Designation: C 474 – 05

Standard Test Methods for Joint Treatment Materials for Gypsum Board Construction[1]

This standard is issued under the fixed designation C 474; 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 physical testing of joint compound, paper joint tape, glass-mesh joint tape, and an assembly of joint compound and paper joint tape.

1.1.1 Joint treatment materials are specified in Specification C 475/C 475M.

1.1.2 The joint treatment material described in this standard are for use with gypsum board installed in accordance with Specification C 840.

1.2 The test methods appear in the following order:

	Section
Joint Compound Tests:	
Viscosity	5
Shrinkage	6
Check Cracking	7
Putrefaction	8
Joint Tape Tests:	
Tensile Strength	9
Width	10
Thickness	11
Paper Joint Tape Tests	
Dimensional Stability	12
Assemblages of Paper Joint Tape and Joint Compound:	
Bond of Paper Joint Tape to Joint Compound	15
Cracking of Joint Compound at Tape Edges	14
Glass-Mesh Joint Tape Test	
Skewness	13

1.3 The values stated in inch-pound units are to be regarded as the standard. The SI (metric) values given in brackets are approximate and are provided for information purposes only.

1.4 The text of this standard references notes and footnotes that provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:* [2]

C 11 Terminology Relating to Gypsum and Related Building Materials and Systems

C 472 Test Methods for Physical Testing of Gypsum, Gypsum Plasters, and Gypsum Concrete

C 475/C 475M Specification for Joint Compound and Joint Tape for Finishing Gypsum Board

C 840 Specification for Application and Finishing of Gypsum Board

C 1396/C 1396M Specification for Gypsum Board

D 685 Practice for Conditioning Paper and Paper Products for Testing

D 828 Test Method for Tensile Properties of Paper and Paperboard Using Constant-Rate-of-Elongation Apparatus

D 3882 Test Method for Bow and Skew in Woven and Knitted Fabrics

E 100 Specification for ASTM Hydrometers

2.2 *TAPPI Standard:*

T 411 Thickness (Caliper) of Paper, Paperboard, and Combined Board[3]

3. Terminology

3.1 *Definitions*—For definitions of terms relating to gypsum, see Terminology C 11.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *bond*, *n—in joint systems*, the quality of adhesion between the paper joint tape and joint compound.

3.2.1.1 *Discussion*—A 0 % bond means that no paper fiber is adhering to the joint compound. A 100 % bond means that there is cohesive failure of the paper joint tape.

3.2.2 *check cracking*, *n—in joint systems*, short, narrow cracks randomly oriented in the surface of the dried joint compound.

3.2.3 *joint compound, powder*, *n*—A drying-type or setting-type cementitious material to be mixed with water.

[1] These test methods are under the jurisdiction of ASTM Committee C11 on Gypsum and Related Building Materials and Systems and are the direct responsibility of Subcommittee C11.02 on Specifications and Test Methods for Accessories and Related Products.

Current edition approved Jan. 1, 2005. Published February 2005. Originally approved in 1961. Last previous edition approved in 2002 as C 474 – 02.

[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] Available from Technical Association of the Pulp and Paper Industry, Technology Park, P.O. Box 105113, Atlanta, GA 30348.

***A Summary of Changes section appears at the end of this standard.**

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3.2.4 *joint compound, ready-mix*, *n*—A drying-type cementitious material that is factory mixed in ready-to-use form.

4. Specimen Preparation

4.1 *Joint Compound, Powder*:

4.1.1 Mix 300 g of joint compound, powder, with approximately 150 to 160 mL of water.

4.1.2 Allow the specimen to stand for 30 min (Note 1), remix and adjust the temperature to 77 ± 2 °F [25 ± 1 °C] by placing the container holding the specimen in warm or cool water.

NOTE 1—Allow setting type compounds to stand for one half of their setting times, as determined by Test Methods C 472 but not more than 30 min, prior to remixing.

4.1.3 Measure the viscosity in accordance with Section 5.

4.1.4 If the measured viscosity is not between 480 and 520 Brabender units, repeat 4.1.1-4.1.3 through with an increase or decrease in water as necessary.

4.1.5 Record the volume of water used to adjust the viscosity to 500 ± 20 Brabender units (see Note 2).

NOTE 2—Making note of the volumes of water, in millilitres per 100 g of material, used to adjust the viscosity, will facilitate specimen preparation in other tests.

4.2 *Joint Compound, Ready-Mix*:

4.2.1 Remix joint compound, ready-mix, to reincorporate any separated ingredients. Adjust the temperature to 77 ± 2 °F [25 ± 1 °C] by placing the container holding the specimen in warm or cool water.

4.2.2 Measure the viscosity in accordance with Section 5.

4.2.3 If the viscosity is more than 520 Brabender units, add water to achieve a viscosity of 500 ± 20 Brabender units (see Note 2).

4.2.3.1 If the original sample viscosity is less than 480 Brabender units, test as received.

JOINT COMPOUND

5. Joint Compound Viscosity

5.1 *Significance and Use*:

5.1.1 This test method provides a procedure for measuring joint compound viscosity.

5.2 *Sampling*:

5.2.1 Sampling shall be in accordance with Specification C 475/C 475M.

5.3 *Specimen Preparation*:

5.3.1 Prepare specimens in accordance with Section 4.

5.4 *Apparatus*:

5.4.1 *Viscosity Specimen Container*, metal or plastic with an open top having an inside diameter of 2½ to 3 in. [65 to 75 mm] and a height of 2½ to 3 in. [65 to 75 mm].

5.4.2 *Viscometer*[4], adjusted to operate at 78 ± 1 r/min, and with a 250 cm-g sensitivity cartridge.

5.4.3 *Viscometer Pin*, having dimensions as follows:

	in. [mm]
Shaft diameter	0.187 ± 0.015 [4.75 ± 0.38]
Pin diameter	0.094 ± 0.015 [2.39 ± 0.38]
Immersion depth (from bottom of spindle)	1.625 ± 0.015 [41.3 ± 0.38]
Length of pin projecting from shaft	0.750 ± 0.015 [19.1 ± 0.38]
Upper pin from bottom of shaft	0.313 ± 0.015 [7.95 ± 0.38]
Lower pin from bottom of shaft	0.125 ± 0.015 [3.28 ± 0.38]

5.5 *Procedure*:

5.5.1 Fill the viscosity container with the mixed specimen until level with the top of the container.

5.5.1.1 Remove all air bubbles by puddling the sample container with a spatula and sharply rapping the bottom of the container on a hard flat surface.

5.5.2 Lock the filled container in the center of the viscometer spindle platform. Raise the platform until the level of the specimen reaches the mark on the viscometer pin and lock the platform in place.

5.5.3 Start the viscometer. Read the viscosity after the pen starts to trace a straight line (usually within 1 min). If the tracing remains inconsistent, estimate the average viscosity reading.

5.6 *Report*:

5.6.1 Report the viscosity of the joint compound specimen in Brabender units.

5.7 *Precision and Bias*:

5.7.1 Precision and bias of this test method have not been determined.

6. Shrinkage

6.1 *Significance and Use*:

6.1.1 This test is used to measure the amount of shrinkage in joint compound. The degree of correlation between this test and service performance has not been determined.

