



Designation: D 5893 – 96

Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements¹

This standard is issued under the fixed designation D 5893; 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.

1. Scope

1.1 This specification covers cold applied, single component, chemically curing silicone sealants that are based on polymers of polysiloxane structures and are intended for use in sealing joints and cracks in portland cement concrete highway and airfield pavements. The specification includes both non-sag and self-leveling types of sealants.

1.1.1 This specification does not purport to cover the properties required of sealants for use in areas of portland cement concrete pavements subject to jet fuel or other fuel spillage, such as vehicle or aircraft refueling and maintenance areas, or a combination thereof.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.3 The following safety hazards caveat pertains only to the test methods portion, Section 8, of this specification: *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 and health practices and determine the applicability of regulatory limitations prior to use.* Specific precautionary statements are given in Appendix X1.

2. Referenced Documents

2.1 ASTM Standards:

- C 639 Test Method for Rheological (Flow) Properties of Elastomeric Sealants²
- C 661 Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer²
- C 679 Test Method for Tack-Free Time of Elastomeric Sealants²
- C 792 Test Method for Effects of Heat Aging on Weight Loss, Cracking, and Chalking of Elastomeric Sealants²
- C 793 Test Method for Effects of Accelerated Weathering on Elastomeric Joint Sealants²

- C 1183 Test Method for Extrusion Rate of Elastomeric Sealants²
- D 412 Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers—Tension³
- D 1985 Practice for Preparing Concrete Blocks for Testing Sealants, for Joints and Cracks⁴
- D 2202 Test Method for Slump of Sealants²
- D 5249 Specification for Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints⁴
- D 5329 Test Methods for Sealants and Fillers, Hot-Applied, for Joints and Cracks in Asphaltic and Portland Cement Concrete Pavements⁴
- D 5535 Terminology Relating to Formed-in-Place Sealants for Joints and Cracks in Pavements⁴
- G 23 Practice for Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials⁵
- G 53 Practice for Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials⁵

3. Terminology

3.1 *Definitions*—Refer to Terminology D 5535 for definitions of the following terms used in this specification: backer material, chemically curing sealant, joint, and sealant.

4. Classification

4.1 Sealants meeting the requirements of this specification shall be classified according to type as one of the following:

4.1.1 *Type NS (Non-Sag)*—A single component sealant that resists sagging after application in horizontal joints and requires tooling or forming into the joint to achieve the desired application configuration.

4.1.2 *Type SL (Self-Leveling)*—A single component sealant that is self-leveling and has sufficient flow characteristics to form a smooth and level surface in horizontal joints without tooling or forming after application.

¹ This specification is under the jurisdiction of ASTM Committee D-4 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.33 on Formed-In-Place Sealants for Joints and Cracks in Pavements.

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² *Annual Book of ASTM Standards*, Vol 04.07.

³ *Annual Book of ASTM Standards*, Vol 09.01.

⁴ *Annual Book of ASTM Standards*, Vol 04.03.

⁵ *Annual Book of ASTM Standards*, Vol 14.02.

5. General Requirements

5.1 The sealant shall be a uniform mixture with a consistency that is appropriate for application to joints in portland cement concrete pavements through pressure feed application units or by hand caulking guns. The sealant shall cure by means of a chemical reaction of the components to form an elastomeric seal that seals joints in concrete throughout repeated cycles of thermal expansion and contraction and against the infiltration of moisture and incompressibles.

5.2 When stored in the original, unopened containers at conditions recommended by the manufacturer, the sealant shall be capable of meeting the specification requirements for at least six months after the original purchase.

5.3 After specified curing in the laboratory, the color of the cured sealant shall be as agreed upon by the purchaser and the manufacturer.

5.4 The sealant is intended for use in appropriately prepared, clean, dry, and frost-free portland cement concrete joints or cracks in new pavements or pavements that are being resealed.

