Standard Test Method for Concentration of Pinhole Detections in Moisture Barriers on Metal Jacketing[1]

1. Scope

1.1 This test method covers the determination of the concentration of pinhole detections in a moisture barrier film or coating that is applied to the interior surface of metal jacketing.

1.2 Since this method relies on the completion through the metal jacketing of an electrical circuit, this method is only applicable to jacketing that is electrically conductive and has a moisture barrier applied which is not electrically conductive.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

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

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C168 Terminology Relating to Thermal Insulation

C1729 Specification for Aluminum Jacketing for Insulation

C1767 Specification for Stainless Steel Jacketing for Insulation

3. Terminology

3.1 *Definitions*—Definitions in Terminology C168 apply to terms used in this specification.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *continuous pinhole detection*—while the test is being conducted, a continuous sounding of the audible test equipment alarm over an area larger than the contact area of the cellulose sponge.

3.2.1.1 *Discussion*—In some cases, large portions of one or more of the test areas (see 8.2.1) or even all of one or more test areas will yield a continuous pinhole detection. This concept of a continuous pinhole detection and the area yielding this performance is necessary to quantify the number of pinhole detections in a sample exhibiting this phenomenon (see 9.2 and 9.3)

3.2.2 *moisture barrier (moisture retarder)*—a layer of plastic film or other material applied to the inner side of metal jacketing to inhibit jacket corrosion by interfering with the formation of a galvanic cell between the dissimilar metals of the pipe and jacket or by preventing crevice or pitting corrosion.

3.2.3 *pinhole*—a hole completely through a moisture barrier typically too small to be seen by the eye.

3.2.4 *pinhole detection*—a single sounding of the audible test equipment alarm while the test is being conducted.

3.2.4.1 *Discussion*—Because pinholes are very small and the dampened cellulose sponge contacts the moisture barrier in an area larger than a single pinhole (see 6.4), it is theoretically possible that multiple pinholes in close proximity to each other would register as a single detection. For this reason, this test method measures the concentration of pinhole detections rather than pinholes.

3.2.5 *holiday*—synonymous with pinhole.

4. Summary of Test Method

4.1 A voltage is applied across the nonconductive moisture barrier on metal jacketing using an electrode consisting of a cellulose sponge dampened with an electrically conductive liquid such as tap water. Holes in the moisture barrier lead to completion of an electrical circuit which triggers an audible alarm in the test equipment. The number of pinhole detections collectively in ten specified test areas is determined and reported.

---

[1] This test method is under the jurisdiction of ASTM Committee C16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.33 on Insulation Finishes and Moisture.

Current edition approved Sept. 1, 2016. Published September 2016. Originally approved in 2013. Last previous edition approved in 2016 as C1785 – 16. DOI: 10.1520/C1785-16A.

[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.

5. Significance and Use

5.1 Corrosion on the interior surface of metal jacketing can be caused by the formation of a galvanic cell between the dissimilar metals of the pipe and jacket or by crevice or pitting corrosion.

5.2 The application of a moisture barrier to the interior surface of the metal jacketing inhibits this corrosion by interfering with the galvanic cell formation or by preventing water from contacting the interior metal surface.

5.3 Holes in the moisture barrier decrease its effectiveness in preventing corrosion. Large holes, scratches, or tears in the moisture barrier visible to the naked eye are easily discerned and are cause for rejection of the metal jacketing.

5.4 Small holes called pinholes or holidays that are not visible to the naked eye but are large enough to allow corrosion are a significant concern and should be avoided to the extent possible.

5.5 This test method is used to quantify the concentration of pinhole detections present in a moisture barrier for the purpose of quality control on metal jacketing with an applied moisture barrier.

5.6 Examples of standards which have specific requirements for the maximum allowable concentration of pinhole detections in the moisture barrier are Specifications C1729 and C1767.

6. Apparatus

6.1 Test equipment shall be a pinhole or holiday detector with an output voltage of 65 to 75 volts DC that emits an audible signal when a connection between the two leads is detected.

NOTE 1—These instruments can be found by performing a web search for "wet sponge pinhole detector" or "wet sponge holiday detector".

6.2 One lead of the pinhole detector shall have a spring tensioned metal clamp capable of being attached to the metal jacketing.

6.3 The other lead of the pinhole detector shall have a metal clamp capable of securing a cellulose sponge.

6.4 The cellulose sponge clamped to the pinhole detector lead shall have a size capable of touching the moisture barrier of 2 ± 1⁄16 by 2 ± 1⁄16 in. (50.8 ± 1.6 by 50.8 ± 1.6 mm).

6.5 Test equipment shall have its test voltage and operability validated on a regular basis.

7. Test Specimens

7.1 Specimens tested are metal jacketing rolls or metal jacketing sheets.

7.2 Any width that can be conveniently placed on a table can be tested but the typical width of metal jacketing is 3 ft (0.91 m) or, rarely, 4 ft (1.22 m).

