Designation: C1628 – 17ε1

Standard Specification for Joints for Concrete Gravity Flow Sewer Pipe, Using Rubber Gaskets[1]

This standard is issued under the fixed designation C1628; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

ε[1] NOTE—Corrections were editorially made in December 2018.

1. Scope

1.1 This specification covers flexible leak resistant joints for concrete gravity flow sewer pipe using rubber gaskets for sealing the joints, where measurable or defined infiltration or exfiltration is a factor of the design. The specification covers the design of joints and the requirements for rubber gaskets to be used therewith, for pipe conforming in all other respects to Specifications C14, C76, C655, C985, and C1417, provided that, if there is conflict in permissible variations in dimension, the requirements of this specification shall govern for joints.

NOTE 1—Infiltration or exfiltration quantities for an installed pipeline are dependent upon many factors other than the joints, and allowable quantities must be covered by other specifications and suitable testing of the installed pipeline and system. This specification covers the design, material, and performance of the rubber gasket joint only. Joints covered by this specification are for hydrostatic pressures up to 13 psi without leakage, when plant tested in accordance with Section 10.

1.2 The values stated in inch-pound units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C14 Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe

C76 Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

C497 Test Methods for Concrete Pipe, Manhole Sections, or Tile

C655 Specification for Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe

C822 Terminology Relating to Concrete Pipe and Related Products

C985 Specification for Nonreinforced Concrete Specified Strength Culvert, Storm Drain, and Sewer Pipe

C1417 Specification for Manufacture of Reinforced Concrete Sewer, Storm Drain, and Culvert Pipe for Direct Design

C1619 Specification for Elastomeric Seals for Joining Concrete Structures

3. Terminology

3.1 *Definitions*—For definitions of terms relating to concrete pipe, see Terminology C822.

4. Basis of Acceptance

4.1 The acceptability of the pipe joints and gasket shall be determined by the approved design submittal information, results of the physical tests prescribed in this specification, and by inspection to determine whether the pipe joints and gaskets conform to this specification as to design and freedom from defects.

[1] This specification is under the jurisdiction of ASTM Committee C13 on Concrete Pipe and is the direct responsibility of Subcommittee C13.08 on Joints for Precast Concrete Structures.

Current edition approved Jan. 1, 2017. Published January 2017. Originally published in 2006. Last previous edition approved in 2011 as C1628 – 11. DOI: 10.1520/C1628-17E01.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

5. Materials and Manufacture for Gaskets

5.1 The gasket shall be fabricated from a rubber compound. The basic polymer shall be natural rubber, synthetic rubber, or a blend of both meeting the physical requirements prescribed in Specification C1619.

5.1.1 Gaskets for standard use shall meet Class E requirements. Gaskets which require oil resistant properties shall meet Class B requirements.

5.2 *Circular Cross-Section Gaskets:*

5.2.1 Circular cross-section gaskets shall be extruded or molded to the specified size within a tolerance of ±1⁄64 in. or ±1.5 % of the cord diameter, whichever is larger.

5.2.2 Circular cross-section gaskets shall have the nominal design cut length tolerance of ±3.0 % for extruded and spliced gaskets.

5.2.3 Each gasket shall be manufactured to provide the volume of rubber required by the pipe manufacturer's joint design with a tolerance of ±3 %for gaskets up to and including l- in. in diameter and ±1 % for gaskets of 1-in. diameter and larger. The allowable percentage tolerance shall vary linearly between ±3 % and ±1 % for gasket diameters between ½ and 1 in.

5.3 *Non-Circular Cross-Section Gaskets:*

5.3.1 Non-circular cross-section gaskets shall be extruded or molded to the design size within a tolerance of ±1⁄64 in. or ±3.0 % on any dimension, measured at any cross section, whichever is larger.

5.3.2 Non-circular cross-section gaskets shall have the nominal design cut length tolerance of ±3 % for extruded and spliced gaskets.

6. Design of Joints

6.1 When requested at time of purchase, the pipe manufacturer shall furnish the owner with a detailed design of the joint or joints to be furnished under this specification. Included within this submittal shall be gasket shape, dimensions, tolerance, and hardness, joint geometry, pipe, and joint dimension tolerances, gasket deformation analysis including manufacturing tolerances, proof of design; hydrostatic and structural test information, manufacturer's quality assurance testing, and documentation procedures. The manufacturing tolerances required in joint design shall be specified by the manufacturer and verified by the manufacturer's written quality assurance testing procedures and documentation.

