



UL 181A

STANDARD FOR SAFETY

Closure Systems for Use With Rigid Air
Ducts

ULNORM.COM : Click to view the full PDF of UL 181A 2021

ULNORM.COM : Click to view the full PDF of UL 181A 2021

UL Standard for Safety for Closure Systems for Use With Rigid Air Ducts, UL 181A

Fourth Edition, Dated January 8, 2013

Summary of Topics

This revision of ANSI/UL 181A 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.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form by any means, electronic, mechanical photocopying, recording, or otherwise without prior permission of UL.

UL provides this Standard "as is" without warranty of any kind, either expressed or implied, including but not limited to, the implied warranties of merchantability or fitness for any purpose.

In no event will UL be liable for any special, incidental, consequential, indirect or similar damages, including loss of profits, lost savings, loss of data, or any other damages arising out of the use of or the inability to use this Standard, even if UL or an authorized UL representative has been advised of the possibility of such damage. In no event shall UL's liability for any damage ever exceed the price paid for this Standard, regardless of the form of the claim.

Users of the electronic versions of UL's Standards for Safety agree to defend, indemnify, and hold UL harmless from and against any loss, expense, liability, damage, claim, or judgment (including reasonable attorney's fees) resulting from any error or deviation introduced while purchaser is storing an electronic Standard on the purchaser's computer system.

No Text on This Page

ULNORM.COM : Click to view the full PDF of UL 181A 2021

JANUARY 8, 2013
(Title Page Reprinted: December 29, 2021)



ANSI/UL 181A-2013 (R2021)

1

UL 181A

Standard for Closure Systems for Use With Rigid Air Ducts

Prior to the first edition, the requirements for the products covered by this standard were included in the Outline of Investigation for Closure Systems for Use With Air Ducts and Connectors, Subject 181A.

The first and second editions were titled "Factory-Made Air Ducts and Air Connectors."

First Edition – June, 1991
Second Edition – November, 1994
Third Edition – May, 2005

Fourth Edition

January 8, 2013

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

The most recent designation of ANSI/UL 181A 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>.

UL's Standards for Safety are copyrighted by UL. Neither a printed nor electronic copy of a Standard should be altered in any way. All of UL's Standards and all copyrights, ownerships, and rights regarding those Standards shall remain the sole and exclusive property of UL.

COPYRIGHT © 2021 UNDERWRITERS LABORATORIES INC.

No Text on This Page

ULNORM.COM : Click to view the full PDF of UL 181A 2021

CONTENTS

INTRODUCTION

1	Scope	5
2	Components	5
3	Units of Measurement	5
4	Undated References	5
5	Referenced Standards.....	5

PART I – PRESSURE SENSITIVE ALUMINUM TAPES FOR USE WITH RIGID FIBERGLASS AIR DUCTS

CONSTRUCTION

6	Materials	6
---	-----------------	---

PERFORMANCE

7	Tensile Strength Test	6
8	Peel Adhesion Test at 180 Degree Angle	6
9	Shear Adhesion Test	7
10	Peel Adhesion Test at 20 Degree Angle	8
11	Surface Burning Characteristics Test.....	9
12	Mold Growth and Humidity Test	10
13	Temperature/Pressure Cycling Test	10
14	Burning Test.....	12

MARKING

15	General	13
----	---------------	----

PART II – HEAT ACTIVATED ALUMINUM TAPES FOR USE WITH RIGID FIBERGLASS AIR DUCTS

CONSTRUCTION

16	Materials.....	13
----	----------------	----

PERFORMANCE

17	Tensile Strength Test	13
18	Peak Adhesion Test at 180 Degree Angle.....	14
19	Shear Adhesion Test	16
20	Peak Adhesion Test at 20 Degree Angle	18
21	Surface Burning Characteristics Test	18
22	Mold Growth and Humidity Test	18
23	Temperature/Pressure Cycling Test	18
24	Burning Test.....	18

MARKING

25	General	19
----	---------------	----

PART III – MASTIC CLOSURE SYSTEMS FOR USE WITH RIGID FIBERGLASS AIR DUCTS**CONSTRUCTION**

26	Materials.....	20
27	Glossary.....	20

PERFORMANCE

28	Tensile Joint Strength Test	20
29	Adhesion Test	21
30	Shear Adhesion Test	22
31	Freeze/Thaw Test.....	24
32	Surface Burning Characteristics Test	24
33	Mold Growth Test	25
34	Temperature/Pressure Cycling Test	25
35	Burning Test.....	25

MARKING

36	General	25
----	---------------	----

INSTRUCTIONS

37	Installation Instructions	26
----	---------------------------------	----

ULNORM.COM : Click to view the full PDF of UL 181A 2021

INTRODUCTION

1 Scope

1.1 These requirements cover closure systems for use with factory-made rigid air ducts or air connectors complying with the Standard for Factory-Made Air Ducts and Air Connectors, UL 181. Closure systems consist of pressure sensitive tapes, heat-activated tapes, and mastics.

1.2 Closure systems are intended for use with rigid air ducts 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 Components

2.1 Except as indicated in 2.2, a component of a product covered by this standard shall comply with the requirements for that component.

2.2 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.

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

2.4 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.

3 Units of Measurement

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

4 Undated References

4.1 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.

5 Referenced Standards

5.1 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

UL 181,
Standard for Factory-Made Air Ducts and Air Connectors

PART I – PRESSURE SENSITIVE ALUMINUM TAPES FOR USE WITH RIGID FIBERGLASS AIR DUCTS

CONSTRUCTION

6 Materials

6.1 Aluminum tape shall consist of an aluminum or aluminum alloy foil 2-1/2 inches (63.5 mm) wide minimum, covered on one side with adhesive. The adhesive surface shall be protected by a release liner intended to be removed at the time of tape installation.

