Designation: C1536 – 10

Standard Test Method for Measuring the Yield for Aerosol Foam Sealants[1]

This standard is issued under the fixed designation C1536; 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 determines the quantity of linear units of a foam sealant having a specified bead diameter that may be obtained from a single can of aerosol product. Four (4) cans are required for each product determination.

1.2 The test method is intended to estimate the contents of the aerosol container (*1*) for purposes of label statements, and (*2*) to provide the user information needed to estimate job requirements.

1.3 Foam sealants are used for a variety of end-use applications but are primarily intended to reduce air movement in the building envelope.

1.4 Currently, two main foam sealant types are applicable to this standard: single component polyurethane and latex.

1.5 There is no other known standard test method to measure aerosol foam sealant yield.

1.6 Values are reported in SI units only. Certain apparatus and supply items are referenced in inch-pound units for purchasing purposes.

1.7 *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.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C717 Terminology of Building Seals and Sealants

C1620 Specification for Aerosol Polyurethane and Aerosol Latex Foam Sealants

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *empty aerosol can (of foam sealant)*—the time at which the product flow of the foam sealant is less than 2.0 linear cm or 1.0 g of continuous foam bead during two continuous seconds of dispensing.

3.1.2 *symbols*—letter symbols are used to represent physical measurements and are defined in Table 1 and Table 2.

3.1.3 *yield*—the yield for an aerosol can of foam sealant is the quantity of a specified nominal diameter of foam bead that is dispensed from a full can as defined by this test method.

4. Summary of Test Method

4.1 *Procedure A*—Suitable for foams that can be measured by water displacement (intended only for polyurethane foams).

4.1.1 The middle of the aerosol can's contents is dispensed at specified bead size segments.

4.1.2 The dispensed foam volume is determined by submerging the foam bead segments in water and measuring the weight of the displaced water.

4.1.3 The yield (defined as the total bead length of a specified nominal bead diameter of cured foam per can) is calculated from the measured foam volume.

4.2 *Procedure B*—Suitable only for foam sealants that cannot be measured by water displacement (Intended only for latex foams).

4.2.1 The middle of the container's contents is dispensed as a specified bead size segments.

4.2.2 The volume of the foam bead is directly measured from the dried or cured foam bead segments by direct measurement. Yield is calculated from these measurements.

NOTE 1—Procedure A uses tap water (see 11.10) to which 4.2 g of Dioctyl Sodium Sulfosuccinate (70 % solids) and 1.2 g of SAG 10 defoamer per 4 litres may be added as wetting agent/defoamer blend. This avoids false readings if air bubbles become a problem. The water is maintained at 23 ± 2°C during the submersion part of the test. It is permissible for a single batch of water to be used up to 48 h.

5. Significance and Use

5.1 The yield measurement of aerosol foam sealants is used to indicate the amount of foam sealant that can be obtained from a single can of product.

5.2 The yield does not predict the performance capability of the foam sealant product or its suitability for the intended application.

[1] This test method is under the jurisdiction of ASTM Committee C24 on Building Seals and Sealants and is the direct responsibility of Subcommittee C24.61 on Aerosol Foam Sealants.

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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.

TABLE 1 Data Acquisition and Calculation Form for Foam Yield Measurement Procedure A

Sample Description		Symbol
Canister	Avg. initial weight (g)	$A = (A_1 + A_2)/2$
	Avg. weight after discharge (g)	$B = (B_1 + B_2)/2$
	Avg. max discharged weight (g)	$A - B$
Specimen Preparation	Temperature (°C)	. . .
	Relative humidity (%)	. . .
	Can's starting weight (g)	$E = (E_1 + E_2)/2$
	Can's finishing weight (g)	$F = (F_1 + F_2)/2$
	Amount of discharged product (g)	$E - F$
Results	Total dischargeable volume of cured beads measured by water displacement (mL)	$H = \sum_{n=1}^{10} \frac{P_n}{\rho_{water}} = \sum_{n=1}^{10} \frac{P_n}{1.0 g/cc}$
	Yield (Y) based on linear metres of 1.0 cm bead per can	$Y = \frac{H(A-B)}{2(E-F)} \cdot \left(\frac{1}{78.5}\right)^A$
	Total can Linear Yield (Y) in meters based on actual post cured bead diameter other than 1.0 cm, dispensed per can.	$Y = \frac{H(A-B)}{2(E-F)} \cdot \left(\frac{1}{25\pi D^2}\right)$

[A] 78.5 is the factor to convert volume (cm^3) to linear meter of 1 cm diameter bead.