6.2 *Sampling*:

6.2.1 Sampling shall be in accordance with Specification C 475/C 475M.

6.3 *Specimen Preparation*:

6.3.1 Specimen preparation shall be in accordance with Section 4.

6.4 *Apparatus*:

6.4.1 *Plastic or Rubber Film*, approximately 5 by 5 in. [130 by 130 mm]. Any thin, flexible film that peels clean from a partially dried patty may be used.[5]

6.4.2 *Balance*, having a sensitivity of 10 mg (Fig. 1 and Fig. 2).

6.4.3 *Beaker, Ring Stand, and Wire Cradle* (see Fig. 1).

6.4.4 *Forced Air Drying Oven*, capable of being maintained at 90 to 120 °F [32 to 49 °C].

6.4.5 *Spatula*, having a blade approximately 4 in. by ½ in. [100 by 13 mm].

6.4.6 *Steel-Reinforced Broad Knife*, a 5 to 8 in. [130 by 200 mm] drywall broad knife reinforced by a steel bar, 1 in. [25 mm] wide by ⅛ in. [3 mm] thick, by the knife width, attached to the back of the knife blade ¼ in. [6 mm] from the edge.

6.4.7 *Hydrometer*, having a range of 0.7 to 0.8 sp gr, in accordance with Specification E 100.

[4] The sole source of supply of the apparatus known to the committee at this time is the Brabender "Visco-Corder" Model VC-3, manufactured by C.W. Brabender Instruments Inc., South Hackensack, NJ. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee [1], which you may attend.

[5] Rubber dental dam dusted with talc, polyethylene, or PTFE films have been found satisfactory for this use.

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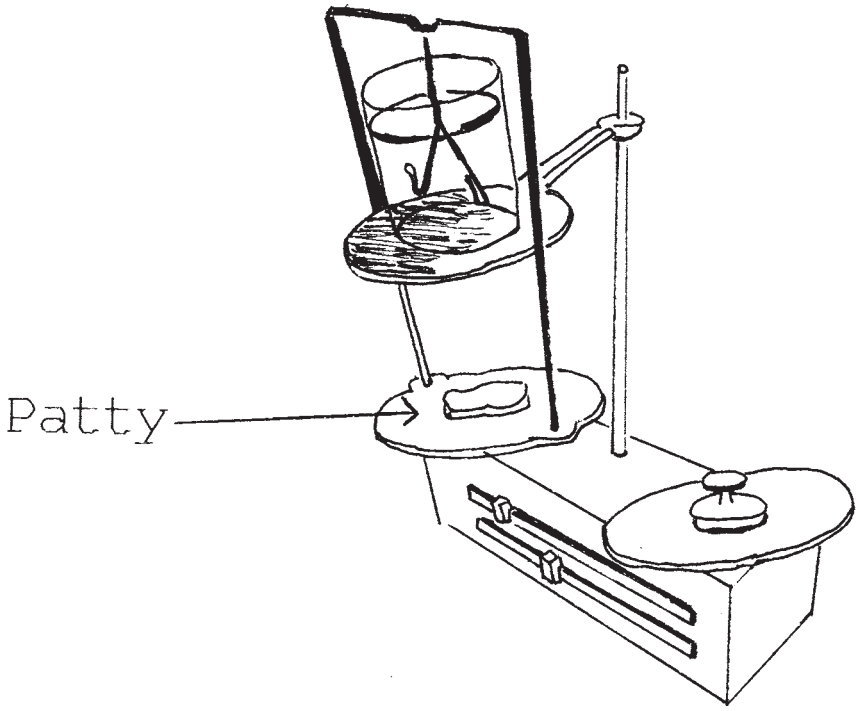

FIG. 1 Wire Cradle in Kerosine

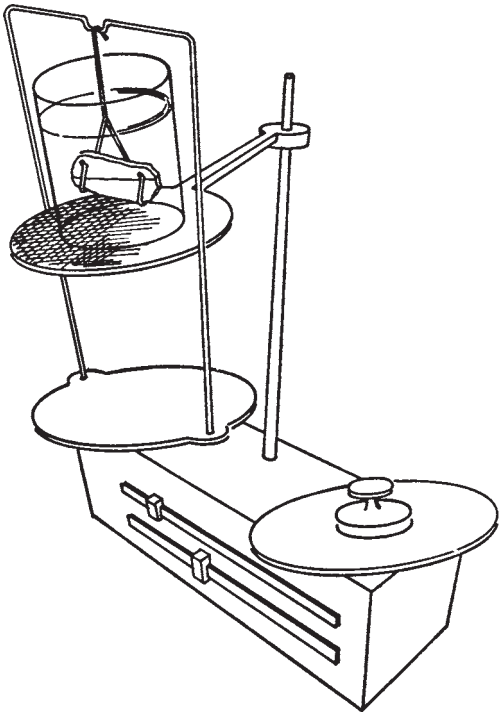

FIG. 2 Patty Immersed in Kerosine

6.4.8 *Volumetric Container*, a container which has a volume between 25 and 300 cm^3.

6.5 *Reagents and Materials*:

6.5.1 *Displacement Fluids*.

6.5.1.1 *Mineral Spirits*, odorless.

6.5.1.2 *Kerosine*.

6.6 *Preparation of Apparatus*:

6.6.1 *Support Plates*—Cover three plastic or glass plates with plastic or rubber film.

6.6.2 Obtain and record the tare weight of each assembly.

6.7 *Calibration*:

6.7.1 *Volumetric Container*—Determine the container volume in cubic centimetres and its tare weight in grams.

6.7.2 *Mineral Spirits, Kerosine*—Using the hydrometer, determine the specific gravity and record the result as *M*.

6.8 *Determination of Wet Volume*:

6.8.1 Prepare a specimen to determine the wet specific gravity by weighing the specimen in the volumetric container.

6.8.1.1 Adjust the temperature to 77 ± 2 °F [25 ± 1 °C] by placing the container holding the specimen in warm or cool water.

6.8.1.2 Puddle the specimen with the spatula to remove entrapped air bubbles.

6.8.1.3 Fill the container completely and strike off the surface flush with the top using the steel-reinforced broad knife.

6.8.1.4 Weigh the filled container to the nearest 0.01 g. Record the weight of the filled container.

6.9 *Preparation of Specimen to Determine Dry Volume*:

6.9.1 Place approximately 30 g of specimen onto each prepared support plate.

6.9.1.1 Spread the specimen into an elongated patty 3⁄16 to ¼ in. [5.0 to 6.5 mm] thick with a spatula.

6.9.1.2 Remove any specimen remaining on the spatula and add to the patty.

NOTE 3—The patty may be scored across its narrowest width to facilitate breaking the patty after it is dry.

6.9.1.3 Weigh and record the total weight of each patty, film and plate.

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6.9.1.4 When testing setting type joint compounds, place the patties in the drying oven one h after the setting time has been reached as determined by Test Methods C 472.

