UL 181B

STANDARD FOR SAFETY

Closure Systems for Use With Flexible Air Ducts and Air Connectors

UL Standard for Safety for Closure Systems for Use With Flexible Air Ducts and Air Connectors, UL 181B

Third Edition, Dated January 8, 2013

Summary of Topics

This revision of ANSI/UL 181B dated December 29, 2021 is being issued to update the title page to reflect the most recent designation as a Reaffirmed American National Standard (ANS). No technical changes have been made.

Text that has been changed in any manner or impacted by UL's electronic publishing system is marked with a vertical line in the margin.

The requirements are substantially in accordance with Proposal(s) on this subject dated November 5, 2021.

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UL 181B

Standard for Closure Systems for Use With Flexible Air Ducts and Air Connectors

First Edition – October, 1995
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Third Edition

January 8, 2013

This ANSI/UL Standard for Safety consists of the Third Edition including revisions through December 29, 2021.

The most recent designation of ANSI/UL 181B as a Reaffirmed American National Standard (ANS) occurred on December 29, 2021. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at https://csds.ul.com.

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INTRODUCTION

1 Scope

1.1 These requirements cover pressure-sensitive tapes, mastic systems, and non-metallic mechanical fasteners for use as a part of the closure system of factory-made flexible air ducts or air connectors complying with the Standard for Factory-Made Air Ducts and Air Connectors, UL 181.

1.2 These requirements cover only pressure-sensitive tapes intended for use at the core to fitting attachment and at the outer moisture barrier. When used at the core to fitting attachment, a mechanical fastener shall be installed over the tape. The tape shall be employed at this location such that it does not disrupt the connection of the mechanical fastener. When tape is used at the outer moisture barrier, mechanical fasteners may or may not be employed.

1.3 These requirements cover only mastic systems intended to be used with joints of factory-made flexible non-metallic air ducts or air connectors which employ mechanical fasteners (see 2.4). The joints, without mastics, shall comply with the requirements of the Standard for Factory-Made Air Ducts and Air Connectors, UL 181.

1.4 Mastic closure systems are intended for use as an additional seal at the attachment of the flexible non-metallic air duct cores (or air connectors). The mastic shall be installed uniformly around the mating surface of the fitting collar (i.e. sleeves, elbows, and the like) and in such a manner that it does not disrupt the connection of the mechanical fastener around the core.

1.5 These requirements cover only non-metallic mechanical fasteners intended for use at the core to fitting attachment and at the outer moisture barrier of factory-made flexible non-metallic air ducts or air connectors. When these non-metallic fasteners are used, beaded fittings are required, and a maximum positive operating pressure shall be limited to 6 inch water column (1.5 kPa). Multiple lengths of fasteners may be joined to achieve longer length.

1.6 Pressure-sensitive tapes, mastic closure systems, and non-metallic mechanical fasteners are intended for use with flexible air ducts and air connectors installed in accordance with the International Mechanical Code (IMC), International Residential Code (IRC), International Energy Conservation Code (IECC), Uniform Mechanical Code (UMC), Standard for the Installation of Air Conditioning and Ventilating Systems, NFPA 90A, and the Standard for the Installation of Warm Air Heating and Air Conditioning Systems, NFPA 90B; and/or other Model codes.

2 Glossary

2.1 For the purpose of these requirements, the following definitions apply.

2.2 AIR DUCT MATERIALS – The materials intended for air duct core construction are: steel, aluminum, aluminum foil, polyethylene terephthalate, chlorinated polyethylene, and pvc coated fabric. The materials intended for air duct moisture barrier construction are: aluminum foil, polyethylene, polyethylene terephthalate, and chlorinated polyethylene.

2.3 FITTINGS – Fittings are collars, sleeves, elbows, and the like to which flexible air ducts are attached. Collars are intended to be a minimum of 2 inches (50.8 mm) in length. Sleeves are intended to be a minimum of 4 inches (101.6 mm) in length. Fittings are intended to incorporate a semi-circular outward bead located on the fitting flange or collar portion where the flexible air duct or air connector is intended to be attached.