TABLE 2 Data Acquisition and Calculation Form for Foam Yield Measurement Procedure B

Sample Description		Symbol
Canister	Avg. initial weight (g)	$A = (A_1 + A_2)/2$
	Avg. weight after discharge (g)	$B = (B_1 + B_2)/2$
	Avg. max discharged weight (g)	$A - B$
Specimen Preparation	Temperature (°C)	. . .
	Relative humidity (%)	. . .
	Can's starting weight (g)	$E = (E_1 + E_2)/2$
	Can's finishing weight (g)	$F = (F_1 + F_2)/2$
	Amount of discharged product (g)	$E - F$
	Total volume of cured beads measured and calculated by $\pi \cdot r^2 \cdot L$ (cm^3)[A]	H
Results	Total dischargeable volume foam per can (cm^3)	$V = \frac{H(A-B)}{2(E-F)}$
	Total Linear Yield (Y) based on 1.0 cm diameter bead per can	$Y = \frac{H(A-B)}{2(E-F)} \cdot \left(\frac{1}{78.5}\right)$
	Total can Linear Yield (Y) in meters based on actual post cured bead diameter other than 1.0 cm dispensed per can.	$Y = \frac{H(A-B)}{2(E-F)} \cdot \left(\frac{1}{25\pi D^2}\right)$

[A] 78.5 is the factor to convert volume (cm^3) to linear meter of 1.0 cm diameter bead.

5.3 Procedure A was developed for use with products that can be volumetrically measured by submersion in water. Procedure B was developed for product that cannot be measured by using a water displacement method.

5.4 Yield is often dependent on the bead size dispensed. Extrapolation of test results using data measured for larger size beads to estimate smaller sized beads has shown inaccuracies. Since yield will be reported based on the diameter of the cured bead (not initial bead size), the operator shall determine the nominal initial bead size required to produce a specific nominal cured bead diameter. This foam characteristic, called "post dispensing contraction" or "post dispensing expansion," is defined in Terminology C717.

6. Apparatus

6.1 A container to hold water. Large enough to submerse foam samples.

6.2 A metal grating heavy enough to keep foam samples submersed.

6.3 *Top Loading Balance,* readable to 0.01 g.

6.4 *PTFE Release Agent,* or equivalent.

6.5 *Fiberglass Insect Screening,* or equivalent.

6.6 *Polyolefin Film or Mesh,* available from various local supply companies, 2 mil thickness or greater film of smooth finish only, matte or textured finishes are not suitable.

6.7 *Corrugated Cardboard 200 Pound Weight Substrate,* available in various sizes, trimmable to 70 ± 10 × 120 ± 15 cm for convenient handling.

6.8 Uncoated smooth brown wrapping paper.

6.9 *Meter Stick,* readable to the nearest 0.1 cm.

6.10 *Vernier Caliper,* readable to the nearest 0.1 mm.

7. Test Specimens and Substrates

7.1 Prepare all test specimens at standard laboratory conditions of 23 ± 2°C and 50 ± 5 % relative humidity.

7.2 Polyurethane foam sealant complying with Specification C1620 (measured using Procedure A) shall be dispensed directly on to polyolefin film covered rigid cardboard or suspended mesh mounted on a frame of convenient size, approximately 40 × 40 cm.

7.3 If in Procedure A, a fiberglass screen is used as the specimen substrate, it shall be lightly coated with a PTFE aerosol spray composition and allowed to air dry 30-45 s

before the foam sealant is applied. If polyolefin film or mesh is used, do not use the PTFE spray.

7.4 Foam sealants complying with Specification C1620 that cannot be measured by water displacement, such as Latex (measured using Procedure B), shall be dispensed directly on to brown paper or corrugated cardboard sheet of convenient size approximately 70 × 120 cm. The brown paper is trimmed away from the specimens in order to facilitate measuring the height and width of the bead. The paper shall not be totally removed from the foam but only trimmed to the foam's edge for measuring purposes.

