



Designation: D4830/D4830M – 98 (Reapproved 2021)

Standard Test Methods for Characterizing Thermoplastic Fabrics Used in Roofing and Waterproofing¹

This standard is issued under the fixed designation D4830/D4830M; 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 These test methods cover the procedures for characterizing thermoplastic fabrics (for example polyester, polyamide, polypropylene, and so forth) used in prefabricated roofing and waterproofing membranes.

1.2 Procedures appear in the following order:

	Section
Unit Mass	3
Thickness	4
Breaking Load, Elongation, and Work-to-Break	5
Trapezoid Tearing Strength	6
Puncture Strength	7
Static Heat Stability	8
Dynamic Heat Stability	9

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the standard.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

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.*

¹ These test methods are under the jurisdiction of ASTM Committee D08 on Roofing and Waterproofing and are the direct responsibility of Subcommittee D08.04 on Felts, Fabrics and Bituminous Sheet Materials.

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2. Referenced Documents

2.1 ASTM Standards:²

- D76/D76M Specification for Tensile Testing Machines for Textiles
- D123 Terminology Relating to Textiles
- D885/D885M Test Methods for Tire Cords, Tire Cord Fabrics, and Industrial Filament Yarns Made from Manufactured Organic-Base Fibers
- D1117 Guide for Evaluating Nonwoven Fabrics (Withdrawn 2009)³
- D1776/D1776M Practice for Conditioning and Testing Textiles
- D4354 Practice for Sampling of Geosynthetics and Rolled Erosion Control Products (RECPs) for Testing
- D5035 Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)
- D5729 Test Method for Thickness of Nonwoven Fabrics (Withdrawn 2008)³
- D5733 Test Method for Tearing Strength of Nonwoven Fabrics by the Trapezoid Procedure (Withdrawn 2008)³
- E1 Specification for ASTM Liquid-in-Glass Thermometers
- E18 Test Methods for Rockwell Hardness of Metallic Materials

3. Unit Mass

3.1 Determine the unit mass of the fabric using procedures described in Guide D1117. Report in g/m² or oz/yd².

4. Thickness

4.1 Determine fabric thickness following procedures described in Test Method D5729.

5. Breaking Load, Elongation, and Work-to-Break

5.1 Determine the breaking load and elongation by the cut strip method described in Test Method D5035 with the following exceptions:

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.

³ The last approved version of this historical standard is referenced on www.astm.org.

5.1.1 *Test Specimens*—Cut each specimen 51 ± 1 mm [2.0 ± 0.05 in.] wide and 203 ± 1 mm [8.0 ± 0.05 in.] long. The gauge length shall be 152 ± 1 mm [6.0 ± 0.05 in.].

5.1.2 *Apparatus*—The apparatus shall be a CRE (constant rate of extension) machine described in Specification D76/D76M. The machine will be set for an extension rate of 5 mm/s or 12 in./min.

5.2 *Calculation*—Report textile conditions and the average breaking load in N/m or lbf/in. and the elongation at break in percent.

5.3 *Work-to-Break*—The procedure and calculation shall be as described in Test Methods D885/D885M, with the exception that the load-elongation curve will be from specimens used in determining breaking load and elongation as described in 5.1 and 5.2.

6. Trapezoid Tearing Strength

6.1 Determine trapezoid tearing strength of the fabric following procedures described in Test Method D5733.

7. Puncture Strength

7.1 Scope:

7.1.1 This test method is used to measure the puncture strength of thermoplastic fabrics used in roofing.

7.1.2 This procedure is applicable to conditioned fabrics.

7.2 Summary of Method:

7.2.1 A specimen of the fabric is clamped without tension between grooved, circular plates of a ring clamp attachment secured in a tensile testing machine. A force is exerted against the center of the specimen by a solid steel rod attached to the load indicator until rupture occurs.

7.3 Significance and Use:

7.3.1 Puncture failures are recognized in the roofing industry. Puncture strength is felt to reflect the fabric's ability to withstand aggregate or ballast stone penetration. This test method is used to obtain the relative puncture resistance of various fabrics.