PERFORMANCE

7 Tensile Strength Test

7.1 The average tensile strength in both the machine and cross-machine directions of each roll of aluminum tape shall be not less than 25 pounds per inch (4.37 N/mm) of width, with no individual specimen having a value of less than 21 pounds per inch (3.67 N/mm) of width, determined in accordance with the Standard Test Method for Breaking Strength and Elongation of Pressure-Sensitive Tape, ASTM D3759. All cross-direction specimens are to be cut from special 6 inch (142.4 mm) wide rolls of tape.

7.2 Three specimens from each of three separate rolls of tape shall be prepared with a laboratory specimen cutter for both machine and cross directions. (A JDC Precision Sample Cutter is acceptable for this purpose. Other cutters having equivalent or comparable characteristics are also acceptable.)

8 Peel Adhesion Test at 180 Degree Angle

8.1 The average peel adhesion strength of aluminum tape shall be not less than 3.75 pounds per inch (0.66 N/mm) of width of tape when tested in accordance with [8.2](#) and [8.3](#). No individual specimen shall have a value of less than 3.20 pounds per inch (0.56 N/mm) of width.

8.2 The peel adhesion strength of aluminum tape is to be determined in accordance with the Standard Test Methods for Peel Adhesion of Pressure-Sensitive Tape at 180 Degree Angle, ASTM D3330, except as modified in [8.3](#). Tests are to be conducted in accordance with Method A – Single-Coated Tapes.

8.3 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 as specified in Standard Test Method for Peel Adhesion of Pressure-Sensitive Tape, ASTM D3330 to the specified stainless steel panel with a steel roller 5 inches (127 mm) in diameter and 1-3/4 inches (44.5 mm) wide, weighing 10 pounds-mass (4.53 kg). The roller is to pass back and forth over each specimen five times at a rate of 12 inches (304.8 mm) per minute. The test load is to be applied 15 minutes after completion of the rolling.

9 Shear Adhesion Test

9.1 The shear adhesion strength of tape shall be such that the tape is able to maintain the test loads specified in [Table 9.1](#) for the indicated test durations without evidence of separation or slippage in excess of 1/32 inch (0.8 mm).

9.2 The shear adhesion strength of aluminum 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 [9.3](#) – [9.7](#).

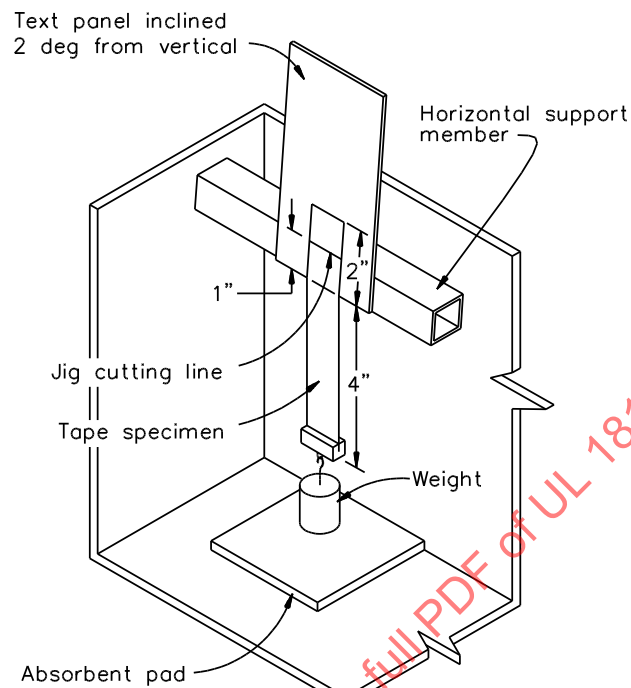
9.3 One specimen from each of four separate rolls of tape are to be tested. Specimens are to be cut in 1 inch (25.4 mm) wide by 6-inch (152-mm) long strips. The cut specimens and stainless steel panels are to be maintained at the application conditions specified in [Table 9.1](#) for a minimum of 1 hour prior to applying the specimens to the panels.

Table 9.1
Shear adhesion test conditions

Application conditions ^a	Dwell time ^b	Test conditions ^a	Test load	Test duration
40°F (4.4°C) dry substrate	15 minutes	40°F (4.4°C)	5 pounds (22.2 N)	6 hours
73.4°F (23°C), 50 percent RH	24 hours	73.4°F (23°C), 50 percent RH	10 pounds (44.5 N)	120 hours
73.4°F (23°C), 50 percent RH	15 minutes	150°F (65.6°C)	5 pounds (22.2 N)	6 hours
^a Application conditions and test conditions shall be controlled within $\pm 3.6^\circ\text{F}$ (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 test conditions, after rolling but prior to the application of the test load.				

9.4 After conditioning, a 2 inch (50.8 mm) length of specimen is to contact the panel. The tape is to be applied to the panel with a roller weighing 10 pounds-mass (4.53 kg). The roller is to pass back and forth over each specimen five times at a rate of 12 inches (304.8 mm) per minute. Using a cutting jig or razor blade, the rolled portion of the specimen is to be trimmed to a 1 by 1 inch (25.4 by 25.4 mm) square on the panel, such that the remaining test specimen measures 1 by 5 inches (25.4 by 127 mm) as shown in [Figure 9.1](#). The tape is to dwell on the panel for the time specified in [Table 9.1](#).

Figure 9.1
Shear adhesion apparatus



S3144B

9.5 After dwelling, the clamp is to be placed on the free end of the specimen. The clamp is to extend completely across the width of the specimen and is to be aligned to uniformly distribute the load. The test load specified in [Table 9.1](#) is then to be applied to the clamp gently so as not to cause any shear impact force on the specimen. The load is to be applied for the test duration time specified in [Table 9.1](#).