2.4 MECHANICAL FASTENERS – Mechanical fasteners are the sole closure means for flexible air ducts and air connectors in accordance with the intent of the requirements of the Standard for Factory-Made Air

Ducts and Air Connectors, UL 181. For the purpose of this Standard, mechanical fasteners, by design, do not include other closure systems such as tapes or mastics.

3 Components

3.1 Except as indicated in 3.2, a component of a product covered by this standard shall comply with the requirements for that component.

3.2 A component is not required to comply with a specific requirement that:

a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard, or

b) Is superseded by a requirement in this standard.

3.3 A component shall be used in accordance with its rating established for the intended conditions of use.

3.4 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

4 Units of Measurement

4.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

5 Undated References

5.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

6 Referenced standards

6.1 Standards referenced in these requirements include those specified below.

ASTM D3759,
Standard Test Method for Breaking Strength and Elongation of Pressure-Sensitive Tape

ASTM D3330,
Standard Test Method for Peel Adhesion of Pressure-Sensitive Tape

ASTM D3654,
Standard Test Method for Shear Adhesion of Pressure-Sensitive Tapes

ASTM C794,
Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants

IEC 60695-11-10,
Test Flames – 50 W Horizontal and Vertical Flame Test Methods

ISO 527-1,
Plastics – Determination of Tensile Properties – Part 1: General Principles

ISO 527-2,
Plastics – Determination of Tensile Properties – Part 2: Test Conditions for Moulding and Extrusion Plastics

PART I – PRESSURE-SENSITIVE TAPES

CONSTRUCTION

7 Materials

7.1 Pressure-sensitive tape shall have a minimum width of 1-7/8 inch (47.6 mm).

PERFORMANCE

8 Tensile Strength Test

8.1 The average tensile strength in the machine direction of each roll of tape shall be not less than 17 pounds per inch (2.97 N/mm) of width, with no individual specimen having a value of less than 15 pounds per inch (2.62 N/mm) of width, when tested in accordance with 8.3.

8.2 The average tensile strength in the cross machine direction of each roll of tape shall be not less than 8 pounds per inch (1.40 N/mm) of width, with no individual specimen having a value of less than 7.5 pounds per inch (1.31 N/mm) of width, when tested in accordance with 8.3.

8.3 The tensile strength of the tape is to be determined in accordance with the Standard Test Method for Breaking Strength and Elongation of Pressure-Sensitive Tape, ASTM D3759.

8.4 Three specimens from each of three separate rolls of tape shall be prepared with a laboratory specimen cutter for both machine and cross directions.

9 Peel Adhesion Test at 180 Degree Angle

9.1 The average peel adhesion strength of the pressure-sensitive tape shall be not less than 30 ounces per inch (0.33 N/mm) of width of tape with no individual specimen having a value of less than 25 ounces per inch (0.27 N/mm) applied to the specified stainless steel panel, and tested in accordance with 9.3 and 9.4.

9.2 The average peel adhesion strength of pressure sensitive tape shall be not less than 25 ounces per inch (0.27 N/mm) of width of tape with no individual specimen having a value of less than 20 ounces per inch (0.22 N/mm) applied to the tape's own backing and tested in accordance with 9.3 and 9.4.

9.3 The peel adhesion strength of the tape is to be determined in accordance with the Standard Test Method for Peel Adhesion of Pressure-Sensitive Tape, ASTM D3330, except as modified in 9.4. Tests are to be conducted in accordance with Method A – Single-Coated Tapes.

9.4 Three specimens from each of three separate rolls of tape are to be tested. Specimens are to be cut in 1 inch (25.4 mm) wide by 12 inch (305 mm) long strips. The tape is to be applied to a stainless steel substrate as specified in the Standard Test Method for Peel Adhesion of Pressure-Sensitive Tape, ASTM D3330. The tape is to be applied to its own backing using double-sided tape between the tape substrate and the supporting steel plate such that no bending is possible during the test. Alternative equivalent means of securing the tape substrate to the support is acceptable. The test load is to be applied immediately after completion of the rolling.

