Designation: C 1635 – 06

Standard Test Method to Evaluate Adhesion/Cohesion Properties of a Sealant at Fixed Extension[1]

This standard is issued under the fixed designation C 1635; 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 describes a laboratory procedure for measuring the adhesion/cohesion properties of a sealant when subjected to tensile loads resulting from an applied specified strain. The adhesion/cohesion properties are evaluated before, during, and after water immersion.

1.2 This test method examines the adhesive and cohesive performance of a sealant on a specified substrate at a strain equivalent to a multiple of the strain/movement capability designated by the manufacturer for the given sealant per Specification C 920.

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

1.4 *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.*

1.5 *Comparable Test*:

1.5.1 ISO 10590, Building construction - Jointing products - Sealants - Determination of adhesion/cohesion properties at maintained extension after immersion in water

1.5.2 ISO 8340, Building construction - Jointing products - Sealants - Determination of tensile properties at maintained extension

2. Referenced Documents

2.1 *ASTM Standards:* [2]

C 717 Terminology of Building Seals and Sealants

C 719 Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle)

C 920 Specification for Elastomeric Joint Sealants

C 1375 Guide for Substrates Used in Testing Building Seals and Sealants

3. Terminology

3.1 *Definitions:*

3.1.1 *casting spacers*—the spacers used in the fabrication of the joints made from wet sealant

3.1.2 *separators*—the device or item used to maintain the specimens at fixed extension.

4. Summary of Test Method

4.1 Test specimens made in accordance with dimensions set forth in Test Method C 719 are fabricated and allowed to cure.

4.2 Test specimens are extended at standard conditions to a specified strain and blocked at the strain for a specified period of time.

4.3 The test specimens are examined for adhesive or cohesive failure, or both, of the sealant at 0, 24 and 168 h.

4.4 A duplicate set of three test specimens are cured at standard conditions, extended to a specified strain, and then immersed (totally) in deionized water or specified medium (3 specimens/liter of liquid).

4.5 Immersed test specimens are observed at 0, 24 and 168 and other additional specified hours.

4.6 This test method uses ASTM standard substrates as described in Guide C 1375. This test method does not exclude the use of any other substrate that provides a suitable flat surface.

5. Significance and Use

5.1 In any sealant application, the sealant must be capable of maintaining an adhesive bond to the substrate when held in strain for its intended service life.

5.2 This test method is an indicator of a sealant's ability to adhere under strain to a given substrate.

[1] This test method is under the jurisdiction of ASTM Committee C24 on Building Seals and Sealants and is the direct responsibility of Subcommittee C24.30 on Adhesion

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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.

5.3 The default test strain is the movement ability of the sealant as designated by the manufacturer. The default joint configuration is 12.7 × 12.7 × 50.8 mm (½ × ½ × 2 in.). Other strains and joint configurations may be used and reported as noted in Section 8 and Table 1.

6. Apparatus and Materials

6.1 *Container*, for immersion made of a material compatible with the immersion medium.

6.2 *Device*, to provide a strain on the test specimen.

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

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

6.5 *Substrates*—Twelve substrates minimum of 25.4 × 76.2 mm (1 × 3 in.) of the same finish are required for each test sample.

6.6 *Casting Spacers*—Made from polytetrafluoroethylene (PTFE) or a suitable rigid material shall be used with each test specimen to which the test sealant will not bond and will provide the appropriate joint dimensions and configurations.

6.7 *Substrate Cleaning Materials*:

6.8 *Primer* (if needed).

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

6.10 *Deionized Water*, or other specified liquid medium for immersion

6.11 *Suitable Probe Type Measuring Device*, capable of measuring defects in the sealant to 1 mm (1/32 in.)

7. Procedure

7.1 *Preparation of Test Specimens.* Six test specimens.

7.1.1 Standard conditions of temperature and relative humidity used throughout this test method are defined as in Terminology C 717.

7.1.2 Clean the substrates per the procedures set forth in Test Method C 719 and Guide C 1375.

7.1.3 *Primers*—Where use of primer is recommended by the sealant manufacturer, substrate materials shall be primed with the recommended primer or primers.

7.1.4 Apply a bead of sealant 12.7 × 12.7 × 50.8 mm (½ × ½ × 2 in.) between parallel 25.4 × 76.2 mm (1 × 3 in.) substrates (or of other desired dimensions and noted in the report). Use appropriate casting spacers to form the proper size bead. Use adhesive tape, rubber bands, or clamps to hold the test assembly together before and after filling it with the sealant. In the case of a pourable-type sealant, use masking or any other suitable tape to retain the sealant. Use masking tape on top surface of substrates to prevent sealant from curing on the top surface. Remove the tape immediately following filling the specimen joint cavity.

7.2 *Curing Method*

7.2.1 Cure specimens under one of the following cycles:

7.2.1.1 *Standard Conditions*—23 ± 2°C (73.4 ± 3.6 °F), 50 ± 5 % relative humidity for a minimum of 21 days.