6. Physical Requirements

6.1 *Cure Evaluation*—The sealant shall cure throughout a 12.7 by 12.7 mm (0.5 by 0.5 in.) cross section within 21 days when evaluated in accordance with 8.3. At 21 days \pm 4 h of curing, the sealant shall not show the presence of any uncured material, as indicated by sealant that has not changed from a liquid to a solid state.

6.2 *Rheological Properties:*

6.2.1 When tested in accordance with Test Method D 2202, Type NS sealant shall not slump more than 7.6 mm (0.30 in.).

6.2.2 When tested in accordance with Test Method C 639 for Type I sealant, Type SL sealant shall exhibit a smooth, level surface with no indication of bubbling.

6.3 *Extrusion Rate*—When tested in accordance with Test Method C 1183 for Type S sealants, the extrusion rate shall not be less than 50 mL/min (3.05 in.³/min).

6.4 *Tack-Free Time*—The sealant shall be tack-free, with no transfer of the sealant to the polyethylene, when tested at 5 h \pm 10 min in accordance with Test Method C 679.

6.5 *Effects of Heat Aging*—The sealant shall not lose more than 10 % of its original weight or show any cracking or chalking when tested in accordance with Test Method C 792.

6.6 *Bond*—The sealant shall be tested in accordance with 8.8 at $-29 \pm 1^\circ\text{C}$ ($-20 \pm 2^\circ\text{F}$) for five complete cycles of 100 % extension each. All three specimens shall meet the following requirements for bond:

6.6.1 *Non-Immersed*—No specimen shall develop any crack, separation, or other opening in the sealant or between the sealant and the concrete test blocks.

6.6.2 *Water-Immersed*—No specimen shall develop any crack, separation, or other opening in the sealant or between the sealant and the concrete test blocks.

6.6.3 *Oven-Aged*—No specimen shall develop any crack, separation, or other opening in the sealant or between the sealant and the concrete test blocks.

6.7 *Hardness:*

6.7.1 When tested in accordance with Test Method C 661 at $-29 \pm 1^\circ\text{C}$ ($-20 \pm 2^\circ\text{F}$), using a Type A-2 durometer, the hardness shall not exceed 25.

6.7.2 When tested in accordance with Test Method C 661 at $23 \pm 2^\circ\text{C}$ ($73.4 \pm 3.6^\circ\text{F}$), using a Type 00 durometer, the hardness shall not be less than 30.

6.8 *Flow*—When tested in accordance with 8.10 at $93.3 \pm 1^\circ\text{C}$ ($200 \pm 2^\circ\text{F}$) for 72 h \pm 30 min, there shall be no flow.

6.9 *Rubber Properties in Tension:*

6.9.1 *Ultimate Elongation*—When tested in accordance with Test Methods D 412 using Die C, at $23 \pm 2^\circ\text{C}$ ($73.4 \pm 3.6^\circ\text{F}$), and using a 500 ± 20 mm/min (20 ± 2 in./min) elongation rate, the ultimate elongation of the sealant shall not be less than 600 %.

6.9.2 *Tensile Stress at 150 % Elongation*—When tested in accordance with Test Methods D 412 using Die C, at $23 \pm 2^\circ\text{C}$ ($73.4 \pm 3.6^\circ\text{F}$), and using a 500 ± 20 mm/min (20 ± 2 in./min) elongation rate, the tensile stress at 150 % elongation shall not exceed 310 kPa (45 psi).

6.10 *Effects of Accelerated Weathering*—After 500 h of exposure in accordance with 8.12, the sealant shall not flow, show tackiness, the presence of an oil-like film, or reversion to a mastic-like substance, form surface blisters either intact or broken, form internal voids, or have surface crazing, chalking, cracking, hardening, or loss of rubber-like properties. The sealant shall not experience any cracking or crazing when subjected to the Test Method C 793 bend test. Evidence of physical change in the surface of the material by visual and tactile examination shall constitute failure of this test.