10 Shear Adhesion Test

10.1 The shear adhesion strength of tape shall be such that the tape is able to maintain the test loads specified in Table 10.1 for 24 hours without evidence of separation or slippage in excess of 1/8 inch (3.18 mm).

Table 10.1
Shear adhesion test conditions

Dwell conditions[a]	Dwell time[b]	Test conditions[a]	Test load	Test duration
N/A	N/A	73.4°F (23°C) 50 percent RH	2 pounds (8.9 N)	24 hours
N/A	N/A	150°F (65.6°C)	100 grams (1.0 N)	24 hours
150°F (65.6°C)	60 days	73.4°F (23°C) 50 percent RH	100 grams (1.0 N)	24 hours

[a] Dwell conditions and test conditions shall be controlled within ±3.6°F (2°C) and ±5 percent RH, where specified.

[b] Dwell time is the time that the test specimen is in contact with the test panel, at dwell conditions, after rolling but prior to the application of the test load.

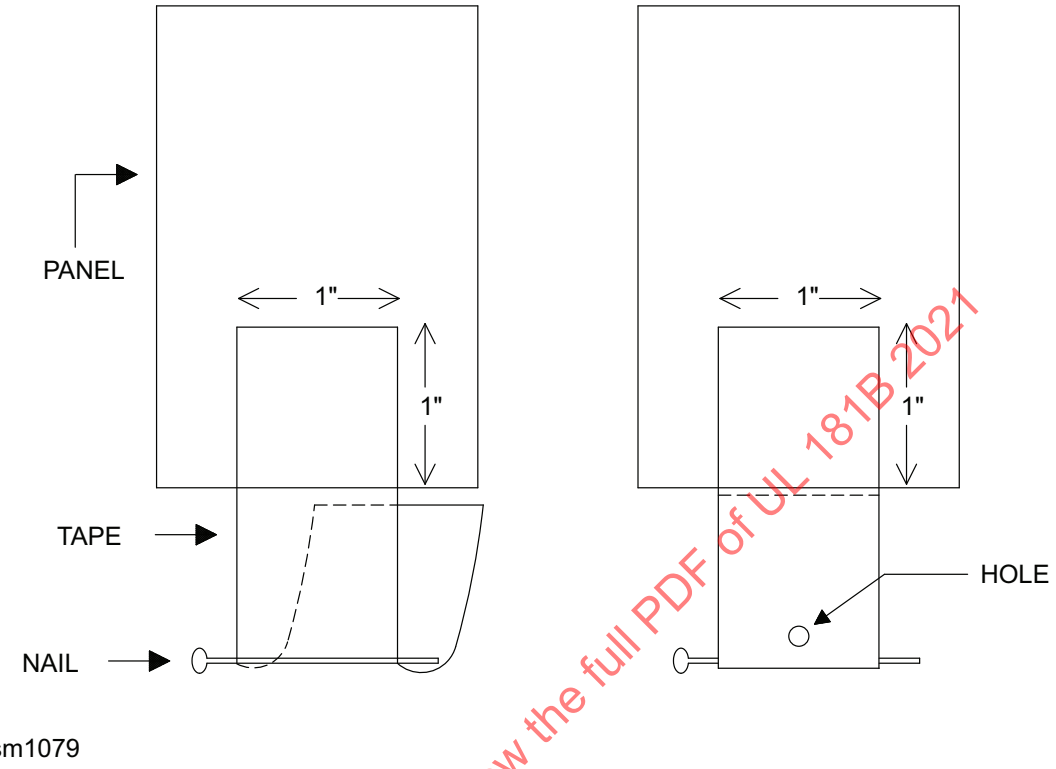
10.2 The shear adhesion strength of pressure-sensitive tape is to be determined in accordance with Procedure A of the Standard Test Method for Shear Adhesion of Pressure-Sensitive Tapes, ASTM D3654, except as modified in 10.3 – 10.7.