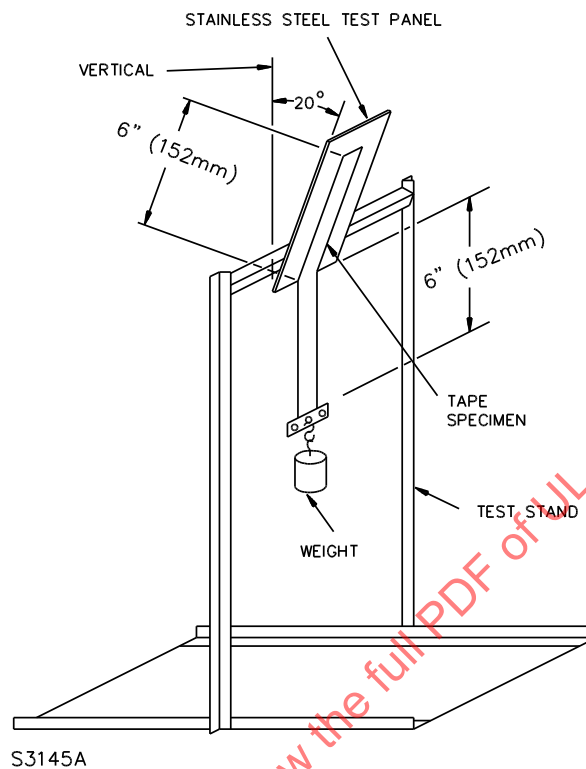
9.6 The test panel is to be positioned at 2 degrees from the vertical so that the back of the test substrate forms a 178 degree angle with the extended tape specimen.

9.7 Individual specimens of tape are to be tested in accordance with each of the conditions specified in [Table 9.1](#). 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.

10 Peel Adhesion Test at 20 Degree Angle

10.1 Aluminum tape specimens shall support a load of 2 pounds (8.9 N) for a period of 24 hours when tested as specified in [10.2](#) and [10.3](#). A typical test stand is shown in [Figure 10.1](#).

Figure 10.1
Peel adhesion apparatus



10.2 Test specimens are to be prepared as described in [8.3](#). Test specimens are to be prepared and tested under ambient conditions of $73.4 \pm 3.6^{\circ}\text{F}$ ($23 \pm 2^{\circ}\text{C}$) and 50 ± 5 percent relative humidity.

10.3 A test stand is to be positioned so that the test panel forms a 20 degree angle with the vertical. The length of the tape adhered to the test panel is to be 6 inches (152 mm), and the length of the test panel is to be at least 7 inches (178 mm). The free end of the tape specimen is to be located at the bottom end of the test panel with the test load applied at the free end of the tape specimen as shown in [Figure 10.1](#).

11 Surface Burning Characteristics Test

11.1 Aluminum tape of the maximum width recommended by the manufacturer 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 rigid fiberglass duct board and tested in accordance with the Tests for Surface Burning Characteristics as specified in the Standard for Factory-Made Air Ducts and Air Connectors, UL 181.

11.2 One strip of tape is to be applied to a 24 inch (610 mm) wide rigid fiberglass duct board that complies with the Standard for Factory-Made Air Ducts and Air Connectors, UL 181. The duct board is to be Type "475" and covered with a foil/scrim/kraft paper facing material. The tape is to be applied to a longitudinal butt joint in the center of the substrate formed by slitting the facing. The tape is to be applied to the substrate in accordance with the recommended field application instructions. For the purpose of establishing these indicies, typically three tests are to be conducted.

12 Mold Growth and Humidity Test

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

12.2 Three specimens of tape with the liner removed, 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 the adhesive side 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/Pressure Cycling Test

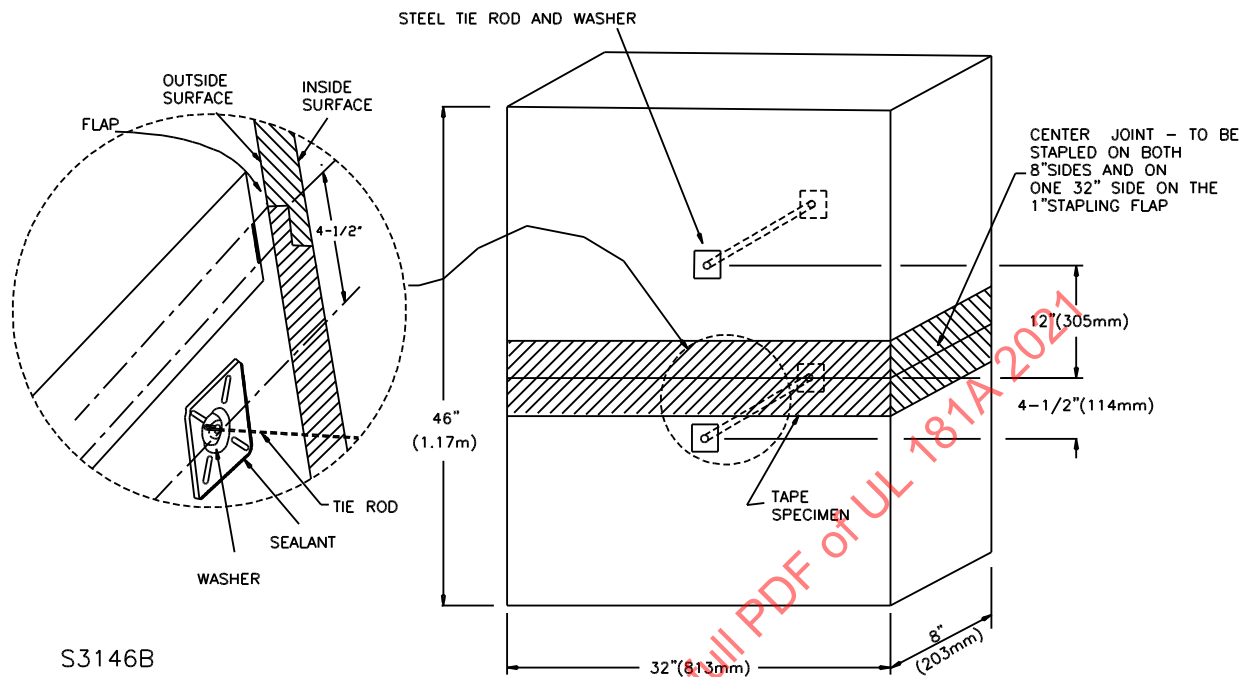
13.1 Aluminum tape shall maintain an applied pressure of 3 ± 0.1 inches water column (746 Pa) during the temperature/pressure cycles specified in [13.7](#) – [13.9](#). At the conclusion of each cycle phase, the leakage rate shall not exceed 15.0 cubic feet per minute ($0.007 \text{ m}^3/\text{s}$) when the pressure is maintained at 3 ± 0.1 inches water column. Additionally, the tape:

- a) Shall not rupture, as evidenced by breaks, tears, rips, or other openings greater than 1/8 inch (3.2 mm); and
- b) Shall remain intact to the extent that it is not displaced more than a total of 1/8 inch from both edges.