7.2.1.2 Alternately, cure for a total of 21 days as follows: *(a)* 7 days at standard conditions above; *(b)* 7 days at 38 ± 2°C (100 ± 3.6 °F) and 95 % relative humidity; *(c)* 7 days at standard conditions.

7.2.1.3 The sealant manufacturer may request conditions other than those specified provided the temperature does not exceed 50°C (122°F).

7.2.2 Remove the casting spacers from the specimens after curing.

7.2.2.1 During the second week of the curing period, make attempts to free the compound from the casting spacer blocks at the ends and bottom without damaging the sealant bead.

7.2.2.2 Separate the casting spacer blocks from the sealant as soon as practical during the curing period without damaging the sealant.

7.3 Extend all specimens until the separation between the substrates provides the desired strain. Apply this strain at a minimum of 3 mm/h (⅛ in./h).

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

7.5 Place three test specimens in water (minimum of 0.33 L (0.09 gal) per specimen) at a specified temperature with the default being 23 ± 2°C. (73 ± 4°F). Ensure that the test specimens are fully immersed.

7.6 Leave three test specimens at standard conditions.

7.7 Unless otherwise specified, record the length and width of the adhesive and cohesive defects at 0, 24 and 168 h after reaching the target strain at the standard conditions and water immersed conditions.

7.8 Record adhesive and cohesive defects observed of each of the test specimens. Record the number, location, length and depth of the defect to the nearest 1 mm (1/32 in.) and note if they are adhesive or cohesive for each sample. Photographs are advisable so that a future review can be made.

8. Test Report

8.1 Report the following information:

8.1.1 Sealant used, color, manufacturers lot number and rated movement capability per Specification C 920 as designated by the manufacturer,

8.1.2 Actual dimensions of the joint and configuration,

8.1.3 Cleaning method,

8.1.4 Description of the test substrate(s),

8.1.5 Primer used,

TABLE 1 Suggested Strains for a 12.7-mm (0.50-in.) Wide Sealant Joint.

Sealant Movement Rating	Distance between panels at 1× movement rating	Distance between panels at 1.5× movement rating	Distance between panels at 2× movement rating	Distance between panels at 4× movement rating
12.5 %	14.0 mm (0.55 in.)	14.7 mm (0.58 in.)	15.5 mm (0.61 in.)	19.0 mm (0.75 in.)
25 %	15.5 mm (0.61 in.)	17.2 mm (0.68 in.)	19.0 mm (0.75 in.)	25.4 mm (1 in.)
50 %	19.0 mm (0.75 in.)	21.8 mm (0.86 in.)	25.4 mm (1 in.)	38.1 mm (1.5 in.)
100 %	25.4 mm (1 in.)	31.8 mm (1.25 in.)	38.1 mm (1.5 in.)	63.5 mm (2.5 in.)

8.1.6 Curing method,

8.1.7 Strain induced on the sealant during the test in % of original joint width,

8.1.8 Strain rate, and

8.1.9 The immersion medium and temperature.

8.1.10 Report the Nature of test effects observed, such as amount of adhesive or cohesive failure, deformation, bubbles, or other characteristics, for each sample at 0, 24 and 168 h for dry and immersed samples.

8.1.11 Deviations from standard conditions including substrates utilized, time of cure, use of primer, observations, and other deviations.

9. Precision and Bias

9.1 Precision and bias testing involved two round-robin testing studies in five laboratories as noted below.[3]

9.1.1 The first study had five laboratories testing five sealants.

9.1.2 Results within a laboratory were repeatable within 10 % and many of the results had no variation whatsoever. If the sealant product adhered or did not adhere to the substrates, it did so consistently when fabricated by the same technician.

9.1.3 Results from the first round robin showed that variation between laboratories was up to ±100 %. However when studying the data carefully, it shows that two products in the five laboratories were the source of the variation. Three of the five products showed variation between laboratories of ±10 %. This result was encouraging.

9.1.4 The second round-robin test was initiated between the same five laboratories using the two products that gave the large deviations between laboratories. The leadership of the test laboratories met in Kansas City, Missouri, United States, in June of 2004 to discuss the variations of technique that can happen in each laboratory. The group decided to retest the two products that were the source of the large variation and focus on laboratory technique.

9.1.5 Results from the second study once again within a single laboratory were repeatable within 10 % or less.

9.1.6 Results between laboratories on one product tested were repeatable within 10 % in all five laboratories. The other product tested was repeatable within 10 % in four of five laboratories and varied by 100 % in the fifth laboratory.

10. Keywords

10.1 adhesion; adhesive defect; casting spacer; cohesion; cohesive defect; constant strain; immersion; primer; sealant; separator; standard conditions; substrate

[3] This data can be found in Research Report C24–1055 available from ASTM Headquarters.