7.4 Apparatus:

7.4.1 *Tensile Testing Machine*, of the constant-rate-of-extension type (CRE), with autographic recorder conforming to the requirements of Specification D76/D76M.

7.4.2 *Ring Clamp Attachment*, consisting of concentric grooved plates with an internal diameter of 44.45 ± 0.025 mm [1.750 ± 0.001 in.], capable of clamping fabrics without slippage.

7.4.3 *Solid Steel Rod*, with a hardness in the range of Rockwell C (HRC) 50 to 60, with a diameter of 7.938 ± 0.013 mm [0.3125 ± 0.0005 in.] and a hemispherical end with a radius of 3.970 ± 0.013 mm [0.1563 ± 0.0005 in.] for contacting the fabric surface (see Fig. 1). The surface of the hemispherical end should be smooth and polished to a surface smoothness of $RMS \leq 8$. (RMS is the root-mean-square method of describing surface smoothness.)⁴

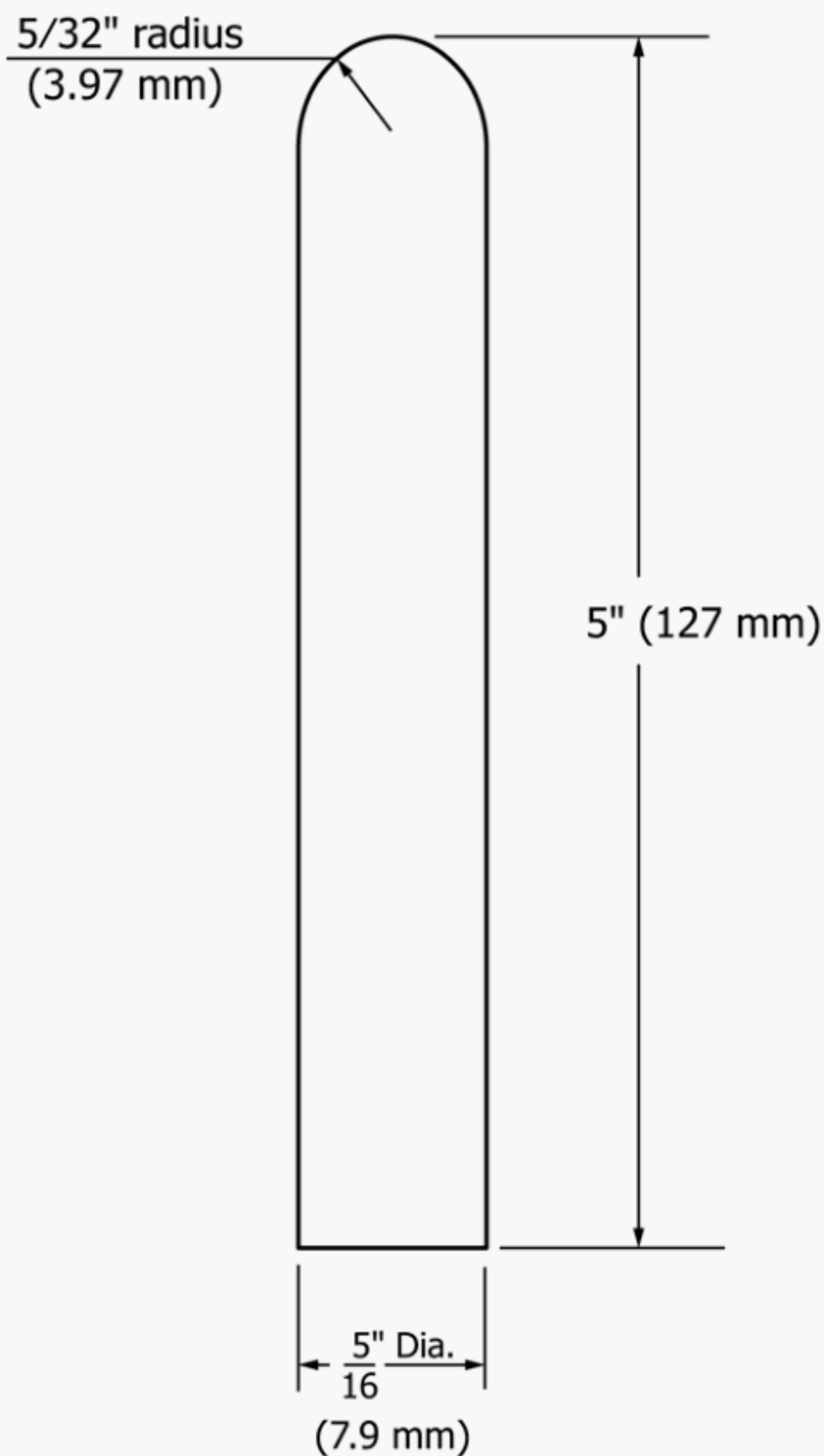


FIG. 1 Steel Rod

7.5 Sampling, Number of Specimens, and Selection of Samples:

7.5.1 *Lot Sample*—As a lot sample for acceptance testing, take at random the number of rolls of fabric directed in an applicable material specification or other agreement between the purchaser and the supplier, such as agreement to sample as directed in Practice D4354. Consider rolls of fabric to be the primary sampling units.

7.5.2 *Laboratory Sample*—Take, for the laboratory sample, a sample extending the width of the fabric and approximately 1.0 m [39 in.] along with the selvage from each roll in the lot sample. The sample may be taken from the end portion of a roll provided there is no evidence that it is distorted or different from other portions of the roll. In cases of dispute, take a sample that will exclude fabric from the outer wrap of the roll or the inner wrap around the core.