6.1.1 The joint shall consist of a bell on one end of a unit of pipe and a spigot on the adjacent end of the joining pipe.

6.1.2 All surfaces of the joint, upon or against which the gasket shall bear, including the bell entrance slope taper, shall be free of imperfections that would adversely affect the performance of the joint.

6.1.3 The joint shall be designed to provide a minimum distance when measured between the nearest end of spigot groove or spigot offset and end of bell, excluding bell entrance chamfer, at the design closure position of ½-in. for pipe 12 to 27 in. diameters and ¾ in. for pipe 30-in. diameter and larger.

NOTE 2—See joint data form in Appendix, dimension "A".

6.1.4 The joints of the pipe shall be of such design that they will withstand the forces caused by the deformation of the gasket when joined and when tested in accordance with Section 9.

6.1.5 The angle of taper on the conic surfaces of the inside of the bell end and the outer surface of the spigot end where the gasket seats shall not be more than 2°, measured from the pipe axis. Tapers up to 3° are not prohibited if proven adequate by plant tests as specified in Section 9 and approved by the owner under the provisions of 6.4. It is not prohibited for the conic surfaces to be modified with grooves or offsets to properly contain and seat the gasket.

6.1.6 The gasket shall be the sole element depended upon to make the joint flexible and leak resistant. The gasket shall be a continuous ring which fits snugly into the annular space between the overlapping surfaces of the assembled pipe joint to form a flexible watertight seal.

6.1.7 Where the particular joint design utilizing a rubber gasket dictates the use of a lubricant to facilitate assembly, the lubricant composition shall have no deterioration or detrimental swelling effects on the performance of the joint due to prolonged exposure.

6.2 *Confined Circular Cross-Section Gasket Joint Design:*

6.2.1 In joints that utilize spigot grooves and solid gaskets of circular cross-section, the smallest potential volume of the annular space provided for the gasket, with the engaged joint design closure in concentric position, shall be not less than the design volume of the gasket furnished. The smallest potential cross-sectional area of the annular space shall be calculated using the minimum bell diameter, maximum spigot diameter, minimum width of groove at surface of spigot, and minimum depth of groove. The smallest potential volume of the annular space shall be calculated considering the centroid of the cross-sectional area to be at the midpoint between the inside bell surface and the surface of the groove on which the gasket is seated at the centerline of the groove.

6.2.2 The gasket shall be of such diameter that when the outer surface of the spigot and the inner surface of the bell come into contact at some point in their periphery (off-center position), the deformation in the gasket shall not exceed 50 % at the point of contact nor be less than 15 % at any point. When determining the maximum percent deformation of the gasket, the minimum depth of groove and the stretched gasket diameter shall be used and calculations made at the centerline of the groove. When determining the minimum percent deformation of the gasket, the minimum groove width, the maximum bell diameter, the minimum spigot diameter, the maximum depth of groove, and the stretched gasket diameter shall be used and calculations made at the centerline of the groove. For gasket deformation calculations, stretched gasket diameter shall be determined as being the design diameter of the gasket divided by the square root of $(1 + x)$ where x equals the design percent of gasket stretch divided by 100.

6.2.3 In joints that utilize spigot grooves described in 6.2.1 and 6.2.2, the gasket shall not be stretched more than 30 % of its original circumference, except that gaskets meeting Class E requirements used on pipe 96-in. diameter and larger shall not be stretched more than 35 %.

6.3 *Non-Circular Cross-Section Gasket Joint Design:*

6.3.1 In joints that utilize gaskets of non-circular cross-section placed on a single offset spigot configuration, the annular space between the gasket contact surfaces of the assembled joint shall have the rubber gasket deformed not less than 15 % or more than 60 % when the pipe is joined with maximum joint surface eccentricity (off-center) with all manufacturing and gasket tolerances being considered. When determining the maximum percent deformation of the gasket, the minimum bell diameter, the maximum spigot diameter, and the stretched gasket height shall be used at design closure. When determining the minimum percent deformation of the gasket, the maximum bell diameter, the minimum spigot diameter, and the stretched gasket height shall be used at design closure. For gasket deformation calculations the stretched height shall be determined by 8.1.2.

