Designation: ~~C1681 – 18~~ C1681 – 23

Standard Test Method for Evaluating the Tear Resistance of a Sealant Under Constant Strain[1]

This standard is issued under the fixed designation C1681; 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 test method evaluates the impact of an induced tear on a sealant specimen that is dimensioned, cured according to the guidelines in Test Method C719 and then subjected to a constant strain. It is effective in differentiating between sealants that are used in dynamic joints subject to abrasion, punctures, tears, or combination thereof.

1.2 Since this test method is for the evaluation of tear propagation, an adhesive failure to the substrates provides no usable data regarding tear propagation. This would be considered a failed test and that data would be discarded, or at least separated from the other data from specimens that did not experience an adhesive failure.

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 ~~The committee with jurisdiction over this standard is not aware of any comparable standards published by other organizations.~~ This standard is similar in concept to European Technical Approval Guidelines (ETAG) 002, Part 1, Section 5.1.4.6.4—Resistance To Tearing.

1.5 *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]

C717 Terminology of Building Seals and Sealants

C719 Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle)

3. Terminology

3.1 *Definitions*—Refer to Terminology C717 for definitions of terms used in this standard, including but not limited to the following: adhesive failure, casting spacers, cohesive failure, separators, standard conditions.

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[1] This test method is under the jurisdiction of ASTM Committee C24 on Building Seals and Sealants and is the direct responsibility of Subcommittee C24.20 on General Test Methods.

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[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.

4. Summary of Test Method

4.1 Test specimens are fabricated and cured in accordance with Test Method C719. At the end of the 21-day cure period, an induced tear is created in the specimens by making a cut with a sharp blade in the midpoint of the joint. The specimens are then extended to a specified strain at both standard conditions and at ~~–26 ± 2°C (–15 ± 3°F).~~ –26 °C ± 2 °C (–15 °F ± 3 °F). Propagation of the induced tear is measured at 0, 24, and 168 h.

5. Significance and Use

5.1 This test method is intended to determine if a joint that is subjected to a mechanically induced cut will resist tear propagation during normal joint movement. ~~A sealant with a high resistance to tear propagation will typically perform better than a sealant with a low resistance to tear propagation.~~

NOTE 1—A sealant with a high resistance to tear propagation may perform better than a sealant with a low resistance to tear propagation.

6. Apparatus and Materials

6.1 A device capable of extending the test specimens to the specified strain.

6.2 *Freezer,* to maintain a constant temperature of –26°C ± 2°C.

6.3 A suitable measuring device such as calipers able to measure the induced tears to 0.01 mm.

6.4 *#17 Knife Blade,* 9 mm (0.375 in.) wide.

6.5 *Spatulas,* for use in applying the sealant.

6.6 *Caulking Gun,* for extruding sealant from cartridges when applicable.

6.7 *Substrates,* twelve substrates, with minimum dimensions of 25.4 mm by 76.2 mm (1 by 3 in.) of the same finish are required for each product to be tested. Glass is the default substrate, however as mentioned in the scope, this is not an adhesion test, therefore the sealant must exhibit excellent adhesion to the substrate. Other rigid substrates in the above noted dimension are acceptable. Substrate blocks or plates should be of adequate thickness or reinforced such that they do not flex or break during the testing.

6.8 *Casting Spacers,* provide joint dimensions of 12.7 mm by 12.7 mm by 50.8 mm (0.5 by 0.5 by 2 in.). See Fig. 5 in Test Method C719.

6.9 *Separators,* to provide a constant strain on the specimen while maintaining parallel bond surfaces.

6.10 *Substrate Cleaning Material.*

6.11 *Primer,* if required on the substrates.

6.12 A suitable measuring device, such as calipers, capable of measuring the induced cut in the sealant and additional changes, if any, in the cut to 0.01 mm.

6.13 *Marker,* to identify the exact placement of the induced cut.