7.3 For rolls, a length of 30 ft (9.1 m) is required.

7.4 For sheets, test as many sheets at a time as will fit on the approximately 30 ft (9.1 m) long testing surface.

8. Procedure

8.1 *Sample Preparation:*

8.1.1 Place specimen(s) on a reasonably flat, level, and clean surface with the moisture barrier facing up.

8.1.2 If necessary, secure the jacketing to the test surface so that it is reasonably flat and does not curl up during testing. This can be done with weights or with clamps. Assure that the securement method does not scratch or damage the moisture barrier.

8.1.3 The moisture barrier must not come in contact with dirt or grit, for example, by walking on the surface, as this is likely to cause damage to the moisture barrier.

8.2 *Test Area Selection:*

8.2.1 For roll jacketing, select about 4.8 to 5.2 ft^2 (0.45 to 0.48 m^2) in each of ten successive 3 lineal ft (0.91 m) long sections of the test specimen. This yields 10 approximately evenly spaced and evenly sized test areas.

8.2.2 For sheet jacketing, select one or more 4.8 to 5.2 ft^2 (0.45 to 0.48 m^2) sections per sheet. Test enough sheets to yield 10 approximately evenly spaced and evenly sized test areas.

NOTE 2—For both roll and sheet jacketing, a series of ten rectangular test areas of size 2 by 2.5 ft (610 by 762 mm) is recommended.

8.3 *Normal Testing Procedure:*

8.3.1 Wet a test area with an electrolyte such as tap water without allowing a wet connection to form between the wetted areas and any bare metal edge of the jacketing. Do not flood the moisture barrier surface with electrolyte.

8.3.2 Water tends to run freely on the surface of painted and plastic film moisture barriers so special care must be taken to prevent contact of the electrolyte with the bare metal edges when testing these types.

8.3.3 Allow 5 min after wetting for the water to permeate the moisture barrier.

8.3.4 Test for pinhole detections between five and ten minutes after initial wetting.

8.3.5 Attach one lead of the pinhole tester to bare metal on the jacketing piece being tested.

8.3.6 Wet the cellulose sponge attached to the other lead and move this sponge over the test area such that all portions of the test area are tested once. The presence of one or more pinholes in the area covered by the sponge allows the completion of an electrical circuit which will be signaled by the test equipment as an audible alarm.

8.3.7 During the test, note the number of discrete soundings of the audible alarm in the test area.

8.3.8 If one or more portions of the test area yield a continuous pinhole detection (see 3.2.1), mark these areas.

8.3.8.1 Determine the size of the marked continuous pinhole detection areas in inches squared (millimeters squared) and note this value.

8.3.9 Repeat steps 8.3.1 through 8.3.8 for each of the remaining nine test areas.

8.4 *Alternative Testing Procedure:*

NOTE 3—This alternative testing procedure is more time-consuming during sample preparation but is useful on those specimens where there are many irregularly shaped relatively small areas of continuous pinhole detection. See X1.2.4 for further information.

8.4.1 Outline a rectangular 4.8 to 5.2 ft^2 (0.45 to 0.48 m^2) test area with a permanent marker. An area of size 2 by 2.5 ft (610 by 762 mm) is recommended.

8.4.2 Using a permanent marker, draw a series of lines 2 in. (51 mm) apart roughly parallel to both sides of the rectangular test area identified and marked per 8.4.1. This will yield 180 marked boxes of size 4 $in.^2$ (2581 mm^2). The left drawing in Fig. 1 shows an example of a test area marked in the manner described in 8.4.1 and 8.4.2. Note that the size of each marked box is about the same as the size of the sponge specified in 6.4.

8.4.3 Wet the test area with an electrolyte such as tap water without allowing a wet connection to form between the wetted areas and any bare metal edge of the jacketing. Do not flood the moisture barrier surface with electrolyte.

8.4.4 Water tends to run freely on the surface of painted and plastic film moisture barriers so special care must be taken to prevent contact of the electrolyte with the bare metal edges when testing these types.

8.4.5 Allow 5 min after wetting for the water to permeate the moisture barrier.

8.4.6 Test for pinhole detections between five and ten minutes after initial wetting.

8.4.7 Attach one lead of the pinhole tester to bare metal on the jacketing piece being tested.

8.4.8 Wet the cellulose sponge attached to the other lead and touch this sponge with light pressure to each of the 180 squares marked in the test area (see 8.4.2). The presence of one or more pinholes in the area covered by the sponge allows the completion of an electrical circuit which will be signaled by the test equipment as an audible alarm.

8.4.9 During the testing of the 180 squares in the test area, count the number of discreet soundings of the audible alarm in the test area and note this number. This technique differs from that in 8.3.6 because each of the 180 marked squares in the test area is tested individually rather than moving the sponge over the entire test area.