6.11 *Resilience*—When tested in accordance with 8.13, the resilience of the sealant shall not be less than 75 %.

7. Sampling

7.1 Samples may be taken at the plant or warehouse prior to delivery or at the time of delivery, at the option of the purchaser. If sampling is conducted prior to shipment, the inspector representing the purchaser shall have free access to the material to be sampled. The inspector shall be afforded all reasonable facilities for inspection and sampling that shall be conducted so as not to interfere unnecessarily with the operation of the works.

7.2 Samples for testing shall consist of not less than 3.78 L (1 gal) of the sealant. If the sealant is supplied in cartridges, a sufficient number of cartridges shall be obtained at random to provide at least 3.78 L (1 gal). If the sealant is supplied in 18.9-L (5-gal) or 207.9-L (55-gal) containers, the sample shall be obtained from an unopened container. The container shall be opened and any surface covering removed to expose the sealant. The required amount of sealant shall be removed from the container quickly and placed in a container that will minimize exposure of the sealant to air. The sample container shall be compatible with the sealant. Use of a liner inside the container may assist in minimizing air exposure. The sample container shall be completely filled in a manner that excludes air entrapment and then sealed. A metal can with a double friction lid lined with a polyethylene bag meets these requirements. After obtaining the sample from containers, any lining or covering shall be replaced to prevent exposure of the

material remaining in the container to air. The container lids shall be replaced tightly.

7.3 When the sample (other than those in cartridges) for testing is opened to begin laboratory testing, it shall be examined for the presence of cured material. Any skins of cured sealant shall be removed from the sample. The material tested shall not contain any cured portions. If sufficient quantities of uncured sealant cannot be obtained from the sample, or if cured portions of sealant are noted within the sample (other than surface skins), the sample shall be discarded and a new sample obtained.

7.4 After opening and examination of the test sample, all test specimens shall be prepared without delay to minimize curing of the sample. The sample should be handled in a manner that minimizes air exposure while preparing test specimens. If any cured material skins form on the sample while preparing test specimens, the cured material shall be removed prior to preparing additional specimens.

8. Test Methods

8.1 *Standard Conditions for Laboratory Tests*—The laboratory atmospheric conditions, hereinafter referred to as standard conditions, shall be $23 \pm 2^\circ\text{C}$ ($73.4 \pm 3.6^\circ\text{F}$) and $50 \pm 5\%$ relative humidity. Condition the sealant sample to be tested for at least 24 h at standard conditions prior to opening and beginning any tests.

8.2 *Test Specimen Curing*—For tests requiring cured specimens, perform curing in accordance with the specified conditions of temperature, humidity, and time listed in the following test methods.

8.3 *Cure Evaluation*—Make and cure one bond sample, as specified in 8.8, at laboratory standard conditions for 21 days ± 4 h. To aid with specimen curing, spacers may be removed prior to reaching the specified cure time, provided that the sealant has cured sufficiently so that no damage or distortion of the sealant occurs. After 21 days of curing, within ± 4 h, remove all spacers and other non-adherent surfaces from the sealant. Remove the sealant from the concrete block surfaces by slicing cleanly along each concrete-sealant bonding surface with an appropriate knife or blade. This produces a sealant portion that has a 12.7 by 12.7-mm (0.5 by 0.5-in.) cross-sectional area and is 50.8 mm (2 in.) in length. Immediately slice this sealant portion in half to produce two sealant portions that are 25.4-mm (1-in.) long. Immediately examine the 12.7 by 12.7-mm (0.5 by 0.5-in.) surfaces of the sealant that were exposed by slicing and the bottom of the sealant portion that was in contact with the spacers or a base sheet for the presence of uncured material, as indicated by sealant that has not changed from a liquid to a solid state. The presence of any uncured sealant shall constitute failure of this evaluation.

