961, 1962, 1963, June 1968, May 1974, December 1978; reconfirmed December 1979, March 1981, March 1982, December 1982; revised December 1983; revised editorially February 1984; reconfirmed December 1988; revised February 1989; approved as an American National Standard September 1989; reaffirmed by ASAE December 1994, December 1995; reaffirmed by ANSI October 1996; reaffirmed by ASAE 2001; reaffirmed by ANSI January 2001; reaffirmed by ASAE December 2001, February 2006; revised editorially February 2006; reaffirmed by ANSI March 2006; reaffirmed January 2011 by ASABE; reaffirmed by ANSI February 2011; reaffirmed by ASABE December 2015; reaffirmed by ANSI December 2015.

Keywords: Concrete, Definitions, Irrigation, Pipe

1 Purpose and Scope

1.1 This Standard is intended as a guide to engineers in the design and installation of low or intermediate pressure nonreinforced concrete irrigation pipelines and for the preparation of detailed specifications for a particular installation. It is restricted to pipelines with vents or stands open to the atmosphere or closed pipelines operating at less than 6 m (20 ft) of head. It is not intended to serve as a complete set of design criteria and construction specifications.

1.2 The systems designed and/or installed under this Standard shall utilize pipe conforming to one or more of the following types of nonreinforced concrete irrigation pipe.

1.2.1 Pipelines with mortar joints. The pipe shall conform to the requirements of ASTM Standard C118, Specifications for Concrete Pipe for Irrigation or Drainage.

1.2.2 Pipelines with rubber gasket joints. The pipe and gaskets shall conform to ASTM Standard C505, Specifications for Nonreinforced Concrete Irrigation Pipe with Rubber Gasket Joints.

1.2.3 Cast-in-place pipelines. The pipe shall conform to American Concrete Institute Standard 346, Specifications for Cast-in-Place Nonreinforced Concrete Pipe.

2 Definition of Terms

2.1 appurtenances

2.1.1 float valve: A valve, actuated by a float in a stand, which automatically controls pressure in the downstream pipeline.

2.1.2 gate: A device used to control the flow of water to, from or in a pipeline. It may be opened and closed by screw action or by slide action; the latter is used in short lengths of pipeline and only where pressures and velocities in the line are so low that sudden closure will not cause excessive water hammer. Types of gates, indicative of the place they will be used, are:

2.1.2.1 line gate: A hub-end screw-type or butterfly gate which is installed in the pipeline.

2.1.2.2 stand gate: A gate in a stand which covers an inlet into or outlet to or from a pipeline and which controls water flow in the pipeline. It may be either a screw or a slide type. A screw-type is used at the outlet from a pipeline into the stand. A slide gate has a device to lock it in any desired position.

2.1.3 inlet: An appurtenance to deliver water to a pipeline system.

2.1.3.1 gravity inlet: A structure to control the flow of water from an open conduit into a pipeline. It may be combined with a baffle, gate, screen and/or a sand trap.

2.1.3.2 pressure inlet: A structure where water enters a pipeline system from a pump or pressure system.

2.1.4 outlet: An appurtenance to deliver water from a pipe system to the land or to any surface pipe system. An outlet may consist of a valve, riser pipe, and/or an outlet gate. Several types of outlets are defined as follows:

2.1.4.1 alfalfa valve: An outlet valve attached to the top of a riser with an opening equal in diameter to the inside diameter of the riser pipe and an adjustable lid or cover to control water flow. A ring around the outside of the valve frame provides a seat and seal for a portable hydrant. Some alfalfa valves have a small air-release valve in the cover to provide drainage following irrigation for mosquito abatement; it also provides supplemental air release during pipeline filling. They are often set 25 to 50 mm (1 to 2 in.) below ground surface to reduce erosion.

2.1.4.2 modified alfalfa valve: This valve is similar to an alfalfa valve except that the outside ring is omitted. Only portable hydrants which fit directly over a riser pipe can be used with this outlet.

2.1.4.3 orchard valve: An outlet valve installed inside a riser pipe with an adjustable cover or lid for flow control similar to an alfalfa valve. However, because the valve opening is smaller than the inside diameter of the riser, its flow capacity is less. The top of the riser may be (1) at or slightly below ground surface, (2) 150 to 300 mm (6 to 12 in.) above ground surface with a notch in the side, or (3) similarly above the ground with two or more outlet or distributing gates installed in the side of the riser.

2.1.4.4 portable hydrant: An outlet used for connecting surface pipe to an alfalfa valve outlet.

2.1.4.5 surface pipe outlet: An outlet for attaching surface pipe to a riser without using a portable hydrant.