6.14 A device which holds a #17 knife blade 9 mm (0.375 in.) wide to induce the cut into the test specimens. See Fig. 1.

~~7. Reagents and Materials~~

~~7.1 *Spatulas,* for use in applying the sealant.~~

FIG. 1 #17 Blade

~~7.2 *Caulking Gun,* for extruding sealant from cartridges when applicable.~~

~~7.3 *Substrates*—twelve substrates, with minimum dimensions of 25 by 75 mm (1 by 3 in.) of the same finish are required for each product to be tested. Glass is the default substrate, however as mentioned in the scope, this is not an adhesion test, therefore the sealant must exhibit excellent adhesion to the substrate. Other rigid substrates in the above noted dimension are acceptable. Substrate blocks or plates should be of adequate thickness or reinforced such that they do not flex or break during the testing.~~

~~7.4 *Casting Spacers*—The casting spacers provide joint dimensions of 12.7 by 12.7 by 50.8 mm (0.5 by 0.5 by 2 in.). See Fig. 5 in Test Method C719.~~

~~7.5 *Separators,* to provide a constant strain on the specimen while maintaining parallel bond surfaces.~~

~~7.6 *Substrate Cleaning Material.*~~

~~7.7 *Primer,* if required on the substrates.~~

~~7.8 A suitable measuring device, such as calipers, capable of measuring the induced cut in the sealant and additional changes in the cut to 0.01 mm.~~

~~7.9 *Marker,* to identify the exact placement of the induced cut.~~

~~7.10 A device which holds a #17 knife blade 9 mm (0.375 in.) wide to induce the cut into the test specimens. See Fig. 1.~~

7. Conditioning

7.1 *Multicomponent Sealants*—Prepare six test specimens for each type of substrate that is to be used in the test. After maintaining the unopened sample for at least 24 h at standard conditions, mix thoroughly for 5 min at least ~~250 g~~ 250 g of base compound with the appropriate amount of curing agent. Extrude the sealant ~~12.7 by 12.7 by 50.8 mm~~ 12.7 mm by 12.7 mm by 50.8 mm (0.5 by 0.5 by ~~2 in.)~~ 2 in.) between parallel ~~25.4 by 76.2 mm (1 by 3 in.)~~ 25.4 mm by 76.2 mm (1 by 3 in.) surfaces of similar blocks or plates of the selected substrate. Use the appropriate casting spacers to form the proper size of the bead. Use adhesive tape, rubber bands, or clamps to hold the test assembly together before and after filling it with the compound. In the case of a pourable-type compound, use masking or any other suitable tape to retain the compound.

7.2 Clean the test substrates using the methods suggested in Test Method C719. Fabricate the joints using the casting spacers. Mask off the top of the substrate edges, extrude the test sealant into the cavity taking care to fill in the all of the corners, tool the top surface flat, and remove the masking tape.

7.3 *Single-Component Sealants*—Prepare six test specimens as described in ~~8.1~~7.1 except that no mixing of components is required. Condition the sealed cartridge or bulk container at standard conditions at least 24 h before use.

7.4 Cure specimens made with multicomponent sealants for 14 days at standard conditions. During the second week of the curing period, free the compound from the casting spacers at the ends and bottom without damaging the sealant bead. Reference Test Method C719 for information on how to proceed if specimens are damaged during casting spacer removal.

7.5 Cure specimens made with single-component sealants for a total of 21 days at standard conditions. See ~~8.6.1~~7.6.1.

7.6 Separate the casting spacers from the sealant as soon as practical during the curing period without damaging the sealant. Fourteen days is typically necessary. Reference Test Method C719 for information on how to proceed if specimens are damaged during casting spacer removal.

7.6.1 The producer may request conditions other than those specified in ~~8.5~~7.5 for the curing period of single-component sealants provided they meet the following requirements: *(1)* The curing period shall extend for 21 days; and *(2)* The temperature during the curing period shall not exceed ~~50°C (122°F).~~50 °C (122 °F).

8. Procedure

8.1 Within 8 h after the cure period (14 days for multicomponent or 21 days for single component products), mark the exact location for the induced cut with a permanent marker and then induce a cut, ~~9 mm (0.375 in.)~~ 9 mm (0.375 in.) in length, and ~~12.7 mm (0.5 in.)~~ 12.7 mm (0.5 in.) deep with the #17 knife blade. See Fig. 2. Make the cut as parallel as possible to the long direction of the sample, located directly on the midpoint and go perpendicularly through the thickness of the sealant.

8.2 Extend all specimens until the separation between the substrates provides the desired/specified extension (in the absence of a specified strain, the sealant shall be strained to its Test Method C719 movement capability). Apply this strain at a minimum rate of 3 mm per hour (0.125 in. per hour). See Appendix X2.

8.3 When the specimens have reached their specified extension, block the specimens with ~~the~~ appropriate ~~separator~~separator(s) and remove from the extension device/machine. Do not remove separators for the duration of test.

8.4 Measure and record the length and width of the induced cut, immediately after the joints have been blocked at the specified strain. This is the 0 hour data.