13.2 Three rigid air ducts, measuring 32-by-8-by-46 inches (813-by-30-by-1168 mm) inner dimensions, with a male/female joint in the center of the specimen, are to be used for this test. The ducts are to be constructed of fiberglass duct board complying with the Standard for Factory-Made Air Ducts and Air Connectors, UL 181. The duct board is to be Type "475" and covered with a foil/scrim/kraft paper facing material. One of the 32-inch wide sides of the center joint in the duct specimens is to be unstapled. The remaining sides of the center joint and the longitudinal joint are to be stapled with outward clinched 9/16 by 0.05 inch (14.3 by 1.3 mm) thick staples, spaced approximately 2 inches (50.8 mm) on center. The staples are to penetrate through both surfaces of the facing material parallel to the seam and are to be located no more than 1/2 inch (12.7 mm) from the edge of the staple flap. The air duct sections are to be cleaned in accordance with the tape manufacturer's recommendations. End caps are to be fabricated and fastened to each end of the duct sections.

13.3 Two No. 12 gauge (0.105 inches) minimum steel tie rod assemblies are to be installed midway across the 32 inch (813 mm) wide face of the duct specimens as shown in [Figure 13.1](#). One tie rod is to be located 4-1/2 inches, minus 0, plus 1/4 inch (114 mm, minus 0, plus 6.4 mm) from the female edge of the center joint. The second tie rod is to be located 12 inches, minus 0, plus 1/2 inch (305 mm, minus 0, plus 12.7 mm) from the male edge of the center joint.

Figure 13.1
Temperature/pressure cycling apparatus



13.4 The tie rod end and washer are to be sealed either using washers with sealants or using silicone rubber compounds applied under standard washers to seal around the tie rod. There shall be no contact made between the tape specimen and sealant. The tape is to be applied to the center and the longitudinal joint in accordance with the tape manufacturer's recommendations. The test specimens are to be conditioned at $75 \pm 3^\circ\text{F}$ ($24 \pm 1.7^\circ\text{C}$) for 24 hours prior to testing.

13.5 The duct specimens are to be placed vertically in a test chamber capable of uniformly maintaining the temperature and humidity conditions specified in [Table 13.1](#). Each air duct specimen is to be fitted with an appropriate entry/exhaust port and pressure sensing probes.

Table 13.1
Temperature/pressure cycling test conditions

Environmental conditions	Pressure conditions	Pressurizing time ^a , seconds	Dwell time, seconds	Depressurizing time, seconds
$165 \pm 5^\circ\text{F}$ ($74 \pm 3^\circ\text{C}$)	0.1 – 3 – 0.1 inch w.c. ^b	32 ± 28	20 ± 1	10 ± 6
$90 \pm 3^\circ\text{F}$ ($32 \pm 2^\circ\text{C}$) 90 ± 5 percent R.H.	0.1 – 3 – 0.1 inch w.c.	32 ± 28	4 ± 2	10 ± 6
$0 \pm 5^\circ\text{F}$ (minus $18 \pm 3^\circ\text{C}$)	0.1 – 3 – 0.1 inch w.c.	32 ± 28	4 ± 2	10 ± 6

^a Defined as time measured from when air first enters sample until full pressure is reached.
^b 0.1 – 3 – 0.1 inch water column is equivalent to 25 – 746 – 25 Pa.

13.6 The test specimens are to be initially tested under ambient laboratory conditions of $73.4 \pm 3.6^\circ\text{F}$ ($23 \pm 2^\circ\text{C}$) and 50 ± 5 percent relative humidity to determine the leakage rate of the specimens. If the leakage

rate is found to be more than 5 cubic feet per minute (0.002 m³/s), then the test specimen is to be reconstructed to yield a leakage rate of less than 5 cubic feet per minute.

13.7 The temperature of the test chamber is to be set at 165 ±5°F (74 ±3°C). The humidity is not required to be controlled. The pressure in the duct is to be cycled from 0.1 to 3 to 0.1 inches water column (25 to 746 to 25 Pa) at the rate specified in [Table 13.1](#). The test is to be continued for 30,000 cycles.

13.8 Upon conclusion of the cycling specified in [13.7](#), the chamber temperature is to be set at 90 ±3°F (32 ±2°C) with a 90 ±5 percent relative humidity. The specimens are to be cycled from 0.1 to 3 to 0.1 inches water column (25 to 746 to 25 Pa) at the rate specified in [Table 13.1](#) for 15,000 cycles.

13.9 Upon completion of the cycling specified in [13.8](#), the test chamber is to be set at 0 ±5°F (minus 18 ±3°C). The humidity is not required to be controlled. The specimens are to be cycled from 0.1 to 3 to 0.1 inches water column (25 to 746 to 25 Pa) at the rate specified in [Table 13.1](#) for 5000 cycles.

14 Burning Test

14.1 Aluminum tape shall not flame or glow for more than 60 seconds after withdrawal of a test flame when mounted as described in [14.2](#) and [14.3](#) and tested in accordance with [14.4](#) – [14.7](#). Flaming or glowing shall not travel from the point of application to the far end of the test sample during application of the test flame or within 60 seconds following removal of the test flame. Any particles dropping from the tape specimens oriented horizontally and at a 45 degree angle shall not ignite untreated surgical cotton.

14.2 Three specimens from one roll of tape are to be tested. The tape specimens are to be applied to an inorganic reinforced cement board substrate with a steel roller 5 inches (127 mm) in diameter and 1-3/4 inches (44.5 mm) wide, weighing 10 pounds-mass (4.53 kg). The roller is to pass back and forth over each specimen five times at a rate of 12 inches (304.8 mm) per minute. The dwell time is to be 15 minutes. See [Table 9.1](#).

