



Designation: **C 990 – 03a**

Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants¹

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1. Scope

1.1 This specification covers joints for precast concrete pipe and box, and other sections using preformed flexible joint sealants for use in storm sewers and culverts which are not intended to operate under internal pressure, or are not subject to infiltration or exfiltration limits. Joint material used in horizontal applications is intended to prevent the flow of solids through the joint.

1.2 For precast concrete manhole sections and other vertical structures, which are subject to internal or external pressure, infiltration or exfiltration limits are not prohibited from being specified. Joints in vertical structures covered by this specification are intended mainly to prevent the flow of solids or fluids through the joint.

1.3 This specification is to be used with pipe and structures conforming in all respects to Specifications C 14, C 76, C 478, C 506, C 507, C 655, C 985, and C 1433, provided that if there is a conflict in permissible variations in dimensions, the requirements of this specification shall govern.

1.4 This specification is the companion to SI specification C 990M; therefore, no SI equivalents are shown in this specification.

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

NOTE 1—This specification covers the material and performance of the joint and sealant only. Infiltration and exfiltration quantities for installed sections are dependent on factors other than the joints which must be covered by other specifications and suitable testing of the installed pipeline.

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2. Referenced Documents

2.1 ASTM Standards:²

- C 14 Specification for Concrete Sewer, Storm Drain, and Culvert Pipe
- C 76 Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
- C 478 Specification for Precast Reinforced Concrete Manhole Sections
- C 506 Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
- C 507 Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
- C 655 Specification for Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
- C 822 Terminology Relating to Concrete Pipe and Related Products
- C 969 Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
- C 972 Test Method for Compression—Recovery of Tape Sealant
- C 985 Specification for Nonreinforced Concrete Specified Strength Culvert, Storm Drain, and Sewer Pipe
- C 1433 Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers
- D 4 Test Method for Bitumen Content
- D 6 Test Method for Loss on Heating of Oil and Asphaltic Compounds
- D 36 Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus)
- D 71 Test Method for Relative Density of Solid Pitch and Asphalt (Displacement Method)
- D 92 Test Method for Flash Fire Points by Cleveland Open Cup
- D 113 Test Method for Ductility of Bituminous Materials
- D 217 Test Method for Cone Penetration of Lubricating Grease
- D 482 Test Method for Ash from Petroleum Products

2.2 AASHTO Standards:³

- T47 Test for Loss on Heating of Oil and Asphaltic Compounds
- T48 Test for Flash and Fire Points by Cleveland Open Cup
- T51 Test for Ductility of Bituminous Material
- T111 Test for Inorganic Matter or Ash
- T229 Test for Specific Gravity of Asphalts and Tar Pitches Sufficiently Solid to be Handled in Fragments

3. Terminology

- 3.1 *Definitions*—For definitions of terms relating to concrete pipe, see Terminology C 822.

4. Basis of Acceptance

4.1 The acceptability of the pipe joint and sealant shall be determined by the results of the physical tests prescribed in this specification, if and when required, and by inspection to determine whether the pipe joint and the sealant conform to this specification as to design and freedom from defects.

5. Materials and Manufacture for Sealants

5.1 Bitumen sealants shall be produced from asphalts, hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler and shall contain no solvents. Butyl rubber sealants shall be produced from blends of butyl rubber and refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler and shall contain no solvents.

5.2 Blends of material used in the manufacture of flexible joint sealants shall be approved by the owner and meet the composition and physical requirements prescribed in Section 6. The joint sealant shall not depend on oxidizing, evaporating, or chemical action for its adhesive or cohesive strength and shall be supplied preformed and of suitable cross section and size to seal the joint annular space when the sections are joined. For a given joint size, the sealing material, as furnished, shall be such so as to encircle the outside circumference of the spigot or tongue of the joint or the inside circumference of the bell or groove and shall not be stretched when seated in the joint. Sealant material shall be furnished in the required length and cross-dimensions, and the dimensions shall be clearly marked. Sealant material shall be preformed to the following specified tolerances:

Length, %	Tolerance
Cross sectional area, %	+ 10, – 0
Volume (in. ³ /linear ft (mm ³ /linear m)), %	+ 10, – 5
Cross-sectional dimensions (inches), %	+ 5, – 5
	+ 10, – 5 ^A

^ADimensions in the field may vary from preformed dimensions

6. Physical Requirements for Sealants

6.1 Bitumen Sealants:

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*, Vol 04.05, volume information, refer to the standard's Document Summary page on the ASTM website.

