SECOND DRAFT OF THE PROPOSED STANDARD TEST METHODS FOR THE EVALUATION OF DETECTABLE WARNINGS AND DIRECTIONAL SURFACES

Prepared by Underwriters Laboratories Inc. for the California Division of the State Architect's Evaluation of Detectable Warnings Advisory Committee

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INTRODUCTION

1 Scope

1.1 These requirements cover Detectable Warnings and Directional Surfaces intended for installation in accordance with The California Code of Regulations, Title 24, Parts 1 and 12.

2 Units of Measurement

2.1 When a value for measurement as given in these requirements for detectable warnings and directional surfaces is followed by an equivalent value in other units, in parentheses, the second value may be only approximate. The first stated value is the requirement.

3 References

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

3.2 Appendix A contains a list of ASTM and ISO test procedures referenced in these requirements for detectable warnings and directional surfaces.

4 Definitions

4.1 For the purpose of the requirements in this document, the following definitions apply.

4.2 ACOUSTIC QUALITY is the sound characteristics of the material, when impacted by an object.

4.3 ATTACHMENT is the ability of a material to maintain a durable mechanical bond with a substrate when installed in accordance with manufacturers' installation instructions.

4.4 COLOR FASTNESS is the ability of the material or coating to retain its original color without significant fading or changing when exposed to environmental conditions.

4.5 CONFIRMATION, see Conformation.

4.6 CONFORMATION is the process of confirming that the detectable warning/directional surface meets dimensional specifications of the truncated domes and raised bars as specified in the California Building Code, California Code

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of Regulations, Title 24, Part 2 and the California Referenced Standards Code, California Code of Regulations, Title 24, Part 12.

4.7 DETECTABLE WARNING is a standardized surface or feature, consisting of truncated domes and the field surface between and surrounding the truncated domes, that is built into or applied to walking surfaces or other elements to warn visually impaired persons of hazards in the path or travel.

4.8 DIRECTIONAL SURFACE is a standardized surface or feature, consisting of raised bars and the field surface between and surrounding the raised bars, that is built into or applied to walking surfaces to guide visually impaired persons along the path or travel.

4.9 RESILIENCE is the capacity of a material to absorb energy when it is deformed elastically (subjected to physical force) and then upon unloading to have this energy recovered.

4.10 SHAPE is the ability of the detectable warning/directional surface material, and in particular the surface features (truncated domes and raised bars) of the material, to retain its original shape when subjected to varying degrees of temperature, moisture, pressure, or other stress.

CONSTRUCTION

5 General

[NOTE to EDWAC – This section will contain or reference dimensional requirements from the California Building Code, California Code of Regulations, Title 24, Part 2 and the California Referenced Standards Code, California Code of Regulations, Title 24, Part 12. The evaluation of a Detectable Warning/Directional Surface will require adherence to these specifications before and after all Performance Tests.]

PERFORMANCE

TEST PREPARATION

6 General

6.1 Selection of samples and test specimens

6.1.1 Samples shall be obtained from the products to be tested, taken at random when possible, and in such case shall be taken in accordance with the requirements for the particular material.

6.2 Preparation of specimens

6.2.1 When it is necessary to machine specimens, the work is to be done in accordance with the manufacturer's recommended technique for the material involved. Tools are to be kept sharp and used so that the possibility of overheating is minimized. Machined surfaces of specimens are to be finished (use No. 3/0 abrasive paper or equivalent material) to eliminate all irregularities, such as tool marks, where such finishing results in a more perfect surface than can be obtained by machining alone. Where a more perfect finish is desired, a polishing compound is to be used. For mechanical test specimens, the direction of cutting and finishing is to be at right angles to the expected line of fracture whenever possible.

6.3 Thickness and directional properties

6.3.1 The properties of plastics may vary with thickness and with orientation of the material. Therefore, when preparing specimens, consideration is to be given to the testing of specimens that are representative of both the thickest and the thinnest sections of the product, and where mechanical tests are involved, the testing of specimens that have been cut lengthwise, crosswise, and also normal to the surface of the material.

6.4 Treatment prior to test

6.4.1 Samples and specimens for tests are not to be heated, immersed in water, or subjected to any mechanical or chemical treatment prior to test except as specifically described in the individual test method.

6.5 Testing conditions

6.5.1 Unless otherwise specified in the individual test method, the standard atmospheric conditions surrounding the specimen prior to and during the test are to be between 15°C and 35°C (59°F and 95°F), and between 45 percent and 75 percent relative humidity.

6.6 Testing for temperature effects

6.6.1 When the relation of properties to temperature is to be determined, tests shall be performed at one or more of the following standard atmospheric temperatures: minus 55°C (minus 67°F), minus 40°C (minus 40°F), minus 35°C (minus 28°F), 0°C (32°F), 50°C (122°F), 70°C (158°F), and 77.0°C (170.6°F). In all cases, specimens

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are to be conditioned at the testing temperature and humidity for at least 24 hours immediately prior to test, unless otherwise specified in the individual test method.

6.6.2 The temperature, the relative humidity, and the period of time for conditioning are to be recorded.

6.7 Test apparatus

6.7.1 Unless otherwise specified in the individual test method, properties shall be determined in any standard type of testing machine that is calibrated and accurate to 1 percent in the range used.