10.3 One sample from each of four separate rolls of tape is to be tested (a total of four specimens). Specimens are to be cut in 1 inch (25.4 mm) wide by 6 inch (152 mm) long strips. The cut specimens and stainless steel panels are to be maintained at an ambient condition of 73.4 ±3.6°F (23 ±2°C) and 75 ±5 percent RH for a minimum of 1 hour prior to applying the specimens to the panels.

10.4 After conditioning in accordance with 10.3, a 1 inch (25.4 mm) length of tape is to contact the panel. The tape is to be applied as specified in the Standard Test Method for Shear Adhesion of Pressure Sensitive Tapes, ASTM D3654. The test load is to be applied at the test condition for 24 hours as specified by Table 10.1. If applicable, the tape is to be allowed to dwell on the panel for the time specified in Table 10.1. Otherwise the test load is to be applied immediately after completion of the rolling. See Figure 10.1.

Figure 10.1

Shear adhesion apparatus



10.5 The clamp is to be placed on the free end of the sample. The clamp is to extend completely across the width of the sample and is to be aligned to uniformly distribute the load. The test load specified in Table 10.1 is then to be applied to the clamp gently so as not to cause any shear impact force on the sample. The load is to be applied for 24 hours.

10.6 The test panel is to be positioned at 2 degrees from the vertical so that the back of the test substrate forms a 178 degree angle with the extended tape specimen.

10.7 Specimens that rip or tear during this test and are unable to support the test load for the test duration specified because of the rip or tear shall be retested.

11 Surface Burning Characteristics Test

11.1 A pressure sensitive tape of the maximum width recommended by the manufacturer shall be tested in accordance with the Standard for Test for Surface Burning Characteristics of Building Materials, UL 723, and shall have:

a) A flame-spread rating of not over 25 without evidence of continued progressive combustion; and

b) A smoke-developed rating of not over 50 when applied to inorganic reinforced cement board.

11.2 One strip of the pressure sensitive tape is to be applied along the longitudinal center of each section of the inorganic reinforced cement board substrate in accordance with the recommended field application instructions. The inorganic reinforced cement board utilized as a test substrate shall have flame spread and smoke developed indices of 0. For the purpose of establishing these indicies, typically three tests are to be conducted.

12 Mold Growth and Humidity Test

12.1 Pressure-sensitive tape shall be resistant to the effects of high humidity under ordinary atmospheric temperature conditions.

12.2 Three samples of tape, each 4 inches (102 mm) long and in the as-received width, are to be tested

12.3 Mold mycelia and spores from Chaetomium Globosium are to be applied to both sides of the specimens. The specimens are to be placed in a closed vessel in which an atmosphere saturated with water vapor is maintained at room temperature under dark conditions. The specimens are to remain in this atmosphere until the maximum extent of growth has been demonstrated, or until the mold and spores have disintegrated, but not less than 60 days.

12.4 The specimens then are to be examined visually for extent of mold and for indications of deterioration of the tape specimens. The mold shall not have spread beyond the inoculated area, and no significant growth of mold shall be observed.

13 Temperature Test

13.1 The tape shall be resistant to the effects of the high temperature conditions to which it is exposed during this test.

13.2 Twelve specimens are to be made by applying a 2 by 2 inch strip of tape to three 4 by 4 inch (102 by 102 mm) samples of each of the following materials: aluminum foil, polyethylene, polyethylene terephthalate, and chlorinated polyethylene. Total of twelve samples are to be tested. The substrate samples with the tape sample applied shall be taped at the edges to 5 by 5 inch galvanized plates for stability.

13.3 Another 4 by 4 inch (102 by 102 mm) control sample of each of the substrate materials are to be cut and also taped at the edges to 5 by 5 inch galvanized plates for stability. Candidate pressure sensitive tape specimens shall not be applied to the control sample.

