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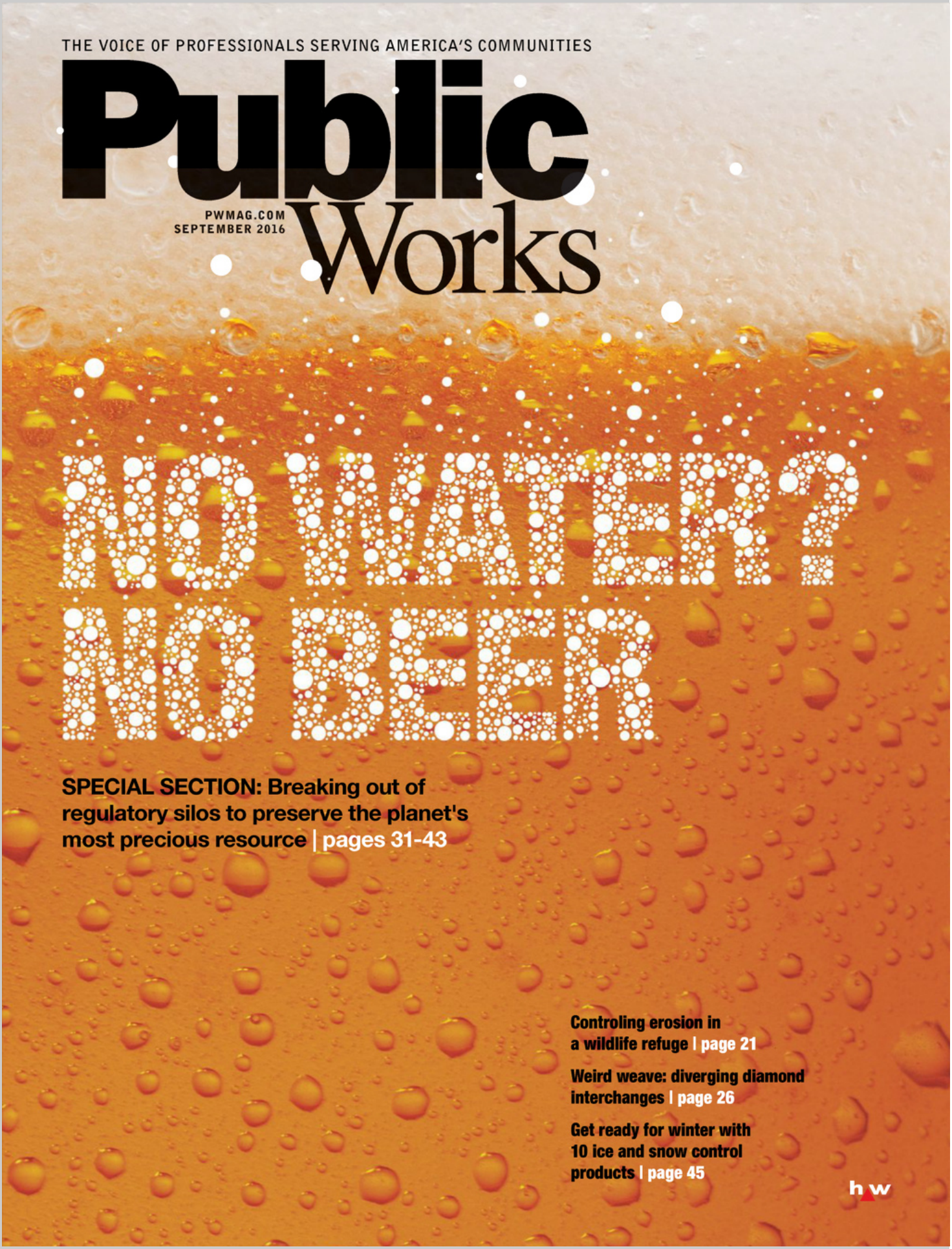

# NO WATER? NO BEER

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# Form follows function

## Pipeline function determines performance requirements of joints.

The first documented U.S. installation of concrete pipe was in Mohawk, N.Y., in 1842. Since then, the design, manufacture, installation, and inspection of concrete wastewater pipelines has grown in complexity.

That complexity has placed increasing demand for critical buried infrastructure of highest quality and reliability that resists natural and man-made calamities. Standard specifications have been initiated, revised, and revised again as more stringent demands are placed on concrete pipeline system components.

Pipeline system joints are no exception because the function of the collection system depends on the performance of the joints.

Whether the purpose is to convey sanitary sewage or stormwater, joints are designed for the easy construction of a continuous line of pipe with an interior free from irregularities. Joints can be designed to provide soil tightness or water tightness, with the ability to accommodate lateral or longitudinal movement, and strength to handle shear or vertical movement. Jointing systems deliver pipelines that resist infiltration of groundwater and backfill material, and exfiltration of sewage or storm water. Some systems, however, are designed to allow infiltration of groundwater for subsurface drainage, or exfiltration for aquifer recharge.