7.5.3 Unless otherwise agreed upon or specified in applicable material specifications, test a number of specimens from

⁴ See *Machinery's Handbook*, 19th edition, Industrial Press, H. L. Horton, Ed.

5.1.1 *Test Specimens*—Cut each specimen 51 ± 1 mm [2.0 ± 0.05 in.] wide and 203 ± 1 mm [8.0 ± 0.05 in.] long. The gauge length shall be 152 ± 1 mm [6.0 ± 0.05 in.].

5.1.2 *Apparatus*—The apparatus shall be a CRE (constant rate of extension) machine described in Specification **D76/D76M**. The machine will be set for an extension rate of 5 mm/s or 12 in./min.

5.2 *Calculation*—Report textile conditions and the average breaking load in N/m or lbf/in. and the elongation at break in percent.

5.3 *Work-to-Break*—The procedure and calculation shall be as described in Test Methods **D885/D885M**, with the exception that the load-elongation curve will be from specimens used in determining breaking load and elongation as described in **5.1** and **5.2**.

6. Trapezoid Tearing Strength

6.1 Determine trapezoid tearing strength of the fabric following procedures described in Test Method **D5733**.

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7.4.2 *Ring Clamp Attachment*, consisting of concentric grooved plates with an internal diameter of 44.45 ± 0.025 mm [1.750 ± 0.001 in.], capable of clamping fabrics without slippage.