13.4 The test specimens and control samples are to be placed in an air circulating oven maintained at 212 ±5°F (100 ±3°C) for a period of 60 days.

13.5 The samples are then to be examined visually for indications of deterioration, brittleness, cracking, flaking, and blistering.

MARKING

14 General

14.1 The tape shall be marked every 6 inches (152 mm) or fraction thereof with all of the following information:

a) The manufacturer's or private labeler's name or identifying symbol;

b) The distinctive type or model designation;

c) The manufacturing location, if the manufacturer produces pressure-sensitive tape at more than one factory; and

d) The marking "181B-FX."

PART II – MASTIC CLOSURE SYSTEMS

CONSTRUCTION

15 Materials

15.1 Mastic closure systems shall consist of mastic supplied in suitable containers.

16 Glossary

16.1 For the purpose of these requirements, the following definitions apply.

16.2 RECOMMENDED SET TIME – The time specified by the manufacturer that is needed for a mastic to dry such that the joint can be moved or the system can be pressurized.

PERFORMANCE

17 Peel Adhesion Test on Stainless Steel

17.1 The average adhesion strength of a mastic system shall not be less than 32 ounces per inch (0.35 N/mm) of width of mastic system when tested in accordance with 17.2 and 17.3.

17.2 The adhesion strength of a mastic system is to be determined in accordance with the Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants, ASTM C794, except as modified in 17.3.

17.3 Three samples are to be prepared in accordance with the Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants, ASTM C794, employing the specified 30 mesh, 10 mil stainless steel airplane cloth, or equivalent. The first layer of mastic (1/16 inch thick) and the cloth is to be applied to a stainless steel panel having dimensions of 5 inch (127 mm) by 2 inch (51 mm) by 0.25 inch (6.3 mm). The samples are to be cured for 7 days in a conditioning chamber maintained at 73.4 ±3.6°F (23 ±2°C) and 75 ±5 percent relative humidity. The second layer of mastic (1/16 inch thick) is to then be applied and followed with 7 days of conditioning in a chamber maintained at 100 ±3.6°F (37.8 ±2°C) and 95 ±5 percent relative humidity, and then 7 days at 73 ±3.6°F (23 ±2°C) and 50 ±5 percent relative humidity. The samples are to be peeled using a constant rate of extension machine at a rate of 2 inches per minute (50.8 mm/minute).

18 Peel Adhesion Test on PVC Coated Fabric

18.1 The average peel adhesion strength of a mastic system shall not be less than 25 ounces per inch (0.27 N/mm) of width of mastic system when tested in accordance with 18.2 and 18.3.

18.2 The adhesion strength of a mastic system is to be determined in accordance with the Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants, ASTM C794, except as modified in 18.3.

18.3 Three samples are to be prepared in accordance with the Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants, ASTM C794, employing the specified 30 mesh, 10 mil stainless steel airplane cloth or equivalent. The first layer of mastic (1/16 inch thick) and the cloth is to be applied to PVC coated fabric samples having dimensions of 5 inch (127 mm) by 2 inch (51 mm) by 0.25 inch (6.3 mm). The samples are to be cured for 7 days in a conditioning chamber maintained at 73.4 ±3.6°F (23 ±2°C) and 75 ±5 percent relative humidity. The second layer of mastic (1/16 in. thick) is to then be applied and followed with 7 days of conditioning in a chamber maintained at 100 ±3.6°F (37.8 ±2°C) and 95 ±5 percent relative humidity, and then 7 days at 73 ±3.6°F (23 ±2°C) and 50 ±5 percent relative humidity. The free end of the PVC coated fabric is to be placed, with a back-up plate to assure 180 degree peel, in one jaw of the

constant rate of extension machine and the cloth is to be placed in the other jaw. The samples are to be peeled using a constant rate of extension machine at a rate of 2 inches per minute (50.8 mm/minute).