The number of joints in a concrete pipeline is an advantage for many installations because line and grade is maintained and checked more frequently, pipe lengths can easily fit and be positioned in standard trench boxes, and longitudinal stresses in pipe walls are relieved when pipelines encounter non-uniform bedding foundations.

Technological advancements over the last century have led to major improvements in joint design and production. Modern-day concrete pipe offers several types of joints that meet stringent industry and national standards for performance.

### Joint selection guidelines – AASHTO

The AASHTO Standards on Materials Committee published a standard recommended practice to provide design guidance for specifying joint performance for different pipeline applications and defines joint performance. The standard details require plant proof-of-design and installed field testing of each pipe joint system to qualify as meeting one of the joint types.

**Soil tight:** A soil-tight joint does not allow sands similar to sugar or table salt to pass (AASHTO PP 63). A soil tight joint resists infiltration of particles larger than those retained on the No. 200 sieve. Soil tight joints protect against infiltration of backfill material containing high percentage of coarse grain soils, and are influenced by the size of the opening and the length of the channel. Soil tight jointing systems can be specified using mastic filler, external geotextile wrap, external sealing bands, or a rubber compound gasket.

**Silt tight:** A silt tight joint would not allow fines as small as talcum (baby powder) to pass (AASHTO PP 63). The joint resists infiltration of particles that are smaller than those passing the No. 200 sieve. Silt tight joints protect against infiltration of backfill material containing a high percentage of fines. Silt tight joints should pass a 2-pounds per square inch gage laboratory test. Silt tight joints can be designed with mastic filler, external sealing bands, and rubber compound gaskets.

**Leak resistant:** Leak resistance refers to a system that is not completely watertight, but is characterized by a maximum rate of 200 gallons/inch diameter/mile/day. For two pieces of standard 24-inch diameter pipe, 14.5 gallons/day are allowed to leak from those pieces according to AASHTO PP 63. Watertightness refers to a system that has zero leakage or infiltration. Such systems typically utilize a resilient rubber compound seal, and are capable of passing a laboratory hydrostatic pressure or vacuum test of at least (10.8 PSI) without leakage (AASHTO PP 63).

**The design, manufacture, installation, and inspection of concrete wastewater pipelines has grown in complexity.**
ACPA

**Special design joint:** Joints requiring special strength in bending or shear, pull apart capabilities or unusual features such as restrained joints placed on severe slopes, welded joints or flanged and bolted joints for high pressures, high heads and velocities are typically described within special provisions of the project specifications.

## Joint system standards

Design engineers must know what is and is not included within suggested pipe standards. When comparing the performance of pipe jointing systems between concrete pipe and alternate products, one should review the standard specifications of each product. Many ASTM and AASHTO specifications are identical or "sister" specifications. The AASHTO Standards are intended to serve as a standard for preparing state DOT specifications; ASTM Standards are typically referenced in other applications.

**ASTM C 443,** Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets, covers rubber gasketed, water tight joints for circular concrete sewer and culvert pipe and precast manhole sections. It includes both the design of joints and the physical requirements for rubber gaskets to be used. ASTM C 443 requires acceptability of concrete pipe joints and gaskets based on the results of proof-of-design tests.

As infiltration and exfiltration standards changed over the last century, so too has the performance of concrete pipe and concrete pipe joints.

- Joints will perform with up to 13 psi (30-foot head) without leakage in a plant/lab test
- When required by the owner, it is a performance test: (1) Straight alignment: 13 psi for 10 min; (2) Deflected (½-inch joint gap on one side): 10 psi for 10 min.

**ASTM C361** – Standard Specification for Reinforced Concrete Low-Head Pressure Pipe is a specification for low head pressure installations (specification covers design of pipe and joints). Pipe is designed for various hydrostatic heads measured to the centerline of the pipe using rubber gasket joints.

- 25 foot head (10.8 psi) 50 foot head (21.7 psi)
- 75 foot head (32.5 psi) 100 foot head (43.3 psi)

- 125 foot head (54.2 psi)
- Plant test required at 20% over design pressure: (1) Straight alignment; (2) While loaded in shear causing maximum annular space (150 lb / inch diameter).

**ASTM C1628** – Standard Specification for Joints for Concrete Gravity Flow Sewer Pipe, Using Rubber Gaskets covers flexible leak-resistant joints for gravity flow sewer pipe using rubber gaskets when measurable or defined infiltration or exfiltration is a factor (joint specification).

- Joints will perform with up to 13 psi (30 foot head) without leakage in a plant / lab test
- In-plant performance tests: (1) Straight alignment: 13 psi for 10 min.; (2) Deflected (1/2 inch joint gap on one side): 10 psi for 10 min; (3) Joint shear test (per C497) strength test.