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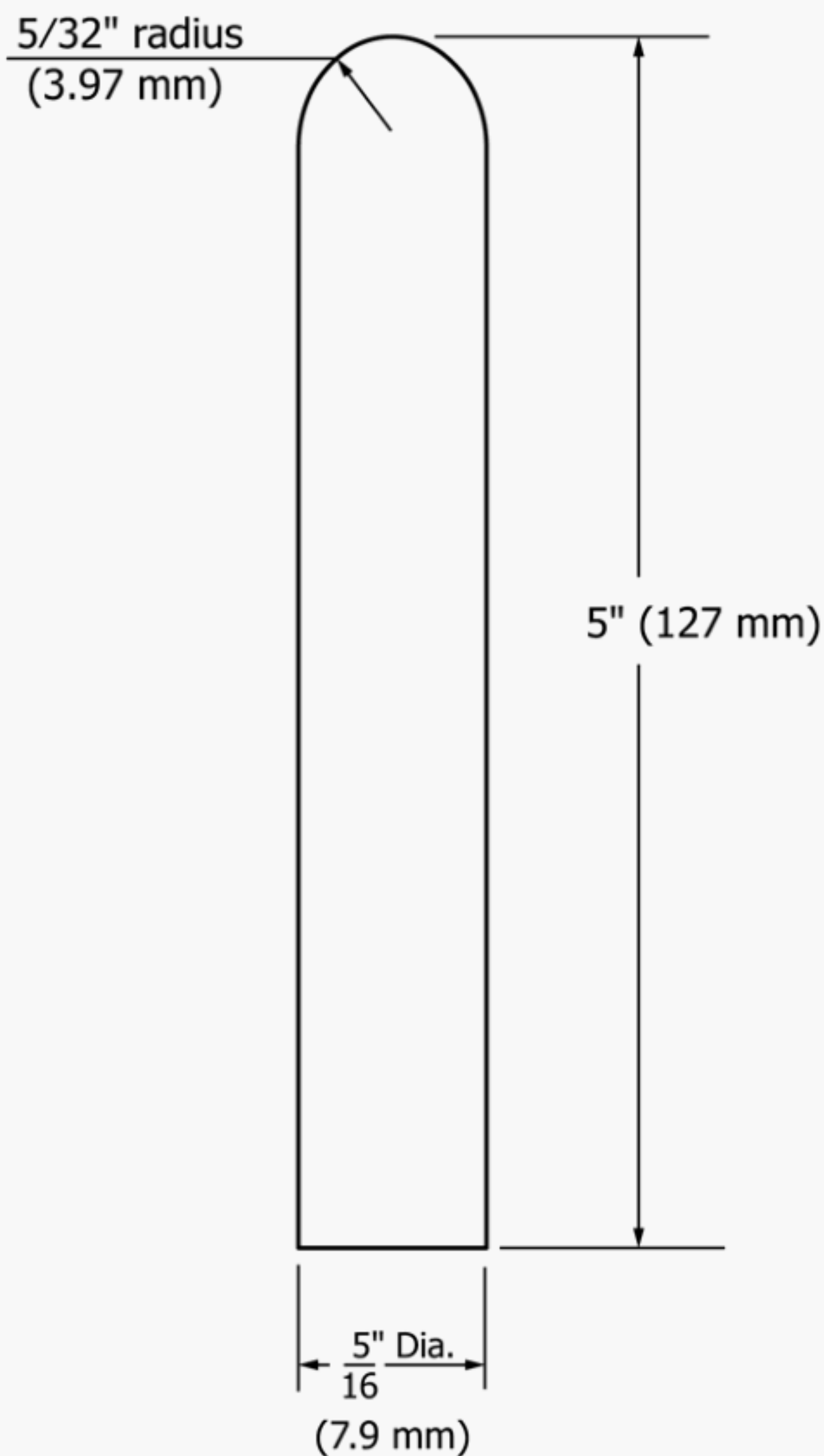


FIG. 1 Steel Rod

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7.5.2 *Laboratory Sample*—Take, for the laboratory sample, a sample extending the width of the fabric and approximately 1.0 m [39 in.] along with the selvage from each roll in the lot sample. The sample may be taken from the end portion of a roll provided there is no evidence that it is distorted or different from other portions of the roll. In cases of dispute, take a sample that will exclude fabric from the outer wrap of the roll or the inner wrap around the core.

7.5.3 Unless otherwise agreed upon or specified in applicable material specifications, test a number of specimens from

8.6 Conditioning:

8.6.1 Condition the specimens as directed in Practice **D1776/D1776M**.

8.7 Procedure:

8.7.1 Perform **8.7.1.1 – 8.7.1.9** at the following suggested temperatures: 177, 191, 204, and $218 \pm 1^\circ\text{C}$ [350, 375, 400, and $425 \pm 2^\circ\text{F}$].