14.3 The tape is to be applied to an inorganic reinforced cement board substrate at least 2 inches (50.8 mm) wider on each side than the tape specimen and 36 inches (914 mm) long. The tape is to be 30 inches (762 mm) long and applied so that each end is 3 inches (76.2 mm) from the end of the substrate. One tape specimen from the roll is to be supported with its axis horizontal, one supported with the axis at 45 degrees from the horizontal, and one supported with the axis vertical.

14.4 The apparatus to be employed consists of a Bunsen burner with a 3/8 inch (9.5 mm) diameter tube and means for controlling the primary air and gas input, a support for the burner, a stopwatch or other timing device, and a supply of untreated surgical cotton. The Bunsen burner is to be supported and held in place by means of a burner stand, ring stand with clamps, or an equivalent type of mechanical support. The gas used is to be commercial grade or purer propane (bottled) gas having a heating value in the range of 2490 – 2510 Btu per cubic foot. The gas bottle is to have a regulator and a valve located between the regulator and the burner. The tests are to be conducted in a location free from drafts.

14.5 Prior to the application of the burner to the sample, the burner is to be adjusted to produce a flame 2-1/2 inches (63.5 mm) high. The air and fuel input are to be adjusted such that the flame has equal parts of blue and yellow. The valve then is to be turned off and the burner positioned such that 1-1/4 inches (31.8 mm) of the test flame will impinge the test sample 3 inches (76.2 mm) from the end of the sample. The valve then is to be turned on and the flame ignited.

14.6 The surface of the three samples oriented in the three positions is to be exposed to the flame for 1 minute and then the flame is to be withdrawn. If flaming or glowing combustion of the sample ceases 60 seconds or less after removal of the test flame, the test flame is to be reapplied at the same place for 1 minute immediately after flaming or glowing combustion of the sample stops. The test flame again is to be

withdrawn and the duration of flaming or glowing combustion of the sample noted. During the test of an individual sample, the original size and characteristic of the test flame is not to be changed.

14.7 If particles drop from the sample oriented horizontally and 45 degrees from the horizontal during the exterior exposure tests, these particles are to be allowed to fall onto a horizontal plane 1 foot (304 mm) below the nearest part of the test sample. The plane is to be covered with a layer of untreated surgical cotton except for that portion of the area directly below the burner extending for a distance of 6 inches (152.4 mm) measured horizontally in all directions from a vertical axis through the tip of the burner flame.

MARKING

15 General

15.1 The tape shall be marked, every 36 inches (914 mm) or fraction thereof, with:

- a) The manufacturer's or private labeler's name or identifying symbol;
- b) The distinctive type or model designation;
- c) The date of manufacturer (at least by quarter and year) which may be in an established or otherwise traceable code; and
- d) The marking "181A-P."

15.2 If a manufacturer produces aluminum tape at more than one factory, each roll of tape shall have a distinctive marking to identify it as the product of a particular factory.

PART II – HEAT ACTIVATED ALUMINUM TAPES FOR USE WITH RIGID FIBERGLASS AIR DUCTS

CONSTRUCTION

16 Materials

16.1 Heat activated aluminum tapes shall consist of an aluminum alloy foil, aluminum laminate, metalized film or a combination of both, minimum 3 inch (76.2 mm) width, coated on one side with heat activated adhesive. Heat activated bond indicating mechanisms shall be located no more than 2 inches (50.8 mm) apart on the uncoated foil side. The product may be reinforced to achieve performance requirements.

PERFORMANCE

17 Tensile Strength Test

17.1 The average tensile strength for heat activated aluminum tapes shall be as specified in [7.1](#), when tested as specified in [7.2](#), except as follows:

- a) Reinforced specimens are to be prepared with a razor cutter capable of holding two single edged razor blades 1 inch (25.4 mm) apart as described in the Standard Test Method for Breaking Strength and Elongation of Pressure-Sensitive Tape, ASTM D3759; and
- b) Clamps are to be used for gripping the sample instead of cylinders with the tensile strength testing machine.

18 Peak Adhesion Test at 180 Degree Angle

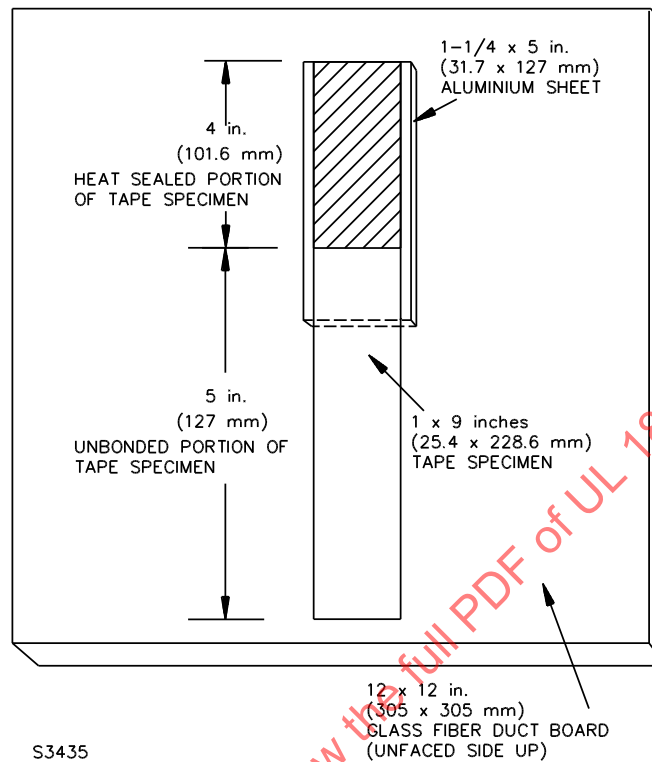
18.1 The average peak adhesion strength of heat activated aluminum tape shall be not less than 4.5 pounds per inch (20.0 N/mm) when tested in accordance with [18.2](#) – [18.7](#). No individual specimen shall have a value of less than 4.0 pounds per inch (17.8 N/mm).