8.5 Place three specimens in the freezer at ~~–26 ± 2°C.~~–26 °C ± 2 °C.

8.6 Place three specimens at room temperature laboratory conditions.

8.7 After 24 and 168 h, measure and record the length and width of the induced cut on the top of the joint and record the observed

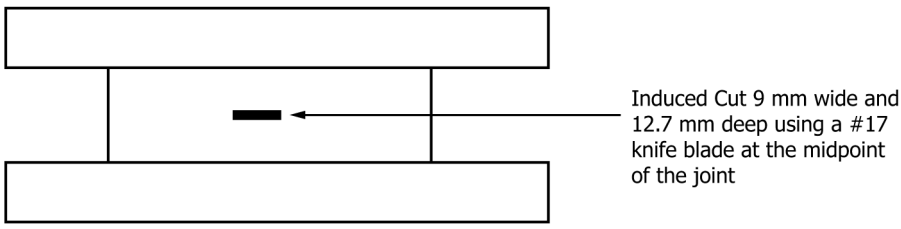


FIG. 2 Top View of Joint Showing the Placement of the Induced Cut

character of the tearing on the *X* and *Y* axis as noted in Fig. 3 (i.e., clean versus jagged, direction of the tear propagation, propagation of the tear at one or both ends of the induced cut, etc.).

9. Calculation or Interpretation of Results

9.1 Report the change in length and width of the induced cut on the top of the joint in the sealant for each specimen along the *X* and *Y* axis noted below to the nearest 0.1 mm.

9.2 Report the average change in dimension for length and width for the room temperature and ~~–26°C~~ –26 °C conditions at 24 and 168 h.

9.2.1 (ΔL1 + ΔL2 + ΔL3)/3 = Average change in Length.

9.2.1.1 L24 h – L0h = ΔL24 h= Change in Length at 24 h.

9.2.1.2 L168 h – L0h = ΔL168 h = Change in Length at ~~168 h.~~168 h.

9.2.2 (ΔW1 + ΔW2 + ΔW3)/3 = Average change in Width.

9.2.2.1 W24 h – W0h = ΔW24 h = Change in Width at ~~24 h.~~24 h.

9.2.2.2 W168 h – W0h = ΔW168 h = Change in Width at 168 h.

9.3 See Table 1 for a suggested table for taking data.

10. Report

10.1 Report the following information:

10.1.1 Sealant used, color, manufacturers' lot, type (single component or multicomponent) and rated movement capability per Test Method C719 as designated by the manufacturer,

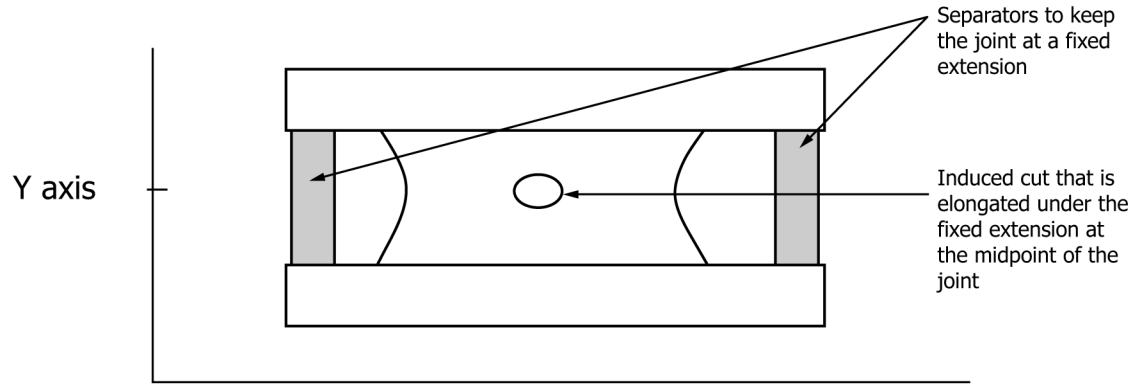
10.1.2 Actual dimensions of the joint and configuration,

10.1.3 Cleaning method for each substrate,

10.1.4 Description of the test substrate(s),

10.1.5 Primer used on specific substrates,

10.1.6 Curing method and duration,



NOTE 1—Measurements of the length of the cut (*X* axis) and width of cut (*Y* axis) are taken and reported at 0, 24, and 168 h.

FIG. 3 Top View of a Joint that is Held Under a Fixed Extension