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Standard Specification for Structural Silicone Sealants[1]

This standard is issued under the fixed designation C 1184; 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 describes the properties of cold liquid applied, single-component or multicomponent, chemically curing elastomeric structural silicone sealants herein referred to as the sealant. These sealants are intended to structurally adhere components of structural sealant glazing systems.

1.2 Only those properties for which there are industry-agreed-upon minimum acceptable requirements, as determined by available ASTM test methods, are described in this specification. Additional properties are presently being defined and will be added as ASTM test methods for those properties become available.

1.3 The values stated in metric (SI) units are to be regarded as the standard. The values in parentheses are for information only.

1.4 Committee C-24, with jurisdiction over this specification, is aware of only one comparable standard, ETAG No. 002.

2. Referenced Documents

2.1 *ASTM Standards:*

C 603 Test Method for Extrusion Rate and Application Life of Elastomeric Sealants[2]

C 639 Test Method for Rheological (Flow) Properties of Elastomeric Sealants[2]

C 661 Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer[2]

C 679 Test Method for Tack-Free Time of Elastomeric Sealants[2]

C 717 Terminology of Building Seals and Sealants[2]

C 792 Test Method for Effects of Heat Aging on Weight Loss, Cracking, and Chalking of Elastomeric Sealants[2]

C 794 Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants[2]

C 1087 Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems[2]

C 1135 Test Method for Determining Tensile Adhesion Properties of Structural Sealants[2]

C 1193 Guide for Use of Joint Sealants[2]

C 1401 Guide for Structural Sealant Glazing[2]

G 53 Practice for Operating Light- and Water-Exposure Appartus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials[3]

G 151 Practice for Exposing Nonmetallic Materials in Accelerated Test Devices That Use Laboratory Light Sources[3]

G 154 Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials[3]

G 155 Practice for Operating Xenon Arc Light Apparatus for Exposure of Nonmetallic Materials[3]

2.2 *European Organization for Technical Approvals Document:*

ETAG No. 002 Guideline for European Technical Approval for Structural Sealant Glazing Systems

3. Terminology

3.1 *Definitions*—Refer to Terminology C 717 for definitions of the following terms used in this specification: adhesive failure, chemically curing sealant, cohesive failure, compatibility, cure, elastomeric, glazing, hardness, non-sag sealant, primer, sealant, shelf life, silicone sealant, structural sealant, substrate, and tooling.

4. Significance and Use

4.1 Not all sealants meeting this specification should be presumed to be suitable for all applications and all substrates. This specification assists in selecting sealants that meet certain minimum standards of performance.

4.2 Although this specification qualifies a sealant for use, it does not address the adhesion capability of the sealant for a specific substrate nor the compatibility of the sealant with the materials it contacts. Adhesion and compatibility characteristics required for specific substrates or finishes can be determined by Test Method C 794 for adhesion and Test Method C 1087 for compatibility.

4.3 To properly specify a sealant for the intended use when using this specification, it is essential that the applicable type and use be included.

5. Classification of Sealants

5.1 A sealant qualifying under this specification shall be classified as to type and use as given in 4.1.1-4.1.4.

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[1] This specification is under the jurisdiction of ASTM Committee C24 on Building Seals and Sealants and is the direct responsibility of Subcommittee C24.35 on Structural Sealants.

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

[3] *Annual Book of ASTM Standards*, Vol 14.04.

5.1.1 *Type S*—Single-component sealant.

5.1.2 *Type M*—Multicomponent sealant.

5.1.3 *Use G*—A sealant that meets the requirements of this specification when tested on a clear, uncoated float glass substrate.

5.1.4 *Use O*—A sealant that meets the requirements of this specification when tested on a substrate other than a clear, uncoated float glass substrate (for example, Use O—Granite).

6. Materials and Manufacture

6.1 Furnish single-component sealants as a homogeneous mixture of a consistency suitable for application and within the manufacturer's stated shelf life. Apply the sealant in accordance with the written recommendations of the sealant manufacturer. The cured sealant shall be an elastomeric solid.

6.2 Furnish multicomponent sealants in two or more components. Mix and apply the sealant in accordance with the written recommendations of the sealant manufacturer. The cured sealant shall be an elastomeric solid.