18.2 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) by 9 inch (229 mm) long strips using a razor cutter and then allowed to condition to 73 $\pm 3^{\circ}\text{F}$ (22.8 $\pm 1.7^{\circ}\text{C}$) in 50 ± 5 percent relative humidity for 24 hours. Specimens shall have a bond indicator visible along that portion of the sample to be heat-sealed.

18.3 One 12 by 12 inch (305 by 305 mm) glass fiber duct board and nine 5 by 1-1/4 inch (127 by 31.75 mm) sheets of uncoated mill finish aluminum 0.012 ± 0.002 inch (0.305 ± 0.05 mm) thick shall be conditioned as specified in [18.2](#). Prior to conditioning, the aluminum sheets are to be cleaned with 200 proof industrial grade ethanol.

18.4 After conditioning, one sheet of the uncoated mill finish aluminum is placed on the unfaced side of the duct board. One tape specimen is positioned and heat-sealed on the aluminum sheet as shown in [Figure 18.1](#), using an industrial-type hand-held flat iron (Modified Robert Seaming Iron or equivalent) with the capability of at least 500 $^{\circ}\text{F}$ (260 $^{\circ}\text{C}$) and a surface area of at least 5 inches (127 mm) long by 2 inches (50.8 mm) wide. Heat-seal the last 4 inches (102 mm) of tape as shown in [Figure 18.1](#) by placing the iron completely over the 4 by 1 inch (102 by 25.4 mm) area to be sealed. Apply uniform pressure distributed across the aluminum sheet surface area in contact with the face of the iron using a smearing action to avoid wrinkles. Iron contact time is to be maintained as recommended by the tape manufacturer installation instructions. The bond indicators over the sealed area shall indicate that sufficient heat has been applied. The free portion of tape specimen is to be bent back and the specimen conditioned at 73 $\pm 3^{\circ}\text{F}$ (22.8 $\pm 1.7^{\circ}\text{C}$) at 50 ± 5 percent relative humidity for 15 minutes.

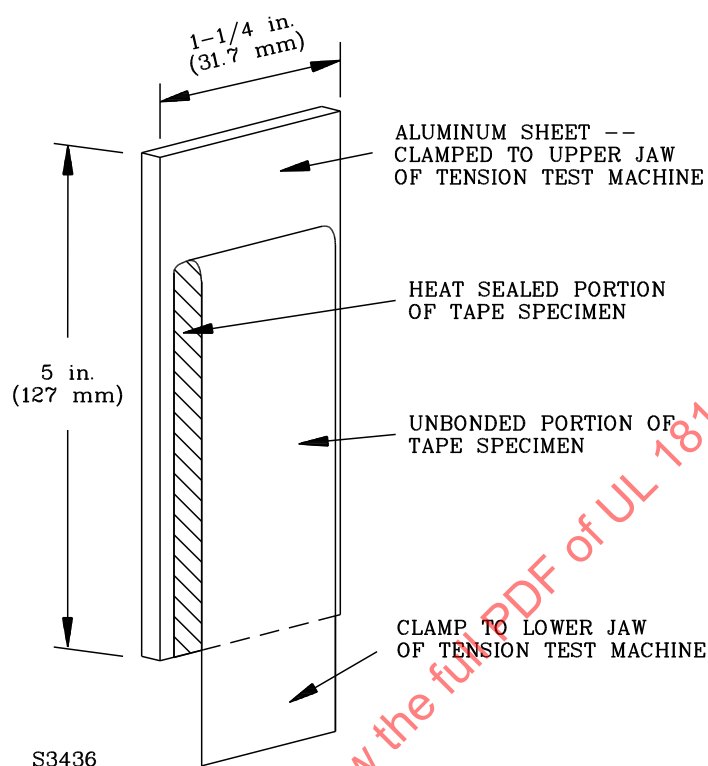
Figure 18.1
Peak adhesion test sample



18.5 The test procedure specified in [18.4](#) is to be repeated for the remaining test specimens, allowing the 12 by 12 inch (305 by 305 mm) duct board to cool to room temperature before heat-sealing specimens to the aluminum sheets.

18.6 The unsealed end of the aluminum sheet is to be clamped in the top jaw of a constant-rate of extension tensile tester so that no contact is made between the jaw and tape specimen. The free end of the bent-back portion of the tape specimen is to be clamped by a padded lower jaw. The specimen should be clamped so that the free portion of the tape specimen is parallel to the bottom portion with no twisting. See [Figure 18.2](#).

Figure 18.2
Peak adhesion tape specimen



18.7 A tensile load is to be applied to the tape specimen at a rate of 12 ± 0.5 inches per minute (305 ± 12.6 mm/min) until complete tearing of the tape specimen has occurred.

19 Shear Adhesion Test

19.1 The shear adhesion strength of tape shall be such that the tape is able to maintain a load of 10 pounds (44.5 N) for the test duration specified in [Table 19.1](#) without evidence of separation or slippage in excess of 1/32 inch (0.8 mm).

