Designation: C 1536 – 03

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

This standard is issued under the fixed designation C 1536; 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 covers the determination of the linear units of specified diameter bead of foam sealant that can be obtained from a single can of aerosol product. Four (4) cans are required for each product determination.

1.2 The 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 Such foam sealants are used for a variety of end use applications 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 types.

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]

C 717 Terminology of Building Seals and Sealants

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *aerosol foam sealant*—foam sealant, which is dispensed from any aerosol can, pressure cylinder or container, intended to seal cracks or gaps.

3.1.2 *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.

3.1.3 *post dispensing contraction*—the decrease in the foam bead diameter or height that can occur immediately after initial foam sealant dispensing up to final curing or drying of the product.

3.1.4 *post dispensing expansion*—the increase in the foam bead diameter or height that occurs immediately after initial foam sealant dispensing up to final curing or drying of the product.

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

3.1.6 *yield*—the yield for an aerosol can of foam sealant is the quantity of a specified nominal diameter of foam bead which 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.

4.1.1 The middle 100 g of the aerosol can's contents is dispensed as a specified size of bead segments.

4.1.2 The dispensed foam volume is determined by measuring the volume of displaced water when the foam bead segments are submersed.

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 for foam sealants that cannot be measured by water displacement.

4.2.1 The middle 100 g of the container's contents is dispensed as a specified size of bead 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.

[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.

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

Sample Description		Symbol
Canister	Avg. initial weight (g)	$(A_1 + A_2)/2 = A$
	Avg. weight after discharge (g)	$(B_1 + B_2)/2 = B$
	Avg. max discharged weight (g)	$A - B$
Specimen Preparation	Temperature (°C)	. . .
	Relative humidity (%)	. . .
	Can's starting weight (g)	$E_1 + E_2/2 = E$
	Can's finishing weight (g)	$F_1 + F_2/2 = F$
	Amount of discharged product (g)	$E - F$
Results	Total dischargeable volume of cured beads measured by water displacement (mL)	H
	Yield (Y) based on linear metres of 1.0 cm bead per can	$Y = [(A - B)/(E - F)]\ [(H/2) \div 78.5]^A$

^{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)	$(A_1 + A_2)/2 = A$
	Avg. weight after discharge (g)	$(B_1 + B_2)/2 = B$
	Avg. max discharged weight (g)	$A - B$
Specimen Preparation	Temperature (°C)	. . .
	Relative humidity (%)	. . .
	Can's starting weight (g)	$E_1 + E_2/2 = E$
	Can's finishing weight (g)	$F_1 + F_2/2 = F$
	Amount of discharged product (g)	$E - F$
	Total volume of cured beads measured and calculated by $\pi \cdot r^2 \cdot L$ (cm^3)	H
Results	Dischargeable volume of cured beads, converted to (L)	$[(A - B)/(E - F)]\ H/1000$
	Yield (Y) based on linear metres of 1.0 cm bead per can	$Y = [(A - B)/(E - F)]\ H/78.5^{A,B}$

^{A} 78.5 is the factor to convert volume (cm^3) to linear meter of 1.0 cm diameter bead

^{B} L =cm and l = liters

5. Significance and Use

5.1 Yield measurement of aerosol foam sealants are used to indicate the amount of 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.

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 3.1.3 and 3.1.4.

6. Apparatus

6.1 *Dioctyl Sodium Sulfosuccinate*, or equivalent.

6.2 *SAG 10 Defoamer*, or equivalent.

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

6.4 *Small Rigid Wooden, Metal, or Plastic Frame*, to support screen or mesh type substrates.

6.5 *Water Tank and Wire Cage Apparatus*, shown in Figs. A1.1-A1.6to measure volume by water displacement for Procedure A.

6.6 *PTFE Release Agent*, or equivalent.

6.7 *Fiberglass Insect Screening*, or equivalent.

6.8 *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.

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

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

6.11 *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 (typically 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 70 × 120 cm.

7.3 If fiberglass screen is used for the specimen substrate in Procedure A it shall be lightly coated with PTFE aerosol spray and allowed to air dry just before the foam sealant is applied. If polyolefin film or mesh is used the PTFE spray is not used.

7.4 Foam sealants that cannot be measured by water displacement (Procedure B) shall be dispensed directly on to Kraft paper or Kraft paper covered corrugated rigid sheet of convenient size approximately 70 × 120 cm. The Kraft 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 off up to the foam 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

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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).