NOTE 2—All polyurethane sealants shall be applied with the substrate laid horizontally on a bench top or other support and allowed to cure for 24 h before measurements are taken. Latex sealants will be applied with the substrate in a position that will allow the product to dispense in the upright position and will be dried for 48 h before measurements are taken.

7.5 For each product tested, it is essential to follow the manufacturer's label directions and to use the dispenser supplied with the product.

8. Conditioning

8.1 Condition and test the sealant specimens under standard laboratory conditions (see 9.8). Condition cans for 24 h at 23 ± 2°C and 50 ± 5 % RH just prior to dispensing.

9. Procedure A

9.1 Prepare the substrate as described in 7.2.

9.2 Remove the overcap, attach the dispensing mechanism and weigh the full assembled can of foam sealant. Record as the starting weight (A_1) in Table 1.

9.3 Shake the can vigorously for 30 s or as recommended in the product's instructions.

9.4 Dispense a full can of foam sealant into a waste container until completely empty (the can is completely empty when gas is primarily being expelled and the product flow rate is less than 2.0 cm or 1.0 g in two continuous seconds). Record the final weight of the can (B_1) with the dispensing mechanism attached.

9.5 With a second full can of foam sealant repeat 9.1-9.4. Record corresponding values for A_2 and B_2.

9.6 With a third can, dispense approximately ⅓ of the container's contents into a suitable waste container. Weigh and record the weight of the can including the attached dispensing mechanism as (E_1). Apply five foam sealant beads 1.0 ± 0.2 cm average cured bead diameter by 15 cm long (since yield will be reported based on the diameter of the cured bead, not initial bead size, the operator shall determine the nominal initial bead size required to produce a specific nominal cured bead diameter) onto the substrate as seen in Fig. A1.1. Some practice is recommended in order to achieve a consistent bead diameter while dispensing. When one specimen bead is complete, momentarily stop dispensing long enough to move to the next bead. After dispensing the five specimens, weigh each can with dispensing mechanism attached and record the weights as (F_1).

9.7 Repeat step 9.6 for a fourth can and record corresponding values for E_2 and F_2.

9.8 Allow foam sealant beads to cure 24 h at 23 ± 2°C and 50 ± 5 % RH.

9.9 Total volume of the cured foam beads is measured by buoyancy weight (force) measured with a top loading balance and container filled with water on the balance. The container should be deep enough to accommodate the 15-cm long specimens. The displacement container in Fig. A1.2, or equivalent, shall be used. Specimens should be measured individually and the results added as indicated in Table 1.

9.10 Place the wire grating or mesh into the water making sure it is fully submersed and then tare the scale.

9.11 Remove the wire grating or mesh and the foam sealant beads from the polyolefin film or mesh and ensure that the water level in the container is filled to the correct level before the cage and foam is submerged. Place the foam bead, Fig. A1.2, gently into the container, then place the grating or mesh on top of the beads to submerge all components. Now, record the buoyancy weight in grams for $P_{1,...5}$ (can 3) and $P_{6,...10}$ (can 4). **Warning**—Make sure the cage and bead are always fully submersed. If necessary add water in step 9.11 prior to taring the scale.

10. Calculations Procedure A

10.1 Calculate the yield for each sample can 3 and 4 using the data acquisition and calculation form in Table 1. Calculate the standard deviation for the duplicate yield determinations.

11. Procedure B

11.1 Prepare the substrate as described in 7.4.

11.2 Weigh a full can of foam sealant without the cap but with the dispensing mechanism attached and record the starting weight (A_1) in Table 2.

11.3 Shake the can vigorously for 30 s or as recommended in the product's instructions.

11.4 Dispense a full can of foam sealant into a waste container until completely empty (the can is completely empty when gas is primarily being expelled and the product flow rate is less than 2.0 cm or 1.0 g in 2.0 s) and record the final weight of the can (B_1).