8.7.1.1 Set the oven to the desired test temperature and allow to stabilize a minimum of $\frac{1}{2}$ h.

8.7.1.2 Select three machine direction specimens and three cross-machine direction specimens. Measure and record the distance between the two scribed lines to the nearest 1.0 mm or $\frac{1}{32}$ in., numbering the specimens as necessary.

8.7.1.3 Place the mounting board in a horizontal position and secure the tops of the six specimens in the clamps up to the top 6-mm [$\frac{1}{4}$ -in.] line.

8.7.1.4 Attach an alligator clip at the center of the lower edge of each specimen. Do not place the clip higher than the lower 6-mm [$\frac{1}{4}$ -in.] line.

8.7.1.5 When the oven temperature has stabilized, put the mounting board in its vertical position (as shown in **Fig. A1.1**) in the oven.

8.7.1.6 Check the oven temperature. Once the oven temperature has returned to the desired test temperature, set the timing device for 5 min. Do not allow the oven temperature to exceed the test temperature.

8.7.1.7 When timing is completed, remove the assembly from the oven and place it vertically at room temperature. Leave the specimens on the mounting board for 15 min with alligator clips still attached.

8.7.1.8 Remove the alligator clips and release the specimens from the board. Lay the specimens on a flat surface and allow them to condition an additional 15 min before any measurements are made.

8.7.1.9 To measure the specimen length, cover the specimen with the ruler. Measure the length of the specimen between the two lines while the specimen is being pressed flat by the ruler. Record this length for each specimen to the nearest 1.0 mm or $\frac{1}{32}$ in.

8.8 Calculations:

8.8.1 Calculate the average length between the scribed lines for the machine direction specimens and for the cross-machine direction specimens at each test temperature, before and after exposure to the oven.

8.8.2 Calculate the percentage change in length for the machine direction and cross-machine direction specimens at each test temperature as follows:

$$\text{Percent Change in Length} = [(A - B)/B] \times 100 \quad (1)$$

where:

A = average length between lines after exposure, and

B = average length between lines before exposure.

8.8.2.1 A positive sign for the percent change in length indicates an increase in specimen length upon heating. A negative sign indicates a decrease in specimen length upon heating.

8.9 Report:

8.9.1 State that the tests were carried out as directed in this test method and report the static heat stability as the percent change in length for both the machine and cross-machine directions at each specific temperature. Describe the product(s) or material(s) sampled, the number of specimens, and the method of sampling used.

8.9.2 The data may be expressed in the form of a graph indicating the percent change in length versus temperature for both the machine and cross-machine directions.

8.10 Precision and Bias:

8.10.1 *Precision*—The precision of the procedure in this test for measuring static heat stability is being determined.

8.10.2 *Bias*—Since there is no accepted reference material suitable for determining the bias for the procedure in this test for static heat stability, no statement on bias is being made.

9. Dynamic Heat Stability

9.1 Scope:

9.1.1 This test method covers the determination of the dynamic heat stability of thermoplastic fabrics at typical asphalt application temperatures and operating stresses during manufacture of prefabricated membrane.

9.2 Summary of Method:

9.2.1 Weights are attached to fabric specimens which are then heated in an oven for a fixed amount of time. The change in length of each specimen is recorded and expressed as a percentage of the original length.

9.2.2 Data are obtained using several different weights and a plot is made comparing the percent change in length versus weight applied.

9.3 Significance and Use:

9.3.1 This test method is used to develop a relationship between the change in length of a fabric specimen and the load applied, at a specific temperature. The loads and temperatures used in this test are typical of those seen in the roofing manufacturing process.

9.4 Apparatus:

9.4.1 *Self-Supporting Aluminum Mounting Board*—See **Annex A1**.

9.4.2 *Oven*—See **8.4.1**.

9.4.3 *Four “Bulldog” Clamps*, 51 mm [2.0 in.] wide and weighing approximately 10 g [0.353 oz], with silicon seal affixed and cured to the inside of the clamps to improve grip on test specimens. The exact weight of each clamp should be determined and recorded.