9. Procedure A

9.1 Prepare the substrate as described in 7.2.

9.2 Weigh the full can of foam sealant without the cap but with the dispensing mechanism attached and record 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) and 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 contents into a suitable waste container and weigh and record weight of can and attached dispensing mechanism as (E_1). Apply the second 100 g ± 10 g of the contents as a continuous 1.0 ± 0.2 cm average initial bead diameter (or slightly more or less than the diameter at which the yield is reported to account for sealant expansion or contraction) onto the substrate in a zigzag pattern (see Fig. A1.1). Some practice is recommended in order to achieve a consistent bead diameter while dispensing. When one specimen board is complete, momentarily stop dispensing long enough to move to the next board. After the nominal 100 g test sample is dispensed weigh the can with the dispensing mechanism attached and record this weight 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 positively displacing water from a full container of water and measuring the weight of the displaced water (prepare water per note under 4.2.2). Water that is displaced by the foam beads will overflow through a tube at the top of the container. The container should be deep enough to accommodate the specimens when cut in half, that is, at least 40 cm. The water displacement tank shown in Fig. A1.2and modified according to Figs. A1.4-A1.6 shall be used.

9.10 Remove the foam sealant beads from the polyolefin film or mesh and holding the beads as a bundle place them in the wire cage with the cut ends facing down. Ensure that the water level in the container is filled to complete overflow before the cage and foam is submerged. The cage, Fig. A1.2 and Fig. A1.3, with the foam beads is gently pushed down into the pail and the overflowing water is collected until the flow stops. The weight of this collected water in grams also represents the volume of the displaced water in mL. The water outlet on the container shall be selected and installed so that it can accurately maintain the water level throughout the test and before and after an object is submerged. The positive displacement container shall be placed on a level surface and not moved during the test. It shall also be calibrated by adding a known amount of water (similar in volume to the expected foam volume) to the container and measuring the over flow output in three separate determinations. When 2000 ± 50 g of water are added the three output measurements shall not differ by more than 4 g. For a well-constructed device the over flowing water will stop sharply indicating it is time to complete the measurement. When dripping slows to less than one drop in 10 s, the water displacement is taken as complete. Since the water level is initially set at the over flow max level with the empty cage submerged, measurement of the cage volume is not needed.

NOTE 3—**Caution:** Avoid any unnecessary water loss when extracting the empty cage during this water level calibration.

10. Calculations Procedure A

10.1 Calculate the yield and overall foam sealant density 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 and attached dispensing mechanism as (E_1). Then apply the second 100 ± 10 g of the contents as a continuous 1.5 ± 0.3 cm average initial bead diameter (or slightly more or less than the diameter at which the yield will be reported to account for sealant expansion or contraction) onto the substrate in a zigzag pattern. Some practice is recommended in order to achieve a consistent bead diameter while dispensing. When one specimen board is complete, momentarily stop dispensing just long enough to move to the next board. After the nominal 100 g test sample is 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*.

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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 at every forth leg of each straight stretch of the zigzag segments using a vernier caliper. The measuring position for each leg cycles to a different point on the measured leg as you move along the zigzag pattern. Leg one is measured just 5 cm into the straight portion of bead length, leg four at the middle of the leg, leg eight at a point 5 cm from the end just before the direction change to the next leg and so on. Thus, legs 1, 1+12, 1+24.… are all measured at the beginning of the leg run. Leg 4, 4+12, 4+24… are all measured in the middle of the leg run. And legs 8, 8+12, 8+24… are measured at the end of the leg run. 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 of the zigzag pattern 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,
π = 3.14, and
r = $D/2$.

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 overall density in kg/m^3.