NOTE 4—If the number of squares exhibiting a pinhole detection is large, it is easier to mark each square in which a pinhole detection occurs and then later count the number of marked squares. A grease pencil is recommended for this since a permanent marker will not work because the surface of the moisture barrier is wet.

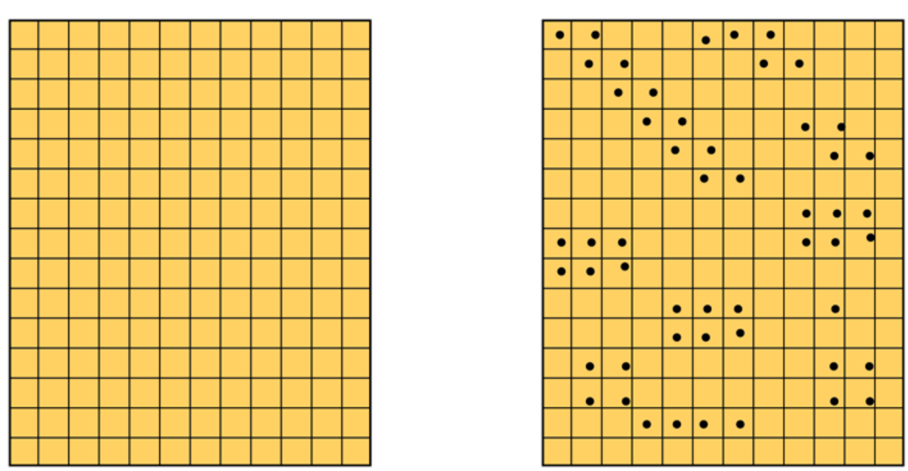
8.4.10 Repeat steps 8.4.1 – 8.4.9 for each of the remaining nine test areas.

9. Calculations

9.1 Sum the number of discrete pinhole detections in each of the ten test areas to yield a total number of pinhole detections collectively in all ten test areas. Call this sum P1.

9.2 Sum the sizes of the marked continuous pinhole detection areas from 8.3.8.1. Call this sum A1.

9.2.1 Divide area A1 in inches squared (millimeters squared) by the contact area of the sponge in inches squared



2 ft × 2.5 ft (610 mm × 762 mm) test area marked off into 180 squares of 2 in. × 2 in. (51 mm × 51 mm) size
- Each square is tested for a pinhole detection and, optionally, marked with a grease pencil if present
- Total number of pinhole detections (marked squares) is counted and recorded for each of the ten test areas.
- Number of pinhole detections reported for a sample is the sum of the number recorded for each of the ten test areas

In the above hypothetical example, there were 52 pinhole detections in the 180 squares. These were arranged in a manner such that the multiple areas of pinhole detection were NOT contiguous and, hence, could not be easily marked and their areas determined. This would be repeated for the other nine test areas and the total number of pinhole detections in all ten test areas would be reported

FIG. 1 Example of Marking and Pinhole Detections Using the Alternative Testing Procedure in 8.4

(millimeters squared). See 6.4. The result is the number of pinhole detections assigned to the continuous pinhole detection areas. Call this P2.

9.3 Sum P1 and P2 to yield the total number of pinhole detections collectively in all ten test areas. Call this amount P3.

10. Report

10.1 Report the following information:

10.1.1 Identification of the material tested including type of metal jacketing and type of moisture barrier.

10.1.2 Date of testing.

10.1.3 Concentration of pinhole detections as the total number of pinhole detections (value P3 from section 9.3) per 50 ft^2 (4.65 m^2).

11. Precision and Bias

11.1 *Precision*—The precision information (repeatability and reproducibility) of this test method will be determined via an inter-laboratory study once it is approved and will be available on or before December 1, 2014.

11.2 *Bias*—No information can be presented on the bias of the procedure in this test method for measuring the concentration of pinhole detections in moisture barriers on metal jacketing because no material having an accepted reference value is available.

12. Keywords

12.1 cladding; holiday; jacket; jacketing; lagging; moisture barrier; moisture retarder; pinhole; pinhole detections; thermal insulation

APPENDIX

(Nonmandatory Information)

X1. DESCRIPTIONS OF PATTERNS IN PINHOLE DETECTIONS ENCOUNTERED AND RECOMMENDED TEST PROTOCOLS FOR EACH PATTERN

X1.1 Background

X1.1.1 In past testing of pinhole detections using Test Method C1785 including testing done in an attempted interlaboratory study, various types of patterns in pinhole detections were observed. It was found that certain test protocols were more effective and efficient in measuring the number of pinhole detections for the various patterns observed.

X1.2 Patterns in Pinhole Detections

X1.2.1 There are three types of patterns to the pinhole detections that have been observed in past testing.