19 Freeze/Thaw Test

19.1 Following the freeze/thaw cycling specified in 19.2, the mastic system shall be able to maintain the peel adhesion test loads as defined in 17.1 and 18.1 when applied in accordance with Section 17, Peel Adhesion Test on Stainless Steel and Section 18, Peel Adhesion Test on PVC Coated Fabric, respectively.

Exception: A mastic system marked in accordance with 23.4 need not be subjected to the freeze/thaw test.

19.2 The mastic is to be subjected in its original container to five freeze-thaw cycles, each cycle consisting of:

a) 16 hours at 0 ±2°F (minus 17 ±1°C);

b) 8 hours at 73.4 ±2°F (23 ±1°C); and

c) 7 days at 122 ±2°F (50±1°C).

Upon completion of five cycles, the sealant is to be conditioned for five days at 73.4 ±2°F (23 ±1°C) and 50 ±5 percent relative humidity.

19.3 The peel adhesion evaluation mentioned in 19.1 is to be conducted in accordance with Section 17, Peel Adhesion Test on Stainless Steel and Section 18, Peel Adhesion Test on PVC Coated Fabric.

20 Surface Burning Characteristics Test

20.1 A mastic closure system of the maximum width recommended by the manufacturer shall be tested as applied to inorganic reinforced cement board in accordance with the Standard for Test for Surface Burning Characteristics of Building Materials, UL 723 and shall have:

a) A flame-spread rating of not over 25 without evidence of continued progressive combustion; and

b) A smoke-developed rating of not over 50.

20.2 One strip of the mastic closure system is to be applied along the longitudinal center of each section of the inorganic reinforced cement board substrate in accordance with the recommended field application instructions, except the set time shall be 7 days. The inorganic reinforced cement board utilized as a test substrate shall have flame spread and smoke developed indices of 0.

20.3 For the purpose of establishing the flame spread and smoke developed indicies, tests shall be conducted on the minimum and/or maximum recommended thickness, whichever is expected to provide the maximum burning capabilities. Typically a minimum of three tests are to be conducted.

21 Mold Growth Test

21.1 The mastic closure system shall be resistant to the effects of mold growth and high humidity under ordinary atmospheric temperature conditions.

21.2 Nine specimens are to be made by applying mastic to three 4 inch by 4 inch (102 mm by 102 mm) samples of each of the following materials: aluminum foil, polyethylene terephthalate, and PVC coated fabric. Total of nine samples shall be tested. Mastics shall be applied at the manufacturer's recommended

application rate and thickness. The specimens are to be dried at 73.4 ±3.6°F (23 ±2°C) and 50 ±5 percent relative humidity for the manufacturer's recommended set time. See 16.2.

21.3 Another 4 inch by 4 inch (102 mm by 102 mm) control sample of each of the substrate materials shall be cut. Mastic is not to be applied to the control sample.

21.4 Mold mycelia and spores from Chaetomium Globosium are to be applied to the adhesive side of the nine test specimens. The specimens and control samples are to be placed in a closed vessel in which an atmosphere saturated with water vapor is maintained at room temperature under dark conditions. The specimens and control samples are to remain in this atmosphere until the maximum extent of growth has been demonstrated, or until the mold and spores have disintegrated, but not less than 60 days.

21.5 The specimens are to be examined visually for extent of mold and for indications of deterioration of the mastic specimens. The mold shall not have spread beyond the inoculated area, and no significant growth of mold shall be observed.

22 Temperature Test

22.1 The substrate to which the mastic is applied shall be resistant to the effects of the high temperature conditions to which they are exposed during this test, at the point of mastic interface.

22.2 Twelve specimens are to be made by applying a 3 by 3 inch area of mastic to 5 by 5 inch galvanized steel plates. Then three 4 by 4 inch (102 by 102 mm) samples of each of the following materials: aluminum foil, polyethylene terephthalate, chlorinated polyethylene, and PVC coated fabric shall be placed on top of the mastic. Total of twelve samples shall be tested. Mastics shall be applied at the manufacturer's recommended application rate and thickness. The specimens are to be dried at 73.4 ±3.6°F (23 ±2°C) and 50 ±5 percent relative humidity for the manufacturer's recommended set time. See 16.2.