6.9.1.5 When testing drying type joint compounds, place the patties in the drying oven immediately after weighing.

6.9.2 Dry patties at a temperature between 100° and 120 °F [32 to 49 °C] for 16 to 24 h.

6.9.3 Strip off the plastic or rubber film, and continue to dry until constant weight is reached.

6.10 *Determination of Dry Volume*:

6.10.1 Immerse each patty in a beaker of the displacement fluid, such that they do not touch the sides of the beaker, until constant weight is reached.

NOTE 4—Each patty may be broken into two or three pieces to fit in the beaker without touching the sides.

6.10.2 Remove each patty from the displacement fluid. Using a cloth moistened in the same fluid, lightly blot off the excess fluid from the surface of the patty.

6.10.3 With the wire cradle suspended in the beaker of displacement fluid, weigh each patty in air on the pan of the balance (Fig. 1), and record as its air weight.

6.10.4 Next, weigh each patty in the wire cradle, making sure that the patty is completely immersed in the liquid and that it does not touch the sides of the beaker (Fig. 2). Record these weights as the immersed weight.

6.11 *Calculation of Shrinkage*:

6.11.1 Determine the net weight of the compound in the volumetric container by subtracting the weight obtained in 6.8.1.4 from the weight obtained in 6.7.1.

6.11.2 Divide the net weight obtained in 6.11.1 by the volume of the container obtained in 6.7.1. Record the result as *G*, grams per millilitre.

$$G = \frac{\text{Total weight} - \text{Container tare weight}}{\text{Volume of Container}} \quad (1)$$

6.11.3 Determine the net weight of each specimen by subtracting the tare weight of its support plate weight and its weight obtained in 6.9.1.3.

6.11.4 Divide the net weight obtained in 6.11.3 by *G*. Record as *V*, volume of patty.

$$V = \frac{\text{Dry weight} - \text{Support plate tare weight}}{G} \quad (2)$$

6.11.5 Subtract the immersed patty weight obtained in 6.10.4 from the air patty weight obtained in 6.10.3. Record as *D*, the weight difference.

6.11.6 Calculate the percent shrinkage as follows:

$$\% \text{ Shrinkage} = D(X/V), \quad (3)$$

where:

D = the difference in air and immersed weight,
X = 100/displacement fluids specific gravity, and
V = weight of wet patty/specific gravity of the compound.

6.12 *Report*:

6.12.1 Take the average of the three patties tested. If there is a difference between the percent shrinkage of the three patties of more than 1.5 %, completely retest an additional three specimens and take the average of the six.

6.13 *Precision and Bias*:

6.13.1 Precision and bias of this test method have not been determined.

7. Check Cracking of Joint Compound

7.1 *Significance and Use*

7.1.1 This test method is used to measure the degree and type of field and edge cracking of joint compound. The degree of correlation between this test and service performance has not been determined.

7.2 *Sampling*:

7.2.1 Sampling shall be in accordance with Specification C 475/C 475M.

7.3 *Specimen Preparation*:

7.3.1 Prepare specimens in accordance with Section 4, except use a quantity of 100 g.

7.4 *Apparatus*:

7.4.1 *Rod*, metal or glass, ⅛ in. [3.2 mm] in diameter by 7 in. [180 mm] in length.

7.4.2 *Steel-Reinforced Broad Knife*, as defined in 6.4.6.

7.4.3 *Gypsum Wallboard*, Specification C 1396/C 1396M.

7.4.3.1 To determine compliance to Specification C 475/C 475M, Specification C 1396/C 1396M gypsum wallboard shall be used.[6]

7.4.4 *Electric Fan*, capable of forcing a continuous current of air at a velocity of 350 to 450 ft/min [1.8 to 2.3 m/s] at a distance of approximately 3 ft [1 m].

7.5 *Procedure*:

7.5.1 Place the rod on a piece of gypsum wallboard and place some of the specimen next to the rod.

7.5.2 Form a 3½ to 4 in. [90 to 100 mm] wide wedge of the specimen with the steel-reinforced broad knife, with the rod on one side and the wallboard on the other side to guide the knife.

7.5.2.1 Hold the broad knife at an angle less than 45° with respect to the plane of the wallboard. Draw the broad knife over the specimen two or more times to leave the surface smooth.

7.5.3 Remove the rod and adjust the wedge to a 5 in. [130 mm] length.

7.5.4 Immediately place the wedge-shaped specimen in front of the fan blowing over the surface of the wedge for 8 to 16 h. The current of air shall be maintained at 70 to 85 °F [21 to 29 °C] and 45 to 55 % relative humidity.

7.6 *Report*:

7.6.1 Report the type and amount of cracking in both the thick half and the thin half of the wedge.

7.7 *Precision and Bias*:

7.7.1 Precision and bias of this test method have not been determined.

8. Putrefaction

8.1 *Significance and Use*:

[6] Other substrates may be used to evaluate the effect that they have on the performance of the joint compound and assemblies of joint compound and joint tape.

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8.1.1 This test method is used to evaluate the tendency of the joint compound to putrefy. The degree of correlation between this test and service performance has not been determined.

8.2 *Sampling*:

8.2.1 Sampling shall be in accordance with Specification C 475/C 475M.

8.3 *Apparatus*:

8.3.1 *Humidity Cabinet*, a chamber capable of maintaining 85 to 95 °F [29 to 35 °C] and 85 to 95 % relative humidity.

8.3.2 *Glass Container*, capable of being sterilized in an autoclave, having a minimum volume of 250 mL.[7]

8.3.3 *Cover*, made of glass or aluminum foil large enough to cover the glass container and capable of being sterilized in an autoclave.

8.3.4 *Autoclave*, capable of maintaining 260 °F [130 °C] at 21 psi [145 kPa] steam pressure for not less than 15 min.

8.4 *Preparation of Apparatus*:

8.4.1 Sterilize the glass container and cover in an autoclave at 21 psi [145 kPa] and 260 °F [130 °C] for 15 min or more.

8.5 *Procedure*:

8.5.1 *Joint Compound, Powder*—Mix 50 g of joint compound with water, as determined in 4.1 in the glass container. Allow it to soak 30 min and then remix. Place the cover over the glass container and place in the humidity cabinet.

8.5.2 *Joint Compound, Ready-mix*—Select an unopened container that has not exceeded the producer's specified shelf life.

8.5.2.1 Open the container. If the material in the container has separated, mix thoroughly.

8.5.2.2 Remove 100 g of joint compound, ready-mix, from the container.

8.5.2.3 Put the specimen in the glass container and cap with the cover.

8.5.2.4 Place in the humidity cabinet.

8.6 *Interpretation of Results*:

8.6.1 Observe daily for putrefaction.

8.7 *Report*:

8.7.1 Report the number of days required to produce putrefaction.

8.8 *Precision and Bias*:

8.8.1 Precision and bias of this test method have not been determined.

JOINT TAPE

9. Tensile Strength

9.1 *Significance and Use*:

9.1.1 This test method is used to evaluate the cross-directional strength of joint tape used to reinforce the joints created by gypsum wallboard construction. The degree of correlation between this test and service performance has not been determined.