Annual Book

³ Available from American Association of State Highway and Transportation Officials, 444 N. Capitol, Washington, DC 20001.

6.1.1 Bitumen sealants shall comply with the following composition and physical requirements. Testing shall be in accordance with the methods prescribed in Section 9.

Bitumen (hydrocarbon blends), % by weight	50-% min
Hydrocarbon Blends, % by weight	50 min
Ash-Inert Mineral Matter, % by weight	30-% min
Ash-Inert Mineral Matter, % by weight	25 min
Volatile Matter, % by weight	3-% max
Volatile Matter, % by weight	3 max
Specific Gravity at 77°F	1.20 min
	1.35 max
Specific Gravity at 77°F	1.15 — 1.40
Ductility at 77°F, cm	5.0 min
Ductility at 77°F, cm	5 min
Flash Point, C.O.C.	350°F min
Fire Point, C.O.C.	375°F min
Softening Point	320°F min
Compression Index at 77°F,	100 lbf/in ³ max
Compression Index at 32°F,	350 lbf/in ³ max
Cone Penetration at 77°F, 150g, 5s, dmm	50–120
Cone Penetration at 32°F, 150g, 5s, dmm	15 min
Penetration at 77°F, 150 gm, 5-s	50 min
	120 max
Chemical Resistance	No deterioration, no cracking, no swelling

6.2 Butyl Rubber Sealant:

6.2.1 Butyl rubber sealants (elastomeric polymer shall be butyl rubber only) shall comply with the following composition and physical requirements. Testing shall be in accordance with the methods prescribed in Section 9.

Butyl Rubber (hydrocarbon blends), % by weight	50 % min
Ash-Inert Mineral Matter, % by weight	30 % min
Volatile Matter, % by weight	3 % max
Specific Gravity at 77°F	1.15 min
	1.40 max
Ductility at 77°F, cm	5.0 min
Flash Point, C.O.C.	350°F min
Fire Point, C.O.C.	375°F min
Compression Test at 77°F, lbf/in. ³	100 max
at 32°F, lbf/in. ³	200 max
Cone Penetration at 77°F, dmm	50 to 120
at 32°F, dmm	30 min
Chemical Resistance	No deterioration, no cracking, no swelling

7. Design of Joints

7.1 The pipe manufacturer shall furnish the owner with the detailed design of the joint. The sealant manufacturer shall furnish a complete list of joint sizes showing the minimum size of material to be used with each size joint, along with complete instructions on recommended installation procedures.

7.1.1 The joint design shall consist of a bell or groove on one end of the section and a spigot or tongue on the adjacent end of the joining section.

7.1.2 All surfaces of the joint upon or against which the sealant will bear shall be free of spalls, cracks or fractures, and imperfections that would adversely affect the function of the joint.

7.1.3 The joints of the sections shall be of such design that they will withstand the forces caused by the compression of the sealant when joined, without cracking or fracturing when tested, in accordance with Section 10.

7.1.4 For horizontal installations, the angle of taper on the conic surfaces of the inside of the bell or groove and the outer surface of the spigot or tongue where the sealant seats shall be not more than 10° measured from the pipe axis. Alternate tapers are permitted if proven adequate by the plant tests specified in Section 10 and approved by the owner.

7.1.5 The annular space measured perpendicular to the sealant bearing surfaces of the assembled and centered joint shall not exceed ½ in. at any point or the maximum specified by the sealant manufacturer, whichever is the lesser. The joint design shall provide for the deflection of a section by opening one side of the outside perimeter of the joint ½ in. wider than the assembled position. Where greater deflections are required than provided by the joint design, beveled joints or elbows may be acceptable if approved by owner.

7.1.6 The sealant shall be the sole element depended upon to make the joint flexible and meet the test requirements set forth in Section 10. The sealant is not prohibited from being composed of one or more pieces and shall be applied as a continuous ring in installation.

7.2 Alternative Joint Designs:

7.2.1 When agreed upon by the owner, manufacturers are not prohibited from submitting to the owner, detailed designs for joints other than those described in 7.1.