6.3 Furnish primer of the type required by, and apply in accordance with, the written recommendations of the sealant manufacturer.

7. Requirements

7.1 The physical, mechanical, and performance properties of the sealant shall conform to the requirements described in Table 1.

7.2 When a primer (see Note 1) is required by the sealant manufacturer, all tests performed in accordance with this specification shall be performed wit the primer. When a primer is not required by the sealant manufacturer, all tests performed in accordance with this specification shall be performed without a primer.

NOTE 1—The proper use of primers is described in Guide C 1401.

7.3 The standard substrate for this specification is clear, uncoated float glass.

7.4 Standard conditions referred to in this specification are a temperature of 23 ± 2°C (73.4 ± 3.6°F) and 50± 5 % relative humidity.

8. Test Methods

8.1 *Rheological Properties*—Test Method C 639, using test procedures for Type II and IV sealants.

8.2 *Extrudability*—Test Method C 603.

8.3 *Hardness*—Test Method C 661, using a Type A-2 durometer.

8.4 *Heat Aging*—Test Method C 792, using a temperature of 88 ± 5°C (190 ± 10°F).

8.5 *Tack-Free Time*—Test Method C 679.

8.6 *Tensile Adhesion*—Test Method C 1135, using a rate of pull of 12.7 mm (½ in.)/min. Determine the average ultimate tensile value for each group of five specimens prepared as described in 8.6.1 and 8.6.2.

8.6.1 Prepare, in accordance with Test Method C 1135, a total of 25 specimens for testing, except that the distance between substrates will be 9.5 mm (⅜in.).

8.6.2 Cure all specimens for 21 days at standard conditions. Condition and test the specimens as described in 8.6.2.1-8.6.2.5.

8.6.2.1 Test five specimens at standard conditions after the initial curing period.

8.6.2.2 Condition five specimens for 1 h at 88 ± 5°C (190 ± 10°F) in a forced air oven. Test the specimens at 88 ± 5°C (190 ± 10°F).

8.6.2.3 Condition five specimens for 1 h at −29 ± 2°C (−20 ± 4°F). Test the specimens at −29± 2°C (−20 ± 4°F).

8.6.2.4 Immerse five specimens in deionized or distilled water at standard temperature for seven days. Test the specimens at standard conditions within 10 min after their removal from the water.

8.6.2.5 Expose five specimens for 5000 h with the bond surface facing the light source and using either of the exposure conditions specified below:

(a)*Fluorescent UV/Condensation Apparatus*—Expose specimens to fluorescent UVA-340 radiation in accordance with Practices G 151 and G 154 using an exposure cycle consisting of 4 h ultraviolet with the uninsulated black panel temperature controlled at 60 ± 3°C (140 ± 5.4°F) followed by 4 h condensation with the uninsulated black panel temperature controlled at 40 ± 3°C (104 ± 5.4°F). The irradiance in apparatus without irradiance control shall be maintained at 0.77± 0.21 W/(m^2· nm) at 60°C (140°F) and 340 nm. Unless otherwise specified, apparatus with irradiance control shall be maintained at an irradiance level of 0.77± 0.08 W/(m^2· nm) at the operational control point.

NOTE 2—Previous versions of this standard referenced G 53 which described specific equipment designs for the fluorscent UV/condensation device. Practice G 53 is being replaced by Practice G 151, which describes performance criteria for all exposure devices that use laboratory light sources, and by Practice G 154, which is a performance-based standard for fluorescent UV/condensation devices.