9.2 *Sampling*:

9.2.1 Sampling shall be in accordance with Specification C 475/C 475M.

9.2.2 A sample for the purpose of testing shall consist of not less than 12 ft [3.6 m] of tape from each roll.

9.2.3 Take ten specimens in the cross direction at not less than 1 ft (300 mm) intervals. Cut each specimen to 1 in. [25 mm] by roll width.

9.3 *Apparatus*:

9.3.1 The apparatus shall be in accordance with Test Method D 828 except that the distance of the jaw spacing shall be reduced to ½ ± 1/64 in. [12.7 ± 0.4 mm]; the rate of elongation shall be 0.66 in./min ± 5 s [17 mm/min ± 5 s].

9.4 *Procedure*:

9.4.1 Condition the specimens for a minimum of 24 h at 72 ± 4 °F [22 ± 2 °C] and 50 ± 2 % relative humidity.

9.4.2 Test in accordance with Test Method D 828 with equipment as set forth in 9.3.

9.5 *Interpretation of Results*:

9.5.1 Accept or reject results of the individual test specimens in accordance with Test Method D 828.

9.5.2 If any results are rejected, test additional specimens so that there are at least ten test results for the evaluation of any unit of tape.

9.6 *Report*:

9.6.1 Report test results as pounds-force per inch (Newtons per millimetre) of width of specimen.

9.7 *Precision and Bias*:

9.7.1 Precision and bias statements as listed in Test Method D 828 are suitable for use with this product.

10. Width

10.1 *Significance and Use*:

10.1.1 This test method is used to determine the average variation in width of the joint tape. The degree of correlation between this test and service performance has not been determined.

10.2 *Sampling*:

10.2.1 Sampling shall be in accordance with Specification C 475/C 475M.

10.3 *Specimen Preparation*:

10.3.1 Cut a specimen of joint tape not less than 12 ft [3.5 m] long from the roll to be tested.

10.4 *Apparatus*:

10.4.1 *Steel Rule, Caliper Rule*, or other measuring device capable of resolving 1/32 in. A metric device must be capable of resolving 1.0 mm.

10.5 *Procedure*:

10.5.1 Measure the width of the specimen in ten places, at least 1 ft [300 mm] apart, to the nearest 1/32 in. [1.0 mm]. Record each measurement.

10.6 *Calculation of Results*:

10.6.1 Determine the maximum and minimum widths. Calculate the average width.

10.6.2 Determine the difference between the maximum and minimum width by subtraction.

10.7 *Report*:

10.7.1 Report the average width, and the difference between the maximum and minimum width.

10.8 *Precision and Bias*:

[7] Deep Petri dishes and 250 mL beakers have been found suitable for this purpose.

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10.8.1 Precision and bias of this test method have not been determined.

11. Thickness

11.1 *Significance and Use*:

11.1.1 This test method is used to determine the average thickness of joint tape. The degree of correlation between this test and service performance has not been determined.

11.2 *Sampling*:

11.2.1 Sampling shall be in accordance with Specification C 475/C 475M.

11.3 *Specimen Preparation*:

11.3.1 Cut a specimen of tape not less than 12 ft [3.5 m] long from the roll to be tested.

11.3.2 Condition the specimen for a minimum of 24 h as described in Practice D 685.

11.4 *Apparatus*:

11.4.1 *Paper Micrometer* having circular faces of 0.25 to 0.33 in.^{2} [160 to 215 mm^2] in area. Faces shall be under steady pressure of 7 to 9 psi [50 to 60 kPa].

NOTE 5—For details see TAPPI T 411, except waive Section 7.

11.5 *Procedure*:

11.5.1 Measure the thickness of the specimen in 10 places, between the edges, at least 1 ft [300 mm] apart. Skived areas on the tape edges shall not be included in the area measured for thickness.

NOTE 6—Skiving is not present on all tapes.

11.5.2 Record the thickness to the nearest 0.001 in. [0.01 mm].

11.6 *Report*:

11.6.1 Report the average thickness.

11.7 *Precision and Bias*:

11.7.1 Precision as reported in the TAPPI Standard T 411 states that the within-laboratory repeatability is 1.25 % and the laboratory reproducibility is 5.50 %.

PAPER JOINT TAPE

12. Dimensional Stability

12.1 *Significance and Use*:

12.1.1 This test method is used to determine the lengthwise and crosswise expansion characteristics of the paper joint tape used to reinforce the joints created in gypsum wallboard construction. The degree of correlation between this test and service performance has not been determined.

12.2 *Sampling*:

12.2.1 Sampling shall be in accordance with Specification C 475/C 475M.

12.3 *Specimen Preparation*:

12.3.1 Cut not less than three specimens of tape 10 to 16 in. [250 to 400 mm] long from the roll to be tested.

12.3.2 Condition the specimens for a minimum of 16 h at 72 ± 4 °F [22 ± 2 °C] and 50 ± 2 % relative humidity.

12.4 *Apparatus*:

12.4.1 *Steel Rule, Caliper Rule, Cathetometer* or other measuring device capable of resolving 0.005 in. over a minimum span of 10 in. A metric rule must be capable of resolving 0.10 mm over a minimum span of 250 mm.

12.4.2 *Sharp Knife, 4 to 5× Magnifying Glass, Pencil*.

12.4.3 *Glass Container* at least 2½ in. [65 mm] deep and 6 in. [150 mm] in diameter.

12.5 *Reagents and Materials*:

12.5.1 *Water*, distilled or deionized.

12.6 *Procedure*:

12.6.1 Place the conditioned specimens on a flat surface.

12.6.1.1 At about ½ in. [10 mm] from each end of the paper tape, cut two ½ in. [10 mm] long reference marks for the length-wise measurement crosswise of the tape with a sharp knife.

12.6.1.2 Place the rule on the tape so that one edge is centered lengthwise.

12.6.2 Move the rule so that starting mark (A) coincides with the reference mark at one end of the tape. Record the value at A. Take the reading at the other reference mark. Read to the nearest 0.005 in. [0.10 mm]. (See Fig. 3).

NOTE 7—Measuring from the 1 in. [25 mm] mark and subtracting this value may be a useful method to obtain an accurate measurement. Reading the rule with a magnifying glass of 4 to 5× is recommended.

12.6.3 Place the rule across the width of the tape.

12.6.3.1 Align the starting mark (B) of the rule with one edge of the tape. Record the value at B.

12.6.3.2 Take the reading at the opposite edge of the tape. Mark the location of this crosswise measurement by drawing a 1½ in. [40 mm] long pencil mark across the tape without marring the edges of the tape. (See Fig. 4.)

12.6.4 Roll up the tape and submerge it in the container full of water at 72 ± 4 °F [22 ± 2 °C].

12.6.5 After 30 min, remove the tape from the water and roll it out on the flat surface. Repeat the lengthwise and crosswise measurements.