8.4 *Rheological Properties:*

8.4.1 *Type NS Sealant*—Test Method D 2202.

8.4.2 *Type SL Sealant*—Test Method C 639, Type I sealant.

8.5 *Extrusion Rate*—Test Method C 1183, Type S sealant.

8.6 *Tack Free Time*—Test Method C 679.

8.7 *Effects of Heat Aging*—Test Method C 792.

8.8 *Bond:*

8.8.1 *Concrete Block Preparation*—Prepare concrete test blocks in accordance with Practice D 1985. If desired, blocks

may be cut in half to produce blocks that are 25.4 by 25.4 by 76.2 mm (1 by 1 by 3 in.).

8.8.1.1 Prepare, store, and clean the blocks in accordance with the procedure of Test Methods D 5329 for bond, non-immersed. After the specified scrubbing and blotting, place the blocks on their 25.4 by 50.8-mm (1 by 2-in.) or 25.4 by 25.4-mm (1 by 1-in.) ends, and allow them to dry for 16 to 24 h at standard laboratory conditions.

8.8.2 *Specimen Preparation*—Prepare three test specimens for each bond evaluation. Assemble each test specimen using two prepared concrete test blocks. Assemble the blocks with their 50.8 by 76.2-mm (2 by 3-in.) or 25.4 by 76.2-mm (1 by 3-in.) surfaces facing, using appropriate spacers to form a cavity in which the sealant is placed between the blocks, which is 12.70 ± 0.13 -mm wide by 12.70 ± 0.13 -mm deep by 50.80 ± 0.13 -mm long (0.500 \pm 0.005-in. wide by 0.500 \pm 0.005-in. deep and 2.000 \pm 0.005-in. long). Use adhesive tape, rubber bands, or clamps to hold the block and spacer assembly together. Center this cavity along the 76-mm (3-in.) length of the blocks; the ends of the sealant cavity shall each be 12.7 mm ($\frac{1}{2}$ in.) from the ends of the concrete test block. The spacers used shall be of appropriate dimensions to create the specified sealant cavity. Construct the spacers of appropriate materials that will permit easy separation from the sealant without damaging the sealant after it has cured. The spacers shall also be compatible with the sealant, and there shall be no reaction between the spacers and the sealant. Suitable materials may include polyethylene, TFE-fluorocarbon, or metal covered with an adhesive-backed release film. Liquid or paste-type release agents can be used; however, extreme care must be used to prevent contamination of the test blocks. Apply sealant into the cavity between the concrete blocks and spacers in a manner that does not entrap air or result in voids in the sealant. Excess sealant should be struck off level with a straight edge. Then cure the specimens at standard conditions for 21 days ± 4 h. To aid with sealant curing, spacers may be removed prior to reaching the specified cure time, provided that the sealant has cured sufficiently so that no damage or distortion of it occurs. After the sealant has been cured for the specified time, remove any remaining spacers carefully, in a manner that does not damage the specimens, and then examine the sealant. The sealant should be cured to a solid state on all outer surfaces and should not show the presence of any voids or other damage such as adhesion loss due to spacer removal. If the specimens do not meet these requirements, discard them and prepare new specimens.

8.8.3 *Non-Immersed Bond*—Test specimens that were prepared and cured in accordance with 8.8.2 using the Test Methods D 5329 procedure for bond, non-immersed, with a $-29 \pm 1^\circ\text{C}$ ($-20 \pm 2^\circ\text{F}$) testing temperature and a 12.7-mm ($\frac{1}{2}$ -in.) extension, for a total of five extension and recompression cycles. Complete the required five extension cycles within seven days.

8.8.4 *Bond, Water-Immersed*—Test specimens that were prepared and cured in accordance with 8.8.2 using the Test Methods D 5329 procedure for bond, water-immersed, with a $-29 \pm 1^\circ\text{C}$ ($-20 \pm 2^\circ\text{F}$) testing temperature and a 12.7-mm