11.5 With a second full can of foam sealant, repeat steps 11.2-11.4 and record corresponding values for A_2 and B_2.

11.6 With a third can, dispense approximately ⅓ of the container contents into a suitable waste container, weigh and record weight of can including the attached dispensing mechanism as (E_1). Apply five foam sealant beads 1.0 ± 0.2 cm average cured bead diameter by 15 cm long (since yield will be reported based on the diameter of the cured bead, not initial bead size, the operator shall determine the nominal initial bead size required to produce a specific nominal cured bead diameter) onto the substrate as seen in A1.1.

NOTE 3—Some practice is recommended in order to achieve a consistent bead diameter while dispensing. After one specimen bead is complete, momentarily stop dispensing long enough to move to the next bead. After the five specimens are dispensed, weigh the can with the dispensing mechanism attached and record this weight as (F_1).

11.7 Repeat step 11.6 for a fourth can and record corresponding values for *E* and *F*.

11.8 Dry or cure the specimens for 48 h at 23 ± 2°C and 50 ± 5 % RH.

11.9 Measure each specimen for both bead width and height using a vernier caliper at 10 equally spaced locations along the length of each bead, with the first measurement starting at 1.0 cm from the end. Then average these values to obtain the average bead diameter (*D*) and record this to the nearest 0.01 mm for each specimen. Average bead diameter here is taken to be the sum of the widths and heights of all the measurements divided by the total number of measurements.

11.10 Measure the total combined length of the foam bead segments by measuring each linear segment using a meter stick and sum the measurements. Record each segment to the nearest 0.5 mm and then total these measurements to obtain the total length (*L*) for each specimen. Total volume (*H*) is then calculated for each specimen using geometric principles:

$$V = \pi r^2 L$$

where:

V = Volume in cm^3,
π = 3.14, and
r = $D/2$ in cm,
L = Length of bead in cm.

This is the preferred method for all foams that cannot be measured by water displacement for any reason.

12. Calculations Procedure B

12.1 Calculate the yield and overall foam sealant density for each sample can 3 and 4 using the data acquisition and calculation form in 11.2. Calculate the standard deviation for the duplicate yield determinations.

13. Report

13.1 Complete name or designation of product tested.

13.2 Label statement of the size or contents of the aerosol in units of grams, weight ounces, or millilitres, etc.

13.3 Statement of the dispensing direction for the product container, upright or inverted.

13.4 Date of initiation of the test.

13.5 Date of report.

13.6 Expiration date of product tested.

13.7 Record whether Procedure A or B was followed.

13.8 Actual average bead diameter tested in cm.

13.9 Average dischargeable volume in L.

13.10 Yield expressed as linear millimetres, centimetres, or metres per can at the 1.0 cm bead diameter.

13.11 If desired yield expressed as linear millimetres, centimetres, or metres per can at other average cured tested bead diameter in cm.

13.12 A statement that the test or tests were conducted in accordance with this Test Method C1536.

14. Precision and Bias

14.1 No precision and bias values have been developed for this method. Plans to establish precision and bias statements are being made at the time of publication of this standard.

15. Keywords

15.1 aerosol; aerosol foam; air barrier foam sealant; air exfiltration; air infiltration; foam sealant; latex foam sealant; polyurethane foam sealant

ANNEX

(Mandatory Information)

A1. WATER TANK AND WIRE CAGE APPARATUS

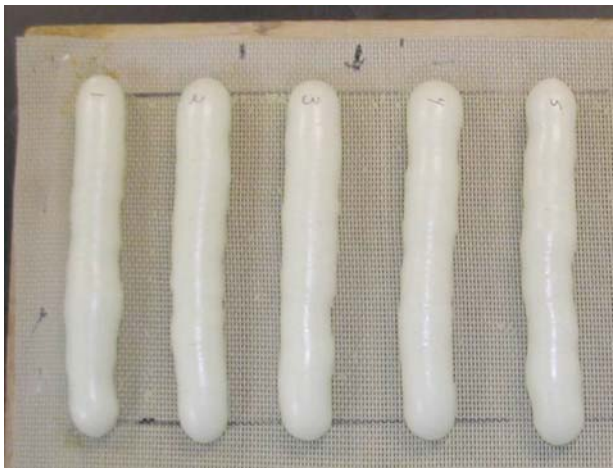

FIG. A1.1 Specimen Dispensing Pattern On Substrate

FIG. A1.2 Foam Beads In Cage Ready For Submersion In Water Tank