12.7 *Calculation of Results*:

12.7.1 Subtract A from the reading obtained in 12.6.2 and record as the dry length of the tape at this point.

12.7.2 Subtract B from the reading obtained in 12.6.3.2 and record as the dry width of the tape at this point.

12.7.3 Determine the amount of expansion by subtracting the original measurement from the final measurement. Divide the expansion in inches (millimetres) by the original reading and multiply by 100 to obtain the percentage expansion.

$$\% \text{ Expansion} = \frac{(\text{Wet Measurement} - \text{Dry Measurement})}{\text{Dry Measurement}} \times 100 \quad (4)$$

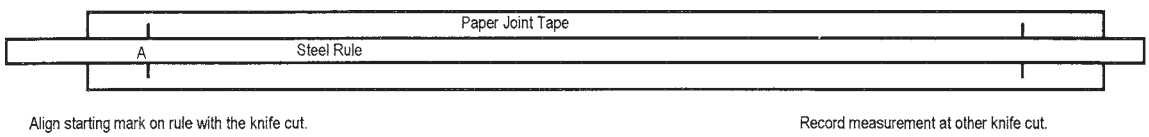

FIG. 3 Arrangement for Length Expansion Measurement

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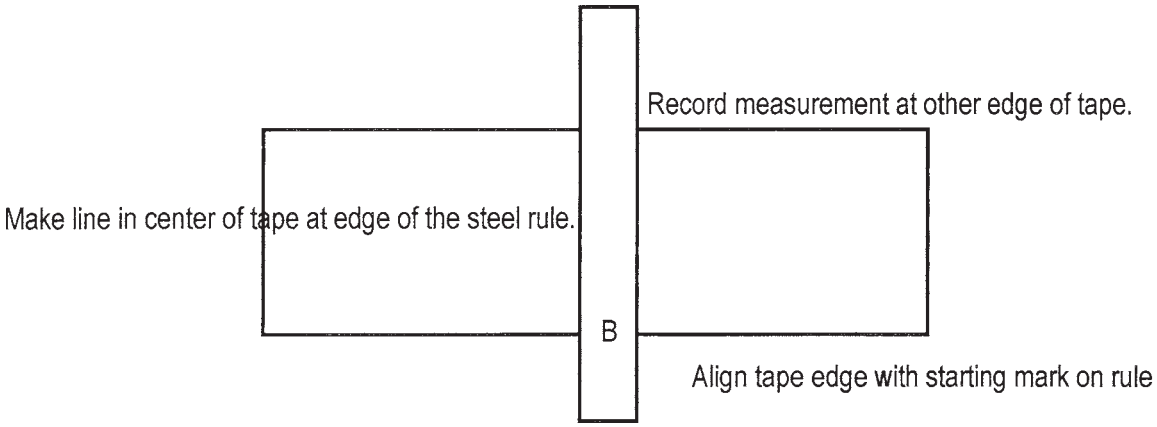

FIG. 4 Arrangement for Width Expansion Measurement

12.8 *Report*:

12.8.1 Report test results as percent expansion in the lengthwise and crosswise directions.

12.9 *Precision and Bias*:

12.9.1 Precision and bias of this test method have not been determined.

GLASS-MESH JOINT TAPE

13. Skewness

13.1 The skewness of the warp and fill yarns shall be tested in accordance with Test Method D 3882.

ASSEMBLAGES OF JOINT TAPE AND JOINT COMPOUND

14. Cracking of Joint Compound at Tape Edges

14.1 *Significance and Use*:

14.1.1 This test method is used to determine the adhesion of the joint compound to the edges of the joint tape. The degree of correlation between this test and service performance has not been determined.

14.2 *Sampling*:

14.2.1 Sampling shall be in accordance with Specification C 475/C 475M.

14.3 *Specimen Preparation*:

14.3.1 Select specimens of joint tape in accordance with 9.2.2.

14.3.2 Cut specimens of joint tape into not less than 12 in. [300 mm] specimens.

14.3.3 Prepare specimens of joint compound in accordance with Section 4, except use a quantity of 200 g.

14.4 *Apparatus*:

14.4.1 *Feeler Gage Strips*, two required for each test, each 12-in. [300 mm] long, ½ in. [13 mm] wide, 0.040 in. [1 mm] thick.

14.4.2 *Steel-Reinforced Broad Knife*, see 15.4.2.

14.4.3 *Gypsum Wallboard*, Specification C 1396/C 1396M (See 7.4.3.1), approximately 6 by 12 in. [150 by 300 mm].

14.4.4 *Electric Fan*, in accordance with 7.4.4.

14.5 *Procedure*:

14.5.1 Place the two feeler gage strips on the face of the wallboard about 4 in. [100 mm] apart.

14.5.2 Fill the space between the feeler gage strips with joint compound specimen and level to the thickness of the feeler gage strips.

14.5.3 After leveling to the correct thickness, center a specimen of joint tape between the feeler gage strips.

14.5.3.1 Using the steel-reinforced broad knife at about a 45° angle, press the tape specimen firmly into contact with the joint compound.

14.5.3.2 Use a final flat stroke of the knife to smooth the joint compound on both sides of the tape. Do not press so hard that the joint compound will be squeezed out from under the tape, but hard enough so that the tape is in full contact with the joint compound.

14.5.4 Remove the feeler gage strips.

14.5.5 Place this assembly in front of the electric fan blowing a current of air over the surface of the assembly. Maintain a current of air at 100 ± 5 °F [38 ± 2 °C] and 25 ± 5 % relative humidity.

14.5.5.1 Alternatively, in very dry air (under 20 % relative humidity) at temperatures between 75 and 90 °F [24 to 32 °C] just allow the electric fan to blow a current of air over the surface.

14.5.6 After 1 h, examine the assembly for cracks along the edges of the tape with a magnifying glass of 4 to 5×.

14.6 *Calculation of Results*:

14.6.1 Measure the total length of any cracking at the edge of the joint tape and joint compound.

14.6.2 Divide the total length of cracked edges by the total length of the edges exposed and multiply 100 to obtain percent of cracked edge.

14.7 *Report*:

14.7.1 Report the percentage of cracking along the edges of the tape.

14.8 *Precision and Bias*:

14.8.1 Precision and bias of this test method have not been determined.

15. Bond of Paper Joint Tape to Joint Compound

15.1 *Significance and Use*:

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15.1.1 This test method is used to determine the bonding properties of the paper joint tape. The degree of correlation between this test and service performance has not been determined.

15.2 *Sampling*:

15.2.1 Sampling shall be in accordance with Specification C 475/C 475M.

15.3 *Specimen Preparation*:

15.3.1 Select specimens of paper joint tape in accordance with 9.2.2.

15.3.2 Cut specimens of paper joint tape into at least 12 in. [300 mm] specimens for use in test.

15.3.3 Prepare specimens of joint compound in accordance with Section 4, except use a quantity of 200 g.

15.4 *Apparatus*:

15.4.1 *Feeler Gage Strips* (two required for each test), each 12 in. [300 mm] long, ½ in. [14 mm] wide, 0.025 in. [0.64 mm] thick with a small hole drilled in one end.

15.4.2 *Steel-Reinforced Broad Knife*, in accordance with 6.4.6.