22.3 Another 4 by 4 inch (102 by 102 mm) control sample of each of the substrate materials shall be cut and taped at the edges to 5 by 5 inch galvanized plates for stability. Candidate mastic shall not be applied to the control sample.

22.4 Immediately following the conditioning described above, the test specimens and control samples are to be placed in an air circulating oven maintained at 265°F ±5 (129.4°C) for a period of 60 days.

22.5 The substrate material, at the point of mastic interface, is to be examined visually for indications of deterioration, brittleness, cracking, shrinkage, flaking, and blistering due to interaction of materials.

MARKING

23 General

23.1 The container of mastic shall be marked with all of the following information:

a) The manufacturer's or private labeler's name or identifying symbol;

b) The distinctive type designation;

c) The date of manufacture (at least by quarter and year) which may be in an established or otherwise traceable code; and

d) The marking "181B-M."

23.2 If the manufacturer produces mastic in more than one factory, each container shall have a distinctive marking to identify it as the product of a particular factory.

23.3 The container of mastic shall be marked with the minimum set time of the mastic (See 16.2). In conjunction with the set time, the container of mastic shall be marked, "Since field temperature/humidity conditions may vary from controlled laboratory conditions, longer set times may be required for specific installations".

23.4 The container of mastic shall be marked, "Warning: Do not freeze or apply at freezing conditions" or the equivalent.

Exception: A mastic that has been evaluated for the effects of freeze/thaw in accordance with 19.1 need not bear this marking.

INSTRUCTIONS

24 Installation Instructions

24.1 The information specified in 24.2 and 24.3 shall be:

a) Marked on the container of mastic; or

b) Included in installation instructions provided with each can of mastic.

24.2 The installation instructions shall include the following information:

a) Application rate;

b) Recommended thickness;

c) Recommended application width;

d) Minimum recommended set time; and

24.3 The installation instructions shall include information regarding the installation method recommended by the manufacturer and the following statement, or the equivalent: "For Use with UL 181 Flexible Air Ducts."

PART III – MECHANICAL FASTENERS FOR USE WITH FLEXIBLE AIR DUCTS

CONSTRUCTION

25 General

25.1 A mechanical fastener shall be capable of clamping the intended air duct diameter to a sleeve or collar.

25.2 A mechanical fastener shall be self-locking or self-holding, so that it is not inadvertently released.

25.3 For sleeve/collar sizes in excess of 12 inch (305 mm) diameter, two clamps may be used.

26 Polymeric Materials

26.1 Materials shall have a minimum flammability classification of HB, determined in accordance with IEC 60695-11-10, Test Flames – 50 W Horizontal and Vertical Flame Test Methods. The flammability classification shall be based on a nominal 0.06 inch (1.5 mm) thickness.

Note: Flammability classification in accordance with the Standard for Test for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, is considered equivalent.

26.2 The relative thermal index of the material used in the device, based on the mechanical-without-impact relative thermal index (RTI – Strength), shall be at least 85°C. The thermal index shall have been determined by a 0.06 inch (1.5 mm) thick material that is selected for the device. The relative thermal index shall be determined as given in the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B. For the purposes of this Standard, the relative thermal index of steel is 572°F (300°C), and the relative thermal index for aluminum is 300°F (150°C).

Note: The relative thermal index of a material is an indication of the material's ability to retain a particular property (such as physical or electrical) when exposed to an elevated temperature for an extended period of time. For each material, a number of relative thermal indices are established, each related to a specific property, and specific thickness of the material.