Table 19.1
Shear adhesion test conditions

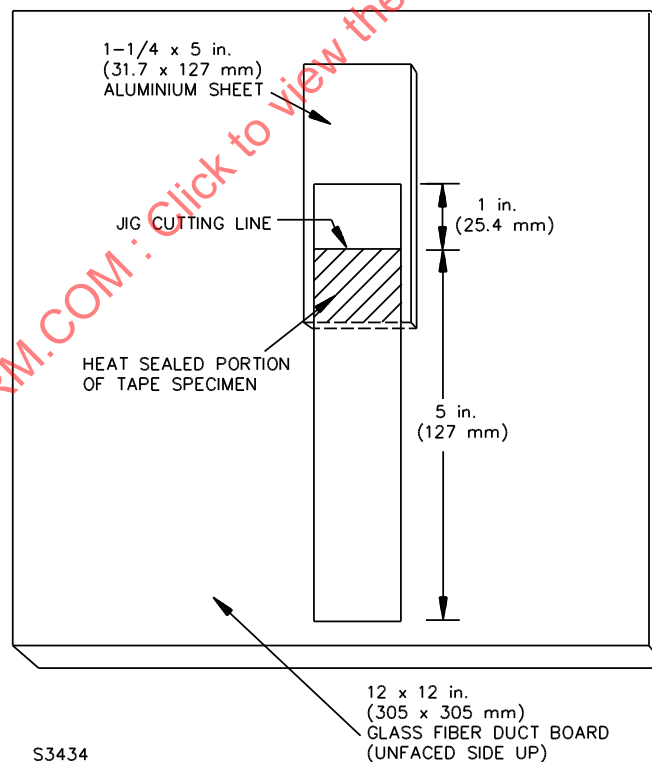
Application conditions ^a	Dwell time ^b	Test conditions ^a	Test load	Test duration
40°F (4.4°C) dry substrate	15 minutes	40°F (4.4°C)	10 pounds (44.5 N)	6 hours
73.4°F (23°C), 50 percent RH	15 minutes	73.4°F (23°C) 50 percent RH	10 pounds (44.5 N)	120 hours
73.4°F (23°C), 50 percent RH	15 minutes	185°F (85°C)	10 pounds (44.5 N)	6 hours
^a Application conditions and test conditions shall be controlled within $\pm 3.6^\circ\text{F}$ (2°C) and ± 5 percent relative humidity, where specified. ^b Dwell time is the time that the test specimen is in contact with the test panel, at test condition, after heating but prior to the application of the test load.				

19.2 The shear adhesion strength of aluminum 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 [19.3](#) – [19.8](#).

19.3 One specimen from each of four separate rolls of tape are to be tested. Specimens are to be cut in 1 inch (25.4 mm) wide by 6 inch (152 mm) long strips. The cut specimens and uncoated mill finish aluminum sheeting panels are to be maintained at the application conditions specified in [Table 19.1](#) for a minimum of 1 hour prior to applying the specimens to the panels.

19.4 After conditioning, the uncoated mill finish aluminum sheet is to be placed on the unfaced side of the 12 by 12 inch (305 by 305 mm) glass fiber duct board. The tape specimen is to be positioned and heat-sealed on the aluminum sheet as shown in [Figure 19.1](#), using an industrial type hand-held flat iron with a capability of at least 500°F (260°C) and a surface area of at least 5 inches (127 mm) long by 2 inches (50.8 mm) wide. The 1 square inch (645 mm²) of tape that is in contact with the test panel is to be heat-sealed by placing the iron completely over the area of tape to be sealed. Apply uniform pressure distributed across the aluminum sheet surface area in contact with the face of the iron using a smearing action to avoid wrinkles. Iron contact time is to be maintained as recommended by the tape manufacturer installation instructions. The bond indicators located in the sealed area shall indicate that sufficient heat has been applied. After heat-sealing, the specimen is to be conditioned at 73 ±3°F (22.8 ±1.7°C) and 50 ±5 percent relative humidity for 15 minutes.

Figure 19.1
Shear adhesion test sample



19.5 The test procedure specified in [19.4](#) is to be repeated for the remaining test specimens, allowing the 12 by 12 inch (305 by 305 mm) duct board to cool to room temperature before heat sealing specimens are applied to the aluminum sheets.

19.6 After dwelling, a clamp with a means to support a test weight is to be placed on the free end of the specimen. The clamp assembly is to be extended completely across the width of the specimen and is to be aligned to uniformly distribute the load. The test load specified in [Table 19.1](#) is then to be applied to the clamp assembly so as not to cause any shear impact force on the specimen. The load is to be applied for the test duration time specified in [Table 19.1](#). 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.

19.7 The test panel is to be positioned at 2 degrees from the vertical so that the test substrate forms a 178 degree angle with the extended tape specimen ([Figure 9.1](#)).

19.8 Individual specimens of tape are to be tested in accordance with each of the conditions specified in [Table 19.1](#). 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.

20 Peak Adhesion Test at 20 Degree Angle

20.1 An aluminum tape specimen shall support a load of 2 pounds (8.9 N) for a period of 24 hours when tested as specified in [20.2](#) and [20.3](#). A typical test stand is shown in [Figure 10.1](#).

20.2 Test specimens are to be prepared as described in [18.2](#) – [18.5](#). Test specimens are to be prepared and tested under ambient conditions of $73.4 \pm 3.6^{\circ}\text{F}$ ($23 \pm 2^{\circ}\text{C}$) and 50 ± 5 percent relative humidity.

20.3 A test stand is to be positioned so that the test panel forms a 20 degree angle from the vertical. The length of the tape adhered to the test panel is to be 6 inches (152 mm), and the length of the test panel is to be at least 7 inches (178 mm). The free end of the tape specimen is to be located at the bottom end of the test panel with the test load applied at the free end of the tape specimen as shown in [Figure 10.1](#).

21 Surface Burning Characteristics Test

21.1 The surface burning characteristics test for heat-activated aluminum tapes shall be as specified in [11.1](#) and [11.2](#).

22 Mold Growth and Humidity Test

22.1 The mold growth and humidity tests for heat-activated aluminum tapes shall be as specified in [12.1](#) – [12.4](#) after the tape has been heated enough to darken the bond indicator devices.

23 Temperature/Pressure Cycling Test

23.1 The temperature/pressure cycling test for heat activated aluminum tapes shall be as specified in [13.1](#) – [13.9](#).

24 Burning Test

24.1 Aluminum tape shall not flame or glow for more than 60 seconds after withdrawal of the test flame when mounted as described in [24.2](#) and [24.3](#) and tested in accordance with [24.4](#) – [24.7](#). Flaming or glowing shall not travel from the point of application to the far end of the test sample during application of the test flame or within 60 seconds following removal of the flame. Any particles dropping from the tape specimens oriented horizontally and at a 45 degree angle shall not ignite untreated surgical cotton.