15.4.3 *Gypsum Wallboard*, Specification C 1396/C 1396M (See 7.4.3.1), two pieces, 6 by 14 in. [150 by 350 mm] with the 14-in. [350-mm] length in the machine direction of the paper.

15.4.4 *Overlay Transparency Grid*—A transparent photo copy of 10 by 10 divisions/in. graph paper. An area 2 by 5 in. [50 by 125 mm] enclosing 1000 square divisions is outlined.

15.5 *Procedure*:

15.5.1 Place two feeler gage strips parallel to each other about 4 in. [100 mm] apart and fasten to the face of the gypsum wallboard with a thumb tack through the hole in the end.

15.5.2 Using the steel reinforced broad knife, apply an amount of joint compound sufficient to cover the area between the feeler gage strips. Spread the specimen evenly between the feeler gage strips leaving the specimen slightly thicker than the strips.

15.5.3 Center a 12-in. [300-mm] length of the paper tape in the specimen. Press one end of the tape into the specimen and hold it in place.

15.5.4 Embed the tape by applying two or three pressure strokes with the steel-reinforced broad knife. Wipe away from the end being held so the excess joint compound is squeezed out.

NOTE 8—The thickness of the joint compound plus the tape is about 0.025 in. [0.64 mm].

15.5.4.1 Carefully remove the feeler gages before drying.

15.5.5 Allow the test assembly to dry to constant weight in an atmosphere of 75 ± 5 °F [24 ± 2 °C] and 50 ± 5 % relative humidity.

15.5.6 When the test assembly is dry, use a sharp knife to make a cut across and perpendicular to the tape 3½ in. [90 mm] from one end. Make a second cut 5 in. [140 mm] from and parallel to the first cut. Make two diagonal cuts across the tape connecting the opposite corners of the 5-in. [140 mm] section. With the tip of the knife, peel back the tabs formed by the "X" cuts and pull up sharply.

15.5.6.1 Make a second test by repeating 15.5.6 below the first test.

15.5.7 Using a sharp pencil, lightly outline the areas where fiber remains attached to the compound. Align the overlay transparency grid so that the grid outline matches the 2 by 5-in. [50 by 125-mm] sides of the tape bond area.

15.6 *Calculation of Results*:

15.6.1 Using the overlay transparency grid, count the number of squares that are more than half bare of fiber separated from the tape and outlined by pencil.

15.6.2 Subtract this number from 1000 and divide by 10 to determine the percent bond. Record the average of the two tests.

15.7 *Report*:

15.7.1 Report the average percent bond failure.

15.8 *Precision and Bias*:

15.8.1 Precision and bias of this test method have not been determined.

16. Keywords

16.1 bond of tape; cracking; glass-mesh joint tape; joint compound; joint tape; joint treatment; paper joint tape; putrefaction; shrinkage; tensile strength; topping compound; viscosity

APPENDIX

(Nonmandatory Information)

X1. TEST METHOD FOR EVALUATING TENSILE PROPERTIES OF GYPSUM PANEL JOINTS

X1.1 *Introduction:*

X1.1.1 ASTM standards do not include a method to determine the strength of a joint between pieces of panel products. After significant investigation, the following procedure is proposed to evaluate reinforced gypsum panel product joints. This method is intended for use with any joint compound or tape intended for use as a joint reinforcement in construction of gypsum panel product systems in accordance with Specification C 840. Forward any comments relating to the suitability of this procedure to Technical Committee C11 for review.

X1.2 *Significance and Use:*

X1.2.1 This procedure is used to determine the tensile strength of the joint created by an assemblage of joint

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compound and joint tape. The degree of correlation between this test and service performance has not been determined.

X1.3 *Sampling:*

X1.3.1 Sampling shall be in accordance with Specification C 475/C 475M, except the number of specimens prepared shall be as shown.

X1.3.2 *Number of Specimens Required*

The number of specimens required for 5 % accuracy with 95 % confidence on the mean, assuming the set in question is a population, is calculated as follows:

$$n = (tv/A)^2 \quad \text{(X1.1)}$$

where:

n = number of samples required
t = student t distribution for 95 % confidence. t_∞= 1.645 for n>30
σ = population standard deviation
μ = population mean
v = coefficient of variation = % standard deviation = σ/μ*100
A = value of the allowable variation (that is, A = 0.05 for 5 % variation)

Without proper historical data for A, set n at 18 samples until such data is achieved.

X1.4 *Apparatus:*

X1.4.1 *Materials Required To Create the Standard Substrate*:

X1.4.1.1 High-density polyethylene plastic ½ in. [12.7 mm] thick,

X1.4.1.2 Jigsaw or table saw with blade suitable for cutting plastic,

X1.4.1.3 Router table with straight edging bit,

X1.4.1.4 Orbital sander with 60-grit sandpaper,

X1.4.1.5 Drill press with ½ in. [12.7 mm] drill bit,

X1.4.1.6 Six ¼ in. by 16 in. by 20 in. [6 mm by 400 mm by 500 mm] aluminum trays, and

X1.4.1.7 Ruler and fine-tip permanent ink marker.

X1.4.2 *Materials Required for Preparation of the Reinforced Joint*:

X1.4.2.1 Joint tape roll (of required tape or style),

X1.4.2.2 Two 20 in. by 1 in. by 0.030 in. [500 mm by 25 mm by 0.76 mm] thick stainless steel spacers,

X1.4.2.3 Two 20 in. by 1 in. by 0.045 in. [500 mm by 25 mm by 1.14 mm] thick stainless steel spacers,

X1.4.2.4 Two 20 in. by 1 in. by 0.055 in. [500 mm by 25 mm by 1.40 mm] thick stainless steel spacers,

X1.4.2.5 Six in. [150 mm] finishing trowel,

X1.4.2.6 Two 4 in. [100 mm] putty knife,

X1.4.2.7 Ruler,

X1.4.2.8 Fine-tip permanent ink marker,

X1.4.2.9 Joint compound, ready-mix or powder prepared in accordance with Test Methods C 474,

X1.4.2.10 One in. [25 mm] masking tape,

X1.4.2.11 Razor knife,

X1.4.2.12 Sanding block with 320-grit sandpaper,

X1.4.2.13 High-purity air-drying conductive silver paint, and

X1.4.2.14 Test circuit: 9 V battery, light-emitting diode, 27 KΩ resistor, wires, and breadboard.

X1.4.3 *Tensile Test Machine*:

X1.4.3.1 A tensiometer, universal test machine, or other suitable device capable of being operated at test speeds of 0.04 in. per min [1.0 mm per min] and 0.4 in. per min [10.0 mm per min].

X1.4.3.2 *Load Cell*—Installed in the load train of the test machine. It shall have a capacity such that the crack and peak values fall within 20 % to 80 % of its stated capacity.

X1.4.3.3 *Specimen Tensile Jaws/Grips*—Installed in the tensiometer. They shall be as illustrated in Fig. X1.1 and Fig. X1.2, or a similar device capable of isolating the joint face along the center line of the apparatus.

NOTE X1.1—Alternately, if the special "eccentric" grips are not available, conventional grips that open greater than 1 in. [25 mm] can be used, provided that ½ in. [13 mm] spacers are used to isolate the joint face along the center line.