26.3 Another polymeric material is able to be substituted in a device having met the requirements of this Standard only when all of the following conditions are met and compliance is determined through appropriate investigation.

a) There is an identical generic description (for example: Type 66, 30 percent glass filled, FR type, polyamide); and

b) Tensile strength of materials, determined in accordance with ISO 527-1, Plastics – Determination of Tensile Properties – Part 1: General Principles, and ISO 527-2, Plastics – Determination of Tensile Properties – Part 2: Test Conditions for Moulding and Extrusion Plastics, shall be compared, and shall indicate that the substitute material has a strength of at least 95 percent of that of the original material. The tensile strengths used in this comparison shall be generated by either:

1) A previous investigation; or

2) Side-by-side testing of both materials.

26.4 Except as indicated in (a) and (b), polymeric materials used to mold or fabricate devices covered by this Standard shall be made from materials that are 100 percent virgin and unmodified by the molder:

a) Devices made from thermoplastic materials are limited to 25 percent regrind by weight of the same material, unless the results of a separate investigation indicate acceptable performance for the material or the specific device.

b) Devices covered by this Standard shall be allowed to employ colorants, flame retardants, fillers, mold-release lubricants, color concentrates, dyestuff, chemical blowing agents or reinforcements in conjunction with the polymeric material, when the additive or concentrate is tested and found not to adversely affect the critical properties of the material. An additive or concentrate of unknown performance shall not be used.

26.5 Devices shall not employ materials that have been blended together unless one of the following conditions have been met:

a) When two materials have already been individually considered acceptable for an application, and are both found to be generically similar, are both produced by the same manufacturer, and are both classed HB in the minimum part thickness when tested in accordance with IEC 60695-11-10,

Test Flames – 50 W Horizontal and Vertical Flame Test Methods, these materials may be dry blended in any proportion by the manufacturer without further testing.

b) When two materials have already been individually considered acceptable for an application and are both found to be generically similar, are both produced by the same manufacturer, each is classed V-0, or V-1, or V-2 in the minimum part thickness when tested in accordance with IEC 60695-11-10, Test Flames – 50 W Horizontal and Vertical Flame Test Methods, and when the results of a separate investigation indicate performance meeting the requirements for the material or the specific device, these materials may be dry blended in any proportion by the manufacturer without further testing.

A device made from blended material described in (a) or (b) shall be considered to have flammability, mechanical, and thermal properties that are no better than the performance of the weaker of the individual constituents on a property-to-property basis.

Note: Flammability classification in accordance with the Standard for Test for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, is considered equivalent.

27 Sharp Edges

27.1 Edges shall be smooth and well rounded so as not to cut or abrade air duct or air connector materials or the user of the device.

27.2 When referee measurements are required to determine that a part as specified in 27.1 is not sharp enough to constitute a risk of injury to persons, the method described in the Standard for Test for Sharpness of Edges on Equipment, UL 1439, shall be employed.

PERFORMANCE

28 Installation Test

28.1 A mechanical fastener, or combination of fasteners, shall latch or otherwise operate in the intended manner. Installation tools, when provided, are to be used according to the manufacturer's instructions. After installation as described in 28.2, each sample shall be examined for proper and secure closure.

28.2 Three samples of a clamp are to be installed on a maximum 16 inch (406 mm) and a minimum 4 inch (102 mm) diameter sleeve or collar to which an air duct or air connector would be installed in the intended manner. For 16 inch (406 mm) diameter or larger sleeves and collars, two clamps may be connected.

29 Mold Growth and Humidity Test

29.1 Non-metallic mechanical fasteners shall be resistant to the effects of mold growth and high humidity under standard atmospheric temperature conditions.

29.2 Three samples of the representative mechanical fastener, each 4 inches (102 mm) long and in the as-received width, are to be tested.

29.3 Mold mycelia and spores from Chaetomium Globosum are to be applied to the samples. The samples are to be placed in a closed vessel in which an atmosphere saturated with water vapor is maintained at room temperature and under dark conditions. The samples are to remain in this atmosphere until the extent of growth has been demonstrated or until the mold and spores have disintegrated, and not less than 60 days.