(b) *Xenon Arc Weathering Device*—Expose specimens to the xenon arc light source with daylight filters in accordance with Practices G 151 and G 155 using an exposure cycle consisting of 102 minutes light only, followed by 18 minutes light plus water spray or immersion on the front surface. Irradiance at the control point shall be 0.50 ± 0.03 W/(m^2· nm) at 340 nm or the equivalent of 55 ± 3.5 W/(m^2· nm) at 300–400 nm or 521 ± 30W/(m^2· nm) at 300–800 nm. The uninsulated black panel temperature during the dry period shall be controlled at 70 ±

TABLE 1 Requirements for Physical, Mechanical and Performance Qualities of the Sealant

Property	Requirement	Test Method
Rheologic, max		C 639
Vertical	4.8 mm (3⁄16in.)	
Horizontal	no deformation	
Extrudability, max	10 s	C 603
Hardness, Shore A	20-60	C 661
Heat aging		
Weight loss, max	10 %	
Cracking	none	
Chalking	none	
Tack-free time, max	no transfer in 3 h	C 679
Tensile value, min		C 1135
Standard conditions:	345 kPa (50 psi)	
88°C (190°F)	345 kPa (50 psi)	
−29°C (−20°F)	345 kPa (50 psi)	
Water immersion	345 kPa (50 psi)	
5000 h weathering	345 kPa (50 psi)	8.6.2.5
Shelf life, min	6 months	9.1

3°C (163 ± 5.4°F). In devices that allow for control of relative humidity, it shall be 50 ± 5% during the light only period.

9. Shelf Life

9.1 If it is desired to test shelf life of a structural sealant, then the test methods listed in Section 8 should be performed on sealant that has been stored to within 30 days of the manufacturer's stated shelf life. All of the requirements of Table 1 should be met.

APPENDIX

(Nonmandatory Information)

X1. STRUCTURAL SILICONE SEALANT MODULUS OF ELASTICITY

X1.1 General

X1.1.1 The purpose of this appendix is to describe modulus considerations for a structural silicone sealant that is intended for a range of applications. Structural silicone sealants should be designed for both strength and flexibility for specific applications; this implies that the sealant's modulus of elasticity should fall between a maximum and minimum value for a specific application.

X1.1.2 The modulus of elasticity of a material describes its elongation response to an applied stress, and therefore is a measure of its flexibility, stiffness, or hardness. The term "modulus" used in this appendix refers to a sealant's secant modulus of elasticity; see Terminology C 717. Note that the units of modulus and stress can be the same (such as pounds per square inch), but they represent different technical concepts. Because the modulus of a sealant is not constant, it is customary in the sealant industry to state both the modulus and the strain at which it was measured (for example, 99 kPa at 12.5 % strain).

X1.1.3 Structural silicone sealants are used to structurally attach glass and other materials to a framing system; to transfer loads applied to the glazing material to the framing system; and to accommodate anticipated movement between the glazed materials and the supporting framework. When selecting a structural sealant for a specific application, the design professional must select a sealant that has the necessary strength to resist applied loads, but also has enough flexibility to accommodate differential movement.

X1.1.4 Currently, structural silicone sealants are manufactured to have performance properties which allow a particular material to be used in a wide variety of applications. If a particular structural silicone sealant is to be used in a specific application, it must have a modulus which is also acceptable for that application.

X1.1.5 The modulus of a sealant may be a function (essentially linear) of temperature. It should be verified that the modulus will fall within the minimum and maximum criteria over the anticipated service temperature range.

X1.1.6 To adequately evaluate a sealant for a specific application, a stress/strain plot should be developed for the specific project conditions utilizing Test Method C 1135. When developing the stress/strain plot, the test conditions (such as sealant joint configuration or environmental conditioning) should be modified to correlate with the conditions specified or predicted for the specific specification. The application-specific stress/strain plots (developed using the average values for each set of test assemblies as described in Test Method C 1135), in combination with the design criteria for the application, can be evaluated to determine if the proposed sealant is appropriate for the application.

X1.2 Minimum Modulus

X1.2.1 The minimum acceptable structural sealant modulus (softest, or highest acceptable flexibility) is based on the premise that the sealant must be sufficiently stiff to retain the panel without excessive deflection. The limiting case is when the sealant depth is stressed by negative (outward acting) wind or other lateral loads up to its design load; even at that stress it must not elongate beyond the practical limit of the design geometry (such as the setting blocks supporting the weight of the panel).

X1.3 Maximum Modulus

X1.3.1 The maximum acceptable modulus (hardest, or least acceptable flexibility) is dictated by the requirement that the structural sealant joint must have sufficient flexibility to respond to the wind strain or differential thermal movement between the panel and the supporting framework, without being stressed in shear in excess of the design parameters.