X1.4.3.4 *Data Acquisition*—The load-versus-extension data shall be acquired by mechanical or electronic means. The data may be captured electronically by data acquisition equipment or mechanically with a chart recorder, either X-Y or strip chart styles. If using a mechanical method, ensure that the plotting parameters (that is, load range and proportion) are such that the maximum load falls between 30 % and 90 % of the chart paper range.

X1.4.4 Eighteen 6 in. [150 mm] wide prepared joints.

X1.5 *Preparation of the Substrate:*

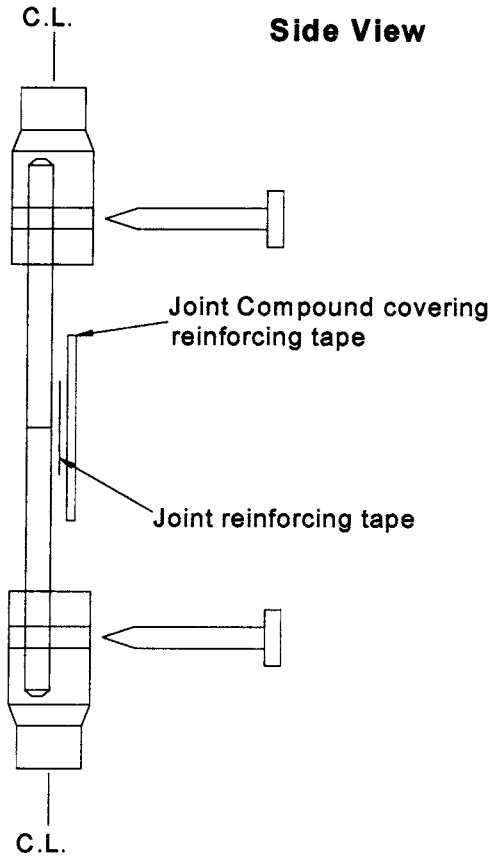

FIG. X1.1 Side View of Test Specimen and Tensile Jaw/Grips

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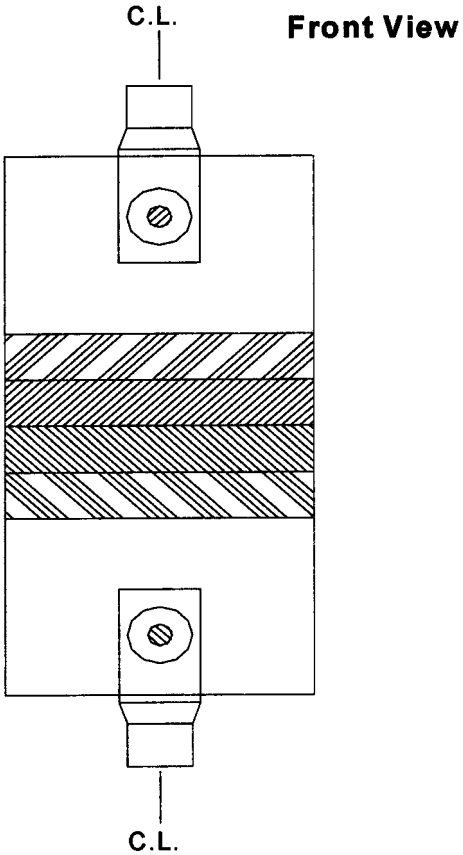

FIG. X1.2 Front View of Test Specimen and Tensile Jaw/Grips

X1.5.1 Sand one surface of high-density polyethylene plastic sheets with the orbital sander loaded with 60-grit sandpaper. Use average pressure and a circular motion to abrade the surface so that the shiny look of the unsanded plastic is completely gone.

X1.5.2 Cut plastic sheets into 6 ¼ in. by 6 ¼ in. [160 mm by 160 mm] pieces. Thirty-six pieces are required for one joint set of 18 samples.

X1.5.3 Set router guide to 6 ⅛ in. [155 mm] and pass each sample through, smoothing one edge of each piece. Send each piece through again, only smoothing the edge perpendicular to the one done previously.

X1.5.4 Set router guide to 6 in. [150 mm] and repeat previous step, but smooth the two remaining unfinished edges.

X1.5.5 Resand the surface of each finished piece to get rid of irregularities caused by cutting and smoothing.

X1.5.6 On each piece, drill a ½ in. [12.7 mm] hole 5 in. [125 mm] from the bottom edge, and 3 in. [75 mm] from either side edge. Also, place an index mark using a fine marker on either side of each piece, 2 in. [50 mm] from the sanded edge. See Fig. X1.3.

X1.6 *Preparation of the Joint Set:*

X1.6.1 Match up the substrate pieces by twos, with sanded faces down. Push one piece to the other and tape the joint tightly using masking tape. Repeat this with remaining 17 pairs.

X1.6.2 Trim excess tape and set three taped pairs on each aluminum tray, with sanded faces up. Maneuver the samples to ensure the joints are aligned. Place a stirp of masking tape across either side of the samples (parallel to the joint), covering the drill holes and securing one sample to another.

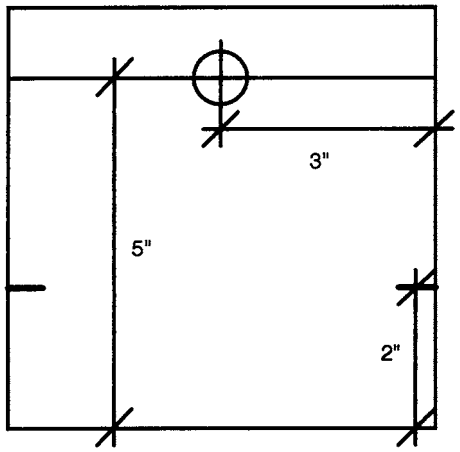

FIG. X1.3 Placement of Drill Hole in Plastic Substrate

X1.6.3 *Applying Glass Mesh Tape and First Coat*:

X1.6.3.1 Apply glass mesh tape centered on joint across the three samples on each tray, and press onto the substrate firmly, ensuring a flat, even adhesion. Trim excess tape.

X1.6.3.2 Set the 0.030 in. [0.76 mm] spacers on the 2 in. [50 mm] marks on either side of the joint. Apply compound to the joint, working it through the tape. Apply more compound, using the guides to estimate when enough compound has been used.

X1.6.3.3 Lightly wet one edge of the trowel. Set the trowel at a 45° angle to the surface of the samples, and smooth along the spacers in two even strokes. Remove any excess compound on the trowel and do one more pass with the trowel set at a 90° angle to the surface of the samples, to finish.

X1.6.3.4 Remove the spacers and any excess compound on the samples. Let samples dry overnight.

X1.6.3.5 Repeat steps for the remaining trays.

X1.6.4 *Applying Paper Tape and First Coat*:

X1.6.4.1 Set the 0.055 in. [1.4 mm] spacers on the 2 in. [100 mm] marks on either side of the joint. Apply general purpose compound to the joint, using the guides to estimate when enough compound has been used.