9.4.4 *Ruler*—See **8.4.3**.

9.4.5 *Hook Weight Set*, to enable testing in the range from 50 to 1000 g.

9.4.6 *Timing Device*—See **8.4.5**.

9.4.7 *Marking Pen*—See **8.4.6**.

9.5 Preparation of Specimens:

9.5.1 Prepare specimens in accordance with **8.5.1** and **8.5.2**.

9.5.2 Each specimen should be 229 ± 3 mm [$9.0 \pm \frac{1}{8}$ in.] long and 25 ± 3 mm [$1.0 \pm \frac{1}{8}$ in.] wide.

9.5.3 Cut twelve specimens from the sample with their long dimension parallel to the machine direction. Label each specimen as a machine direction specimen.

9.5.4 Cut twelve specimens from the sample with their long dimension parallel to the cross-machine direction. Label each specimen as a cross-machine direction specimen.

9.5.5 Marking and Reinforcing the Specimens:

9.5.5.1 Lay out a specimen fully extended on a flat, horizontal surface. Draw a line on the specimen 25 mm [1.0 in.] from the end, parallel to the short dimension (width). Draw a similar line on the other end of the specimen.

9.5.5.2 Fold over one end of the specimen, bringing it up to the nearest scribed line. Fasten the end of the specimen using two staples, placed side by side along the line. Do not cover the line. Repeat for the other end of the specimen.

9.5.5.3 Prepare the other specimens as in 9.5.5.1 and 9.5.5.2.

9.6 Conditioning:

9.6.1 Condition the specimens as directed in Practice D1776/D1776M.

9.7 Procedure:

9.7.1 Repeat 9.7.3 – 9.7.11 at a specific temperature until three values are obtained at each of the following loads, for each direction: 50, 100, 200, and 500 g. The following temperatures are recommended: 177, 191, 204, or 218 ± 1 °C [350, 375, 400, or 425 ± 2 °F].

NOTE 1—The weight of the clamp should be added to the above weights when reporting the results and plotting the data.

9.7.2 Additional tests may be performed using 1000 g, or any desired combination of weights. Test specimens may be shortened to 152 mm [6.0 in.] between scribed lines to accommodate longer weights.

9.7.3 Set the oven to the desired test temperature and allow to stabilize a minimum of ½ h.

9.7.4 Select four test specimens, numbering each and identifying its major direction. Measure and record the distance between the two scribed lines to the nearest 1.0 mm or 1/32 in.

9.7.5 Place the mounting board in a horizontal position and secure the tops of the four specimens in the clamp up to the top scribed line.

9.7.6 Attach a “bulldog” clamp to each specimen, using the lower line as a guide.

9.7.7 Put the mounting board in the upright position (as shown in Fig. A1.1) and attach the 50-g, 100-g, 200-g, and 500-g weights, respectively, to the four “bulldog” clamps.

9.7.8 When the oven temperature has stabilized, put the mounting board in the oven in the upright position.

9.7.9 Check the oven temperature. Once the oven temperature has returned to the desired test temperature, set the timing device for 5 min. Do not allow the oven temperature to exceed the test temperature.

9.7.10 When timing is completed, remove the assembly from the oven and place it upright at room temperature. Leave the specimens on the mounting board for 15 min with weights still attached.

9.7.11 Record the value of the weight used for each specimen, including the clamp. Remove the weights and clamps and release the specimens from the board. Lay the specimens on a flat surface and allow them to condition an additional 15 min before any measurements are made.

9.7.12 To measure the specimen length, cover the specimen with the ruler. Measure the length between the two lines while the specimen is being pressed flat by the ruler. Record this length of each specimen to the nearest 1.0 mm or 1/32 in.

9.8 Calculations:

9.8.1 Calculate the percent change in length for each specimen as follows:

$$\text{Percent Change in Length} = [(A - B)/B] \times 100 \quad (2)$$

where:

A = length between lines after exposure, and

B = length between lines before exposure.