X1.2.2 A relatively small number of discreet pinhole detections. These are easily counted as the test sponge is moved over the test area such that all portions of the test area are tested once. The key to this pattern is not the number of pinhole

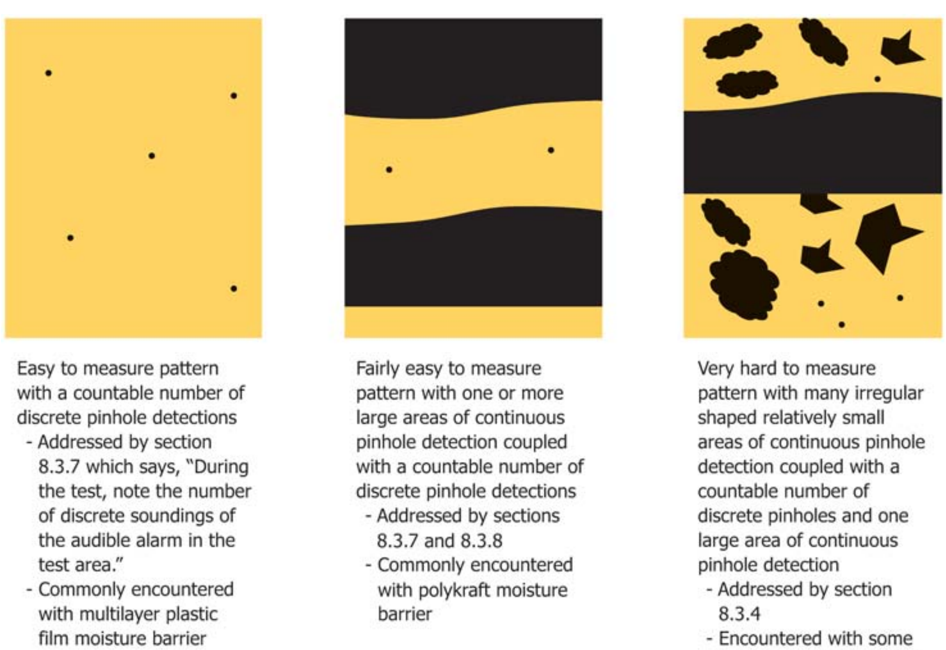


FIG. X1.1 The Three Patterns of Pinhole Detections

detections but, rather, that they are discreet and countable with a clear separation between the incidents of pinhole detection. The left drawing in Fig. X1.1 shows an example of this pattern with five discreet pinhole detections shown as black dots but there could be fewer or more discreet pinhole detections and the sample would still fall into this pattern. This pattern is commonly encountered with multilayer plastic film moisture barrier. This pattern is easily measured using the technique described in 8.3.7.

X1.2.3 A very large portion of a test area consists of one or more areas exhibiting continuous pinhole detection coupled with some or no discreet pinhole detections in the areas not exhibiting continuous pinhole detection. The center drawing in Fig. X1.1 shows an example of this pattern with two large areas of continuous pinhole detection shown in black coupled with two discreet pinhole detections shown as black dots but there could be fewer or more discreet pinhole detections and the sample would still fall into this pattern. A commonly encountered situation with polykraft type moisture barrier applied to stucco embossed jacketing where this pattern occurs is where most of the test area exhibits continuous pinhole detection and there are only a small number of small areas which do not exhibit continuous pinhole detection. This pattern is measured using the techniques described in 8.3.7 and 8.3.8.

X1.2.4 Many irregularly shaped relatively small areas of continuous pinhole detection coupled with optional presence of large areas of continuous pinhole detection and optional presence of discreet pinhole detections. The right drawing in Fig. X1.1 shows an example of this pattern with many irregularly shaped relatively small areas of continuous pinhole detection shown in black, one large area across the middle of the sample exhibiting continuous pinhole detection shown in black, and four discreet pinhole detections shown as black dots but there could be fewer or more pinhole detections and the sample would still fall into this pattern. This is the most difficult pattern in which to quantify the area of the sample exhibiting continuous pinhole detection due to the large number and irregular shape of the smaller areas of continuous pinhole detection. Marking the outlines of these areas and determining their area is difficult. This pattern has been encountered in some samples with a painted moisture barrier. The difficulty in measuring the concentration of pinhole detections in samples exhibiting this pattern can be eliminated using the techniques described in 8.4.

X1.2.4.1 There is no specific point at which a sample is more easily measured using the technique in 8.4 instead of 8.3.7 and 8.3.8. Both techniques will yield proper measurements. The user of this method must determine for themselves which technique is preferable for a given sample or test area. The technique in 8.4 takes more time in advance of actual measuring to draw all of the necessary lines on the sample but may be faster and easier in determining the areas of constant pinhole detection when there are many irregularly shaped relatively small areas of continuous pinhole detection.