X1.6.4.2 Lightly wet one edge of the trowel. Set the trowel on a 45° angle to the surface of the samples, and smooth along the spacers in two even strokes. Remove any excess compound on the trowel and make one more pass with the trowel set at a 90° angle to the surface of the samples.

X1.6.4.3 Cut a length of selected paper tape slightly longer than the samples on the tray, and gently place the paper tape centered on the joint.

X1.6.4.4 Change spacers to the 0.030 in. [0.76 mm] spacers. Apply a small amount of compound to the working edge of the trowel and work the tape into the compound with the trowel at 45° as in X1.6.4.2, but use no water. This step ensures that the tape is at a level of 0.030 in. above the substrate.

X1.6.4.5 Repeat steps for the remaining trays.

X1.6.5 *Applying Second Coat*:

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X1.6.5.1 Second coat is to be applied on the day following the application of the first coat (that is, allow a 24-h cure for the first coat).

X1.6.5.2 Set the 0.045 in. [1.14 mm] spacers on either side of the joint. Apply compound to the joint, using the guides to estimate when enough compound has been used.

X1.6.5.3 Lightly wet one edge of the trowel. Set the trowel at a 45° angle to the surface of the samples, and smooth along the spacers in two even strokes. Remove any excess compound on the trowel and do one more pass with the trowel set at a 90° angle to the surface of the samples.

X1.6.6 *Applying Conductive Paint*:

X1.6.6.1 Lightly sand the joint surface with a 320-grit sanding block to smooth out any superficial irregularities.

X1.6.6.2 Apply conductive paint no sooner than one day after the application of the second coat (that is, allow a minimum 24-h cure for the second coat) and no later than 24 h before tensile testing.

X1.6.6.3 Using a razor knife, score the compound between the samples to separate them from one another. Also, trim any excess compound from the ends of each sample to ensure a 6 in. [150 mm] joint length.

X1.6.6.4 Shake the bottle of silver conductive paint to ensure uniform consistency. Draw a trace in conductive paint over the test area as shown in Fig. X1.4. Extend the trace at least 0.4 in. [10 mm] from the centerline, and have a spacing of 0.4 in. [10 mm]. The thickness of the trace should not exceed 0.08 in. [2 mm]. At each end of the trace, paint an excess amount as a "pad" for attaching the circuit.

X1.6.7 *Test Circuit*:

X1.6.7.1 Connect the battery, LED, and resistor in series, leaving two long wires to attach to the test trace "pads" (see Fig. X1.5). The resistor is included to save battery life, and the resistance may be reduced if a brighter light is desired.

X1.6.8 *Curing Time*:

X1.6.8.1 Cure prepared samples for six days following the application of the second coat in a room or cabinet at a temperature of 70 ± 3.5 °F [21 ± 2 °C] and relative humidity of 50 ± 2 %. The total time from sample preparation and curing to testing is seven days.

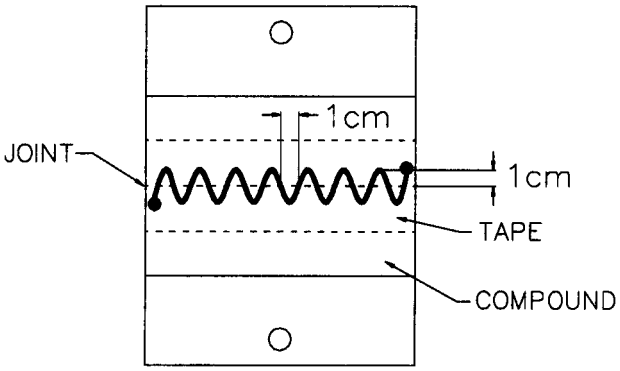

FIG. X1.4 Conductive Paint Trace

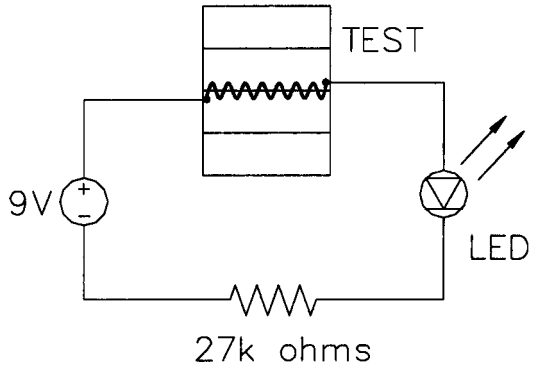

FIG. X1.5 Test Circuit Schematic

X1.7 *Tensile Testing:*

X1.7.1 Use extreme care while handling the samples, as cracking at the joint may occur, rendering the sample invalid.

X1.7.2 Use the tensiometer with a load cell having limits such that the crack and peak values fall within 20 % to 80 % of its capacity. Use plotting parameters (that is, load range and proportion) to ensure that the maximum load falls between 30 % and 90 % of the chart paper range. Set the speed of testing to 0.04 in. per min [1.0 mm per min] until first visible crack, then 0.4 in. per min [10 mm per min] until joint failure occurs.

X1.7.3 Load a sample by placing the pins in the loading apparatus through the drilled holes in the sample. Connect the trace into the circuit by taping the free wires to each end of the conductive paint line. This completes the circuit, illuminating the LED. Place a 10 lbf [50 N] preload on the sample by jogging the crosshead up slightly.

X1.7.4 Start the machine at 0.04 in. per min [1 mm per min] and note first crack at circuit failure when the LED deactivates. Increase the speed to 0.4 in. per min [10 mm per min] until failure of the joint occurs. Repeat these steps until all samples have been tested.

X1.8 *Report:*

X1.8.1 In all reports, a description of the preparation, conditioning, and testing conditions is necessary.

X1.8.2 Set up all data in a tabular format. Include the following information in the table, along with the corresponding standard deviation values:

X1.8.2.1 Force at first cracking (at circuit failure) in pounds-force (Newtons),

X1.8.2.2 Extension at first cracking (at circuit failure) in inches (millimeters),

X1.8.2.3 Force at peak load in pounds-force (Newtons), and

X1.8.2.4 Extension at peak load in inches (millimeters).

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SUMMARY OF CHANGES

Committee C11 has identified the location of selected changes to this test method since the last issue, C 474 – 02, that may impact the use of this test method. (Approved January 1, 2005)

(*1*) Section 15, which contained test methods specifically applicable to glass-mesh tape, has been moved and renumbered as Section 13. No content was changed.

(*2*) The title of the sections applicable to assemblages of tape has been renamed to ASSEMBLAGES OF JOINT TAPE AND JOINT COMPOUND to indicate that there are some test methods applicable to paper and glass-mesh joint tapes.

(*3*) Section 14, which contained a test method to evaluate Cracking of Joint Compound at Tape Edges, has been moved so that it immediately follows the heading referenced in item change (*2*). Instructions that contain the word "paper" as a modifier for joint tape were changed to have the word "paper" removed to indicate that the method is applicable to paper and glass-mesh joint tape.

(*4*) The information formerly in Section 13 has been moved to Section 15. The word "paper" in the section title indicates that it is applicable only to paper joint tape.

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