9.8.2 A positive sign for the percent change in length indicates an increase in specimen length upon heating. A negative sign indicates a decrease in specimen length upon heating.

9.8.3 Calculate the average percent change in length for each direction at each weight level used. Plot the percent change in length versus weight used for each direction.

9.9 Report:

9.9.1 State that the tests were carried out as directed in this test method and report the dynamic heat stability as the percent change in length versus weight used for each direction at each temperature. Describe the product(s) or material(s) sampled, the number of specimens, and the method of sampling used.

9.10 Precision and Bias:

9.10.1 *Precision*—The precision of the procedure in this test for measuring dynamic heat stability is being determined.

9.10.2 *Bias*—Since there is no accepted reference material suitable for determining the bias for the procedure in this test for dynamic heat stability, no statement on bias is being made.

10. Keywords

10.1 heat stability; prefabricated roofing and waterproofing membrane; thermoplastic fabric; trapezoid tearing strength

ANNEX

(Mandatory Information)

A1. INSTRUCTIONS FOR THE BUILDING OF THE MOUNTING BOARD (SEE FIGS. A1.1 AND A1.2)

A1.1 Obtain a piece of aluminum sheet of suitable dimension such that when bent it will have a 381 by 381 by 3.2-mm [15 by 15 by 1/8-in.] face and a base which is 381 mm wide and extends 152 mm [6.0 in.] back. The face should be at an angle of 10° from the vertical.

A1.2 Draw a line across the top of the board no more than 76 mm [3.0 in.] from the top edge.

A1.3 Remove the clamps from two standard clipboards. The clamps should be at least 152 [6.0 in.] wide. Place the board in a horizontal position. Place the clamps side by side on the board with the lower edges of the clamps positioned along the line which was drawn. Drill the necessary holes into the board and affix the clamps using screws or rivets.

A1.4 Secure the clamps in an open position. Build up an even 3-mm [1/8-in.] layer of silicone seal which extends 6 mm [1/4 in.] on either side of the scribed line. This may be accomplished by building up layers of masking tape (or any other suitable material) 6 mm [1/4 in.] from both sides of the line to act as a template for the seal. This technique is illustrated in Fig. A1.2. Keep the clamps secured in an open position for one day to allow the seal to cure. Carefully remove the template once the seal has cured.