13.10 Average dischargeable volume in L.

13.11 Yield expressed as linear millimeters, centimeters, or meters per can at the average tested bead diameter in cm.

13.12 A statement that the test or tests were conducted in accordance with this Test Method C 1536.

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

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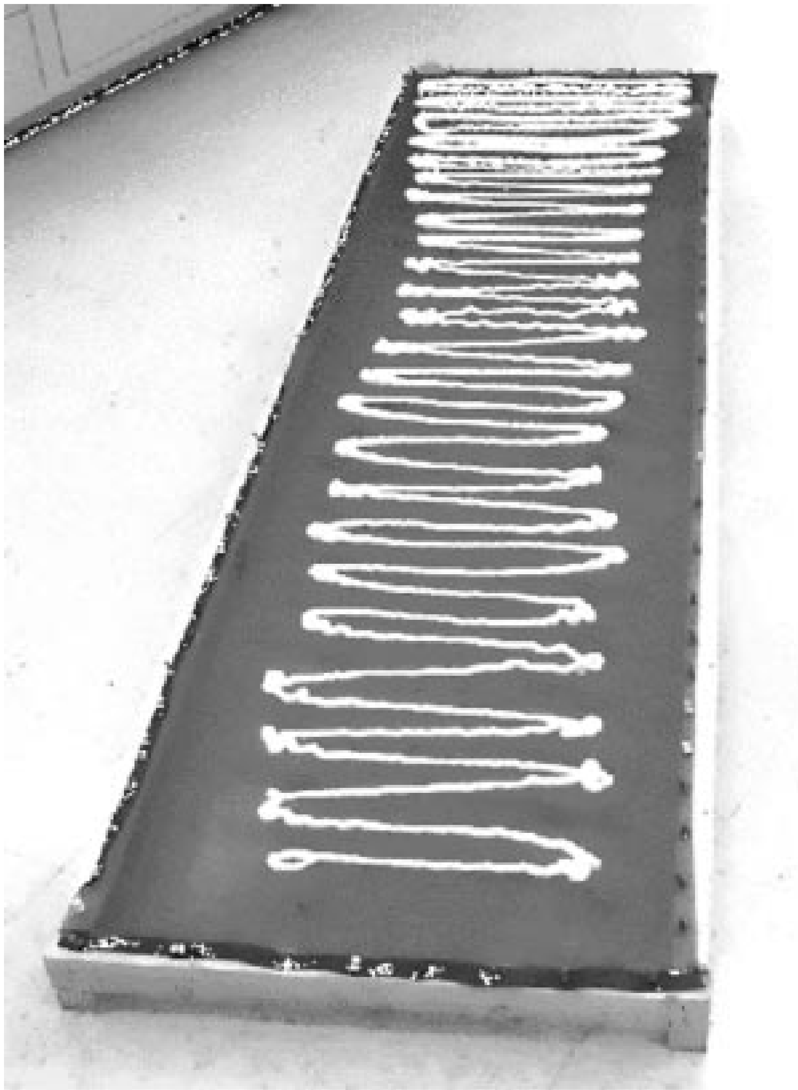

FIG. A1.1 Specimen Dispensing Pattern Over Screen Mesh

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

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FIG. A1.3 Cage Detail

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FIG. A1.4 Submersion Water Tank With Overflow Tube

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FIG. A1.5 Overflow Tube Detail

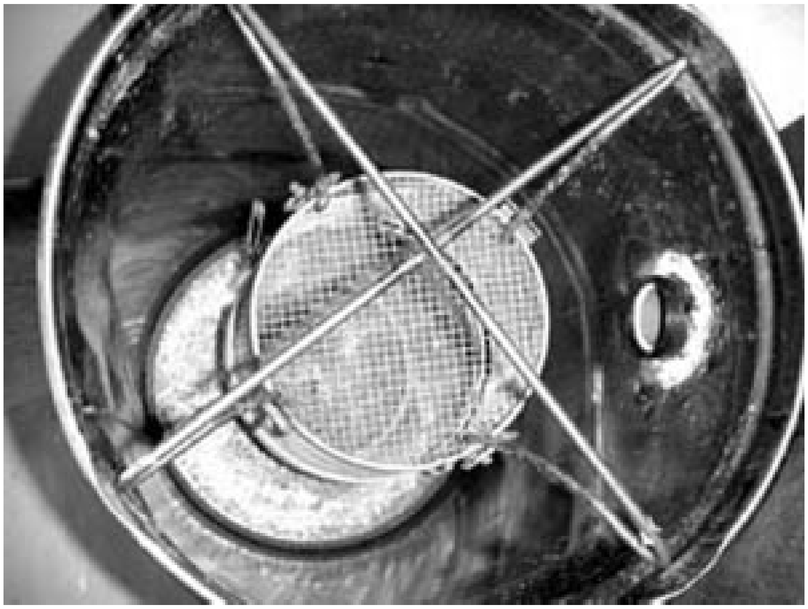

FIG. A1.6 Top View Of Water Tank And Cage With Submerged Foam Beads

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