2.1.4.6 swivel-arm distributor: This outlet has a valve and two short arms of gated pipe which swivel upward from the top of a riser (usually a steel pipe riser). When chained to a center post, they are removed from the cultivation path, and when dropped, the gates distribute the water into furrows.

2.1.4.7 outlet gate: Usually a slide gate, or other type of gate, which is used to control the flow of water from an outlet.

2.1.4.8 capped riser or pot: A riser extending above ground with a watertight cap over its top and outlet gates on its sides slightly above the ground surface (capped riser). To accommodate more outlet gates, a pot with a diameter larger than that of the riser pipe is sometimes installed on the top of the riser (capped pot). Die-cast screw-type valves are sometimes used on capped pots instead of outlet gates. Outlet gates must be placed on the outside of a capped riser or pot and tend to produce an erosive jet of water, which the die-cast valves eliminate. The outlets should normally be operated at heads less than 1.2 m (4 ft) to reduce erosion.

2.1.4.9 open pot: An outlet consisting of an orchard valve installed in the top of a riser with a section of larger diameter pipe mortared to the riser and extending above it. Two or more outlet gates are mounted on the sides of the pot.

2.1.5 stand: A structure formed from vertical sections of pipe or from cast-in-place concrete (box stand). It may serve as a pump stand, gate stand, or float valve stand. It may also function as a vent or sand trap, or both. When gates are not required inside the stands, the stand may be capped and have a smaller vent pipe rising to a height of the hydraulic gradeline plus freeboard. Float valve stands are used on steep slopes and where the water supply rate can be varied to provide automatic control.

2.1.6 vent: An appurtenance to the pipeline which permits the passage of air to or from the pipeline.

2.2 hydraulic terms: Hydraulic terms shall be as defined in the American Society of Civil Engineers Manual of Engineering Practice No. 11, except as noted below:

2.2.1 freeboard: The vertical distance above the elevation of the hydraulic gradeline at working head to the tops of vents or stands.

2.2.2 surge: That transient or cyclic phenomenon wherein water flowing in conduits at atmospheric pressure becomes unsteady with a rocking or oscillating motion as it moves from one steady state condition to another. It may be initiated by valves opening or closing, by pumps turning on or off, or by entrainment and release of large volumes of air.

2.2.3 water hammer: That phenomenon which occurs when the velocity of water flowing in pipelines is rapidly changed, usually by a rapid or sudden gate or valve closure, starting or stopping of a pump, or sudden release of air. The resulting pressure waves pass through the water at high velocities and can produce very high momentary positive and/or negative pressures. Water hammer is not to be confused with surge which occurs in systems open to the atmosphere, although under certain conditions both may be initiated simultaneously.

2.2.4 design working head: The vertical distance that water will rise in a vent or stand above the centerline of the pipeline at design flow at any point in the system. On pipeline profiles the maximum working head will be, at any point, the vertical distance from the centerline of the pipeline to a straight line drawn between the tops of consecutive vents and/or stands. Thus, the maximum working head is the design working head plus freeboard.

3 Design Criteria

3.1 Pipeline

3.1.1 Safety factors

3.1.1.1 External load limit. Although loads are generally light on this type of installation, where there are excessively high fills over the pipe, a safety factor of at least 1.25 shall be applied to the three-edge-bearing test in computing allowable heights of fill over precast nonreinforced concrete pipe. The loads shall be determined by the methods outlined in ASAE Engineering Practice EP260, Design and Construction of Subsurface Drains in Humid Areas.

3.1.1.2 Pressure. Maximum working head for cast-in-place pipelines shall be 4.5 m (15 ft) above the centerline of the pipe. Maximum working heads for precast nonreinforced concrete pipe with mortar joints shall not exceed one-fourth the certified hydrostatic test pressure as prescribed in ASTM Standard C118, Specifications for Concrete Pipe for Irrigation or Drainage, and for pipelines with rubber-gasket joints, one-third the certified hydrostatic test pressure as prescribed in ASTM Standard C505, Specifications for Nonreinforced Concrete Irrigation Pipe with Rubber Gasket Joints.

3.1.1.3 Soil conditions

3.1.1.3.1 Concrete pipelines shall not be installed on sites where the sulfate salt concentration exceeds 1.0% as water soluble sulfate in soil samples, or 4000 parts per million (ppm) sulfate in groundwater samples. Concrete pipe shall be made with cement of the type shown for the following conditions:

Cement	Water Soluble Sulfate in Soil, %	Groundwater Sulfate, ppm
Type V (tricalcium aluminate < 8%)	0.2 to 1.0	1000 to 4000
Type II (tricalcium aluminate < 5%)	0.1 to 0.2	150 to 1000
Not restricted	< 0.1	< 150