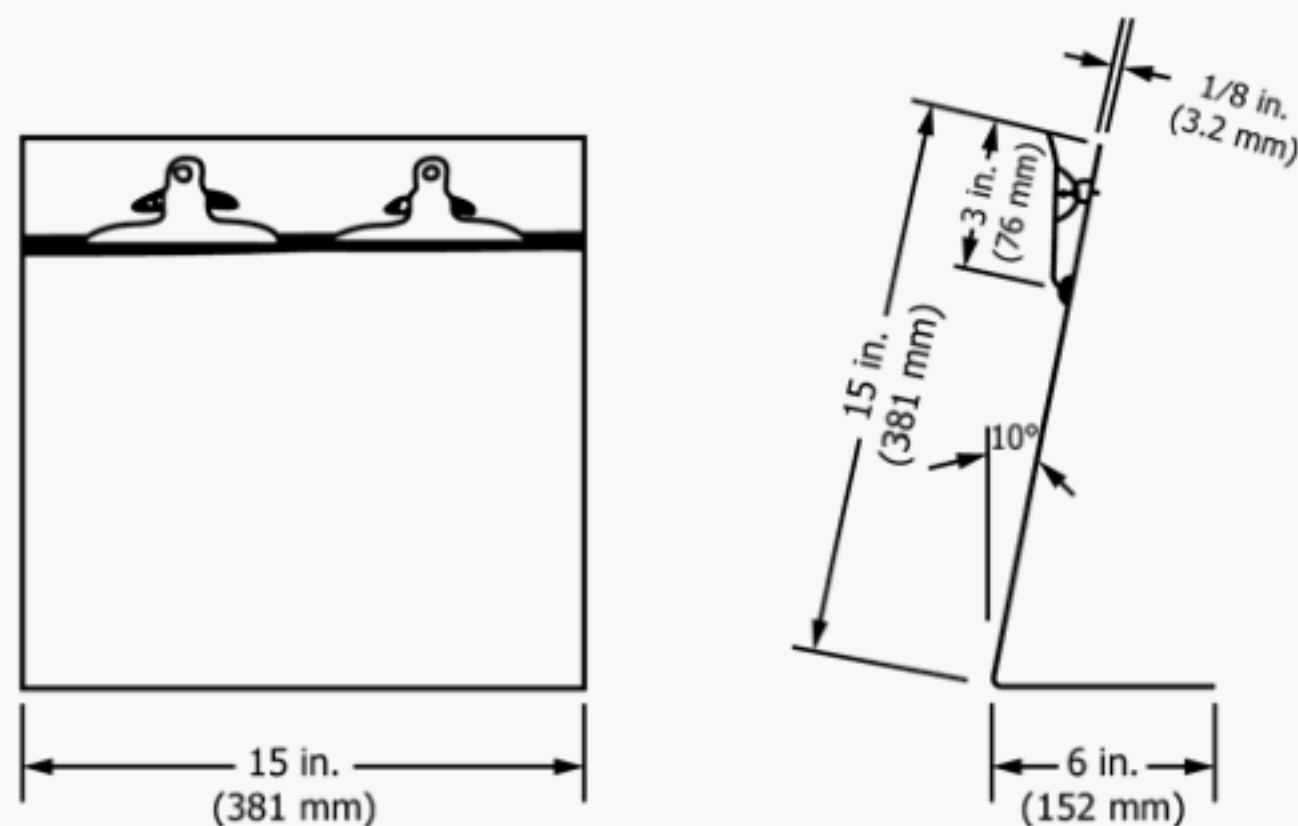


FIG. A1.1 Self-Supporting Aluminum Mounting Board

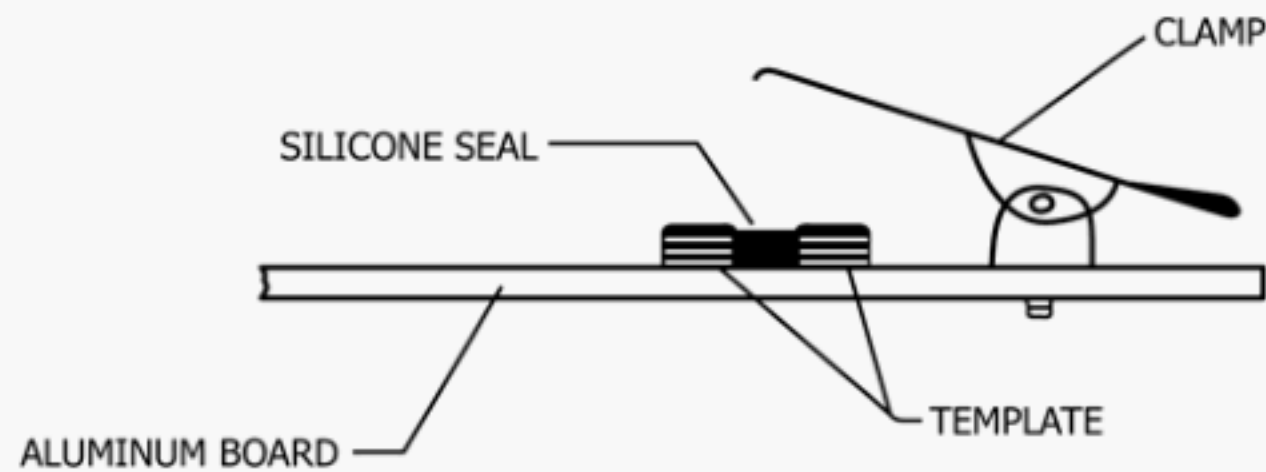


FIG. A1.2 Schematic Diagram of Template

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