**ASTM C990** – Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants includes joints sealed with preformed flexible joint sealant (joint specification). Joints under this specification are "Not intended for operation under internal pressure or subject to measurable infiltration and exfiltration limits."

- The requirements of this specification for horizontal pipe are intended to prevent flow of solids through the joint
- Plant test – 10 psi for 10 min. (a quality control test only, and not intended for service conditions.)

**ASTM C76** – Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe is not intended to be used to specify joint performance (pipe manufacturing specification). "Joints are designed such that pipe sections form a continuous line," but it does specify some manufacturing requirement for joints:

If a non-rubber compound gasket:

- Pipe diameter smaller than 36 inches requires no reinforcing steel in the joints
- Pipe diameters 36 inches and larger require reinforcing in either the spigot or the bell
- The maximum end cover is ½ of the joint length or 3 inches, whichever is less

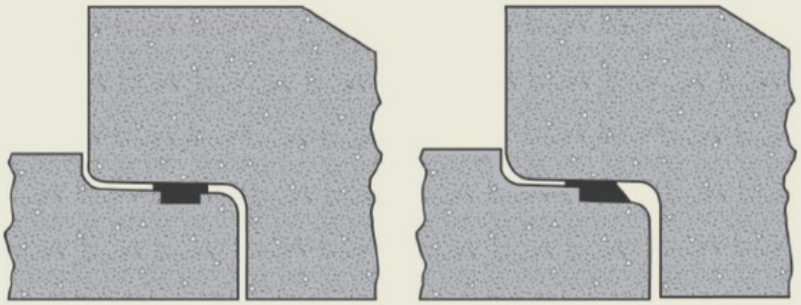
If a rubber compound gasket joint:

- Pipe diameters 12 inches and larger require the bells to have reinforcing steel
- The maximum end cover of the last circumferential is 2 inches

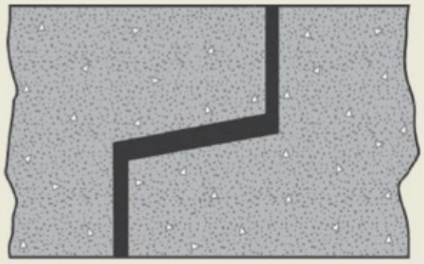
## Sealants and gaskets

Mastic sealants are sticky rubber compounds. The joint surfaces should be cleaned thoroughly and dried before installation. Use a sufficient amount of sealant to fill the annular joint space with some "squeeze-out." During cold weather, workability of the mastic sealant is obtained by warming the sealant and joint surfaces.

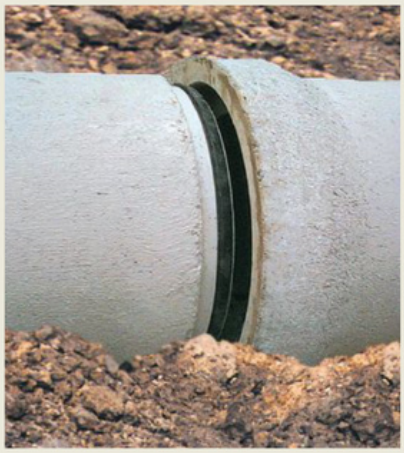
- External sealing bands are designed to be wrapped around the exterior of the joint to provide resistance to infiltration and/or exfiltration. Geotextile filter fabrics, 1 to 2 feet (.3 to .6 meters) wide may be wrapped around the exterior of the pipe joint and secured with tape or stitching. The bands are stretched tightly and



**Concrete joints with a groove or offset on the spigot and/or bell utilize a rubber compound gasket, which fits against the shoulder or in the groove of the joint.**



**Joints utilizing flexible mastic sealants typically perform as a soil tight system unless higher performance expectations are described in the project specifications.**



**Concrete surfaces with opposing shoulders on both ends, such as the bell and spigot and the modified tongue and groove joints, generally utilize a rubber compound gasket or flexible mastic for leak-resistant, silt-tight and soil-tight sealing.** ACPA

held in place by the weight of the backfill material.

- O-ring gaskets are available in multiple cord diameters, compounds, and durometers to meet pipeline applications and soil conditions. Gasket manufacturers certify the volumetric size and strength of the splice, but check these features. The correct-sized gasket must be installed on the pipe or it will break the bell if the gasket diameter is too large or not seal the joint, if too small.
- Use profile gaskets in confined or single offset joints. They come in a variety of shapes and sizes and perform well because profile gaskets are less prone to displacement during pipe joining than the O-ring. The bell and spigot of the two pipes to be joined have to be lubricated; they can't be installed backwards if non-symmetrical.
- Install pre-lubricated gaskets by placing the gasket firmly against the shoulder of the pipe spigot. No field lubrication is needed, since the lubrication is self-contained inside the gasket. Pre-lubricated gaskets cannot be hung for storage because the lubrication will drain to the low end of the gasket. Pre-lubricated gaskets save time in the field, but cost more than traditional gaskets. PW

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