6.3.2 In lieu of the deformation limit design method described in 6.3.1, the manufacturer is not prohibited from submitting a gasket force analysis. This design method shall analyze the annular space between the gasket contact surfaces of the assembled joint and compare it to the compression versus force characteristics for the proposed non-circular cross-section gasket as described in gasket compression curves as furnished by the gasket manufacturer, pipe joint manufacturer, or an independent testing laboratory. The joint design analysis shall have the rubber gasket deformed within the limits of the specified design force limits when the pipe is joined off-center with all manufacturing and gasket tolerances being considered. When determining the maximum deformation of the gasket, the minimum bell diameter, the maximum spigot diameter, and the stretched gasket height shall be used. When determining the minimum deformation of the gasket, the maximum bell diameter, the minimum spigot diameter, and the stretched gasket height shall be used.

6.3.3 In joints that utilize offsets on the bell and spigot to confine a non-circular cross-section gasket, the gasket shall be of such height that when the outer surface of the spigot and the inner surface of the bell come into contact at some point in their periphery, the deformation in the gasket shall not exceed 55 % at the point of contact nor be less than 15 % at any point. When determining the maximum percent deformation of the gasket, the minimum bell diameter, the maximum spigot diameter and the maximum stretched gasket height shall be used. When determining the minimum percent deformation of the gasket, the maximum depth of shoulders, the maximum bell diameter, the minimum spigot diameter, and the minimum stretched gasket height shall be used. For gasket deformation calculations, the stretched height shall be determined as described in 8.1.2.

6.3.4 The gasket for joints described in 6.3 shall not be stretched more than 30 % of its unstretched length when seated on the spigot end.

6.4 *Alternative Joint Designs:*

6.4.1 Alternative joint designs, other than those described in 6.1, 6.2, and 6.3, shall not be used unless they are approved in writing by the owner and provided all the tests comply with this specification. The pipe manufacturer shall submit to the owner detailed designs for any alternative joint or gasket, or both. Design submissions shall include joint geometry, tolerances, gasket characteristics, gasket deformation analysis, plant quality control tests, and such other information as required by the owner to evaluate the joint design for required field performance. Joints and gaskets of alternative joint designs shall meet all test requirements of Sections 5and 9 contained within this specification.

7. Permissible Variations in Dimensions

7.1 The diameter of pipe joint gasket bearing surfaces is confirmed by taking three equally spaced diametric measurements with a calibrated instrument accurate within ±0.005 in., all of which shall be within the minimum and maximum limits used in Section 6.

7.1.1 Specific methods, frequency, and record keeping of joint measurements shall be included in the manufacturer's written quality assurance testing procedures and documentation.

8. Test Methods for Gaskets

8.1 In addition to Specification C1619, the physical properties of the gaskets shall be determined in accordance with the following methods:

8.1.1 *Gasket Volume Determination*—Determine the volume of gasket sections in accordance to Test Method C497.

8.1.2 *Non-Circular Cross-Section Gasket Stretch Height*—Determine the stretch height of gasket sections in accordance to Test Method C497.

8.1.3 *Gasket Length*—Determine the stretch length of gasket sections in accordance to Test Method C497.

9. Performance Requirements for Joints

9.1 The hydrostatic and structural tests are conducted to serve as a proof-of-design test and the results shall be included within the joint submittal documents to the owner. The hydrostatic and structural tests and results shall be witnessed and certified by an independent testing agency, an owner's representative, or manufacturer's employee who is identified within the manufacturer's quality assurance program.

9.1.1 At or before the time of placing an order the owner is permitted to require an additional proof-of-design test to verify compliance to this specification.

9.1.2 Any modifications to a previously proof tested and approved joint which met this specification such as, but not limited to; gasket profile or hardness, manufacturing tolerance revision, a reduction of concrete compressive strength or reinforcement which affect the joint design or performance shall require a new proof-of design tests described in the appropriate sections of 9.2, 9.3, or both.

9.2 *Hydrostatic Tests for Joints*—The manufacturer shall conduct off-center hydrostatic joint tests described in Test Method C497 and herein on joint types covered by this specification.

9.2.1 It is not prohibited that the assembled joint stands under a pressure of 13 psi or less, for a maximum of 24 h prior to the test. The assembled joint shall pass the prescribed hydrostatic tests without leakage at the joints. Moisture or beads of water appearing on the surface of the joint will not be