24.2 Three specimens from one roll of tape are to be tested. The tape specimens are to be firmly applied to the faced side of a Type "475" rigid glass fiber air duct board substrate using sufficient heat from a heat

bonding iron to achieve proper bonding as indicated by the tape's bond indicating mechanism. The dwell time (see [Table 19.1](#)) is to be 15 minutes.

24.3 The tape is to be applied to a Type "475" rigid glass fiber air duct board substrate at least 2 inches (50.8 mm) wider on each side than the tape sample and 36 inches (914 mm) long. The tape is to be 30 inches (762 mm) long and applied so that each end is 3 inches (76.2 mm) from the end of the substrate. One tape specimen is to be supported with its axis horizontal, one supported with the axis at 45 degrees from the horizontal and one supported with the axis vertical.

24.4 The apparatus to be employed consists of a Bunsen burner with a 3/8 inch (9.5 mm) diameter tube and means for controlling the primary air and gas input, a support for the burner, a stopwatch or other timing device, and a supply of untreated surgical cotton. The Bunsen burner is to be supported and held in place by means of a burner stand, ring stand with clamps, or an equivalent type of mechanical support. The gas used is to be commercial grade or purer propane (bottled) gas having a heating value in the range of 2490 – 2510 Btu per cubic foot. The gas bottle is to have a regulator and a valve located between the regulator and the burner. The tests are to be conducted in a location free from drafts.

24.5 Prior to the application of the burner to the sample, the burner is to be adjusted to produce a flame 2-1/2 inches (63.5 mm) high. The air and fuel input are to be adjusted such that the flame has equal parts of blue and yellow. The valve then is to be turned off and the burner positioned such that 1-1/4 inches (31.8 mm) of the test flame will impinge the test sample 3 inches (76.2 mm) from the end of the sample. The valve then is to be turned on and the flame ignited.

24.6 The surface of the three samples oriented in the three positions is to be exposed to the flame for 1 minute and then the flame is to be withdrawn. When flaming or glowing combustion of the sample ceases 60 seconds or less after removal of the test flame, the test flame is to be reapplied at the same place for 1 minute immediately after flaming or glowing combustion of the sample stops. The test flame again is to be withdrawn and the duration of flaming or glowing combustion of the sample noted. During the test of an individual sample, the original size and characteristic of the test flame is not to be changed.

24.7 When particles drop from the sample oriented horizontally and 45 degrees from the horizontal during the exterior exposure tests, these particles are to be allowed to fall onto a horizontal plane 1 foot (304 mm) below the nearest part of the test sample. The plane is to be covered with a layer of untreated surgical cotton except for that portion of the area directly below the burner extending for a distance of 6 inches (152.4 mm) measured horizontally in all directions from a vertical axis through the tip of the burner flame.

MARKING

25 General

25.1 The tape shall be marked every 36 inches (914 mm) or fraction thereof with:

- a) The manufacturer's or private labeler's name or identifying symbol;
- b) The distinctive type or model 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 "181A-H."

25.2 If the manufacturer produces aluminum tape in more than one factory, each roll of tape shall have a distinctive marking to identify it as the product of a particular factory.

PART III – MASTIC CLOSURE SYSTEMS FOR USE WITH RIGID FIBERGLASS AIR DUCTS

CONSTRUCTION

26 Materials

26.1 Mastic closure systems shall consist of mastic supplied in suitable containers and a suitable scrim reinforcements (see [26.2](#)). These mastic systems are to be installed in a minimum width of 3 inches (76 mm).

26.2 The fiberglass scrim to be used with the mastic is plain weave, 20 x 10 count, 0.005 in. thick min., with a weight of 1.8 + 0.2 oz./sq. yard, and a minimum tensile strength property of 70 lbs/in. in both the warp and fill directions.

Note: The fiberglass scrim specified in [26.2](#) is currently referenced on the installation instructions of rigid duct having been found to comply with the requirements of the Standard for Factory-Made Air Ducts and Connectors, UL 181.

27 Glossary

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

27.2 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. See [36.3](#).

PERFORMANCE

28 Tensile Joint Strength Test

28.1 The average tensile joint strength of mastic system joints shall be not less than 25 pounds per inch (4.37 N/mm) of width.

28.2 For the purposes of this test, virgin duct board facing is to be used in the machine direction. To verify that the sample facing is oriented in the machine direction when used during testing, the original cut sample, and every cut sample thereafter, is to be marked to indicate the machine direction. The sample facing is to be clean and free from dust. The duct board facing is to be cut into three 16 inch (400 mm) long by 4 inch (100 mm) wide pieces and three 16 inch (400 mm) long by 4-1/2 (114 mm) inch wide pieces with the machine direction along the width. (This procedure will result in the tensile load being applied in the machine direction of the facing.)

28.3 The virgin facing used in this test is to be tested to verify that it has a tensile strength greater than 30 pounds per inch (5.24 N/mm). Three 2 inch (50 mm) by 10 inch (250 mm) samples of the virgin facing are to be cut and marked to indicate the machine direction as described in [28.2](#). The samples are to be tested, in the machine direction, on a constant rate of extension machine with 2 inch wide clamps. The distance between the jaws of the clamps shall be 7.1 inches (180 mm) and the test is to be conducted at a rate to provide a 5 – 15 second break.

28.4 Using the remaining six pieces of duct board facing, position the 4 inch (100 mm) wide and the 4-1/2 inch (114 mm) wide pieces of facing with an overlap, as shown in [Figure 28.1](#), onto stainless steel plates. Test specimens are to be prepared at ambient conditions of 73.4 ±3.6°F (23 ±2°C) and 50 percent relative humidity. Apply the mastic system over the facing overlap per the manufacturer's recommendations. By holding on to the stainless steel plates, immediately place samples in a conditioning chamber maintained at 73.4 ±3.6°F (23 ±2°C) and 75 ±5 percent relative humidity for the manufacturer's recommended set time. See [27.2](#). After completing the conditioning for the recommended set time, place one sample in an oven at 150 ±5°F (65.5 ±3°C) for 7 days. The second sample is to be placed in a