7.2.2 Design submissions shall include joint dimensions, tolerances, proposed plant tests, and such other information as required

by the owner to evaluate the joint design for field performance.

7.2.3 Joints of alternative designs shall meet all test requirements of this specification unless waived by the owner. Alternative joint designs shall be acceptable provided the designs are approved by the owner prior to manufacture and provided the test pipe joints comply with the tests as described in Section 10.

8. Permissible Variations in Dimensions

8.1 The planes formed by the ends of nonbeveled pipe sections shall not vary from the perpendicular to the longitudinal axis by more than $\frac{3}{16}$ in. for internal horizontal spans of 30 in. and smaller; or by more than $\frac{1}{4}$ in. for internal horizontal spans of 33 to 54 in. inclusive; or by more than $\frac{3}{8}$ in. for internal horizontal spans of 60 in. and larger.

9. Test Methods for Sealants

9.1 The composition and physical properties of bitumen or butyl sealants shall be determined in accordance with the following test methods:

9.1.1 *Bitumen or Butyl Rubber (hydrocarbon blends)*—Test Method D 4.

9.1.2 *Ash-Inert Mineral Matter*—AASHTO T111.

9.1.3 *Volatile Matter*— Test Method D 6 or AASHTO T47.

9.1.4 *Specific Gravity*— Test Method D 71 or AASHTO T229.

9.1.5 *Ductility*—Test Method D 113 or AASHTO T51.

9.1.6 *Softening Point*— Test Method D 36.

9.1.7 *Penetration*— Test Method D 217.

9.1.8 *Flash Point and Fire Point* —Test Method D 92. The cup shall be heated by an electric heater or oven.

9.1.9 *Chemical Resistance*—Chemical resistance shall be determined by 30-day separate immersion in 5 % solutions at ambient room temperature of HCl (hydrochloride acid), H₂SO₄ (sulfuric acid), NaOH (sodium hydroxide), KOH (potassium hydroxide), H₂S (saturated hydrogen sulfide solution).

9.1.10 *Compression Test*— Test Method C 972.

9.2 The sealant manufacturer shall, if required, furnish certified copies of test reports specified under this specification.

10. Performance Requirements for Joints

10.1 The sections shall be tested hydrostatically in vertical alignment and a sufficient number of sections shall be assembled in straight alignment to develop a pressure of at least 10 psi for 10 minutes at the test joint. Alternate test methods are acceptable as long as the designated internal hydrostatic pressure is achieved at the joint. No mortar or concrete coatings, fillings or packing shall be placed prior to water tightness tests. There shall be no visible leakage. Moisture or beads of water appearing on the joint will not be considered as leakage.

10.2 The user of this specification is advised that the hydrostatic test is intended only for use as a quality control test, and not as a simulated service test. The 10 psi pressure criterion for sections should not be considered an indication of the hydrostatic pressure capability of the joint and sealant under installed conditions. Field tests for completed portions of concrete pipe and structures are not covered by this specification, but shall be included in the specifications for installation.

11. Storage

11.1 The sealant shall be stored in as cool and as clean a place as practicable, preferably at a temperature between 50 to 70°F.

12. Inspection

12.1 The quality of the materials and the joint and sealant shall be subject to inspection and approval by the owner.

13. Rejection

13.1 Pipe joints and sealants shall be subject to rejection upon failure to conform to any of the requirements of this specification.

13.2 Sealants shall be subject to rejection whenever they show surface checking, weathering, or other deterioration prior to installation in the work.

13.3 Joints that are damaged because of carelessness or continuing failure to prevent recurrent imperfections in manufacturing or damage during handling shall be subject to rejection.

14. Repairs

14.1 Spalled areas, manufacturing imperfections, or damage during handling of a pipe or box or other section that will adversely affect the joint, are not prohibited from being repaired. The repairs will be acceptable if, in the opinion of the owner, the repairs are sound, properly finished and cured, provided the length of a single area to be repaired does not exceed 10 % of the total perimeter length, and the length of several areas to be repaired does not exceed 20 % of the total perimeter length. The finished repair shall conform to the requirements of 7.1.2. At the option of the owner, the pipe joint that has been repaired shall be subjected to the designated hydrostatic test in 10.1.

15. Keywords

15.1 concrete manholes; concrete pipe; flexible; joints; sealants

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