6.8 Tests results

6.8.1 Unless otherwise specified in the individual test method, the average of the results for the specimens tested are to be used to determine conformance of materials tested under these requirements for detectable warnings and directional surfaces.

6.8.2 Unless otherwise specified in the individual test method, the test results of specimens that reveal a break at an obvious flaw or that do not break between the predetermined bench marks, are to be discarded. Additional specimens are to be tested in place of the specimens with discarded test results.

6.8.3 Unless otherwise specified in the individual test method, results that deviate from the mean value of all tests are to be rejected if the deviation of the doubtful value is more than three times the standard deviation from the mean obtained by including the doubtful value. Additional specimens are to be tested in place of the specimens with discarded test results.

TEST CONDITIONS

7 General

7.1 Detectable Warning Surfaces/Directional Surfaces exposed to the applicable conditions as described in XX – XX shall show performance as given in Table 7.1.

Table 7.1
Tests for the Evaluation of Detectable Warnings/Directional Surfaces

Test	Requirement
a) Abrasion Resistance – See Section 9.	The critical dimensions of the Detectable Warning/Directional Surface shall not be changed by more than 10 percent.
b) Impact Resistance – See Section 10.	Impact resistance shall not be reduced by more than 10 percent from the "as received" value as a result of aging. In addition, no sample shall exhibit a mean failure energy less than X J (Y ft-lbf).
c) Cold Impact – See Section 11	Samples subjected to cold impact shall withstand an impact of X J (Y ft-lbf) without cracking or separating from the substrate.
d) Water Absorption – See Section 12.	Dimensions shall not change by more than 10 percent, mass shall not increase by more than 10 percent, and the specimen shall show no signs of warping or cracking as a result of the exposure.
e) Ball Pressure – See Section 13	Polymeric materials shall comply with the ball pressure test at 75°C in the as received condition
f) Coefficient of Restitution – See Section14.	Material shall maintain at least 90 percent of it's coefficient of restitution following conditioning.
g) Bond Strength – See Section 15.	Minimum average bond strength shall be 90 percent of the "as received" value, with no value below X.

Table 7.1
Tests for the Evaluation of Detectable Warnings/Directional Surfaces
(Continued)

Test	Requirement
h) 60° Load Test – See Section 16	Material shall not fail mechanically when placed under stress
i) Color Fastness – See Section 17.	ΔE_{ab}(calculated color difference) between as received and conditioned samples shall be less than 10 (15?) CIELAB units.
j) Acoustic Quality – See Section 18.	Sound spectrograph shall remain easily distinguishable over the audible range from standard concrete and asphalt sound spectrographs following conditioning.
k) Slip Resistance – See Section 19	Material shall demonstrate a coefficient of friction of not less than 0.6 in the wet condition
l) Flammability – See Section 20	Material shall maintain a flame spread

8 Environmental Conditioning

8.1 General

8.1.1 All Detectable Warning/Directional Surfaces are to be subjected to a combination of conditions and test methods as specified in Table 8.1

Table 8.1
Exposure conditions for detectable warning/directional surfaces

Exposure conditions	Tests Required
a) 48 hours in a standard atmosphere	(a) (b) (c) (d) (e) (f) (g) (h) (i) (k) (l)
b) Freeze-Thaw Cycling – See 8.2.	(a) (b) (f) (g) (h) (i) (j)
c) Salt Spray Exposure – See 8.3.	(a) (b) (f) (g) (h) (i) (j)
d) Chemical Resistance – See 8.4.	(a) (b) (d) (f) (g) (h) (i) (j)
e) Accelerated Weathering – See 8.5	(a) (b) (d) (f) (g) (h) (i) (j)
a. Abrasion Resistance b. Impact Resistance c. Cold Impact d. Water Absorption e. Ball Pressure f. Coefficient of Restitution	g. Bond Strength h. 45° Attachment i. Color Fastness j. Accoustic Quality k. Slip Resistance l. Flammability

8.2 Freeze-thaw cycling

8.2.1 The exposure method for determination of the resistance to freezing and thawing of detectable warning/directional surfaces is to be as described in the Standard Test Method for Evaluating the Freeze-Thaw Durability of Manufactured Concrete Masonry Units and Related Concrete Units, ASTM C 1262.

8.2.2 This exposure method is intended to evaluate the freeze/thaw resistance of the detectable warning/directional surface.

8.2.3 The apparatus used shall be in accordance with ASTM C 1262.

8.2.4 The freeze thaw cycle is to be conducted 50 times. Prior to testing, the samples are to be conditioned at 48 hours at 23ºC ±2ºC, with a relative humidity of 50 ±5 percent.

8.3 Salt spray exposure

8.3.1 The exposure method for determining the resistance of detectable warning/directional surfaces to salts is described in the Standard Practice for Operating Salt Spray (Fog) Apparatus Salt Spray, ASTM B 117.

8.3.2 This exposure method is intended to evaluate the resistance of the detectable warning/directional surface to salts, which may be encountered in de-icing or coastal applications.

8.3.3 The apparatus used is to be accordance with ASTM B 117.

8.3.4 The duration of the salt fog exposure is to be 200 hours. Prior to testing, samples are to be conditioned at 48 hours at 23ºC ±2ºC, with a relative humidity of 50 ±5 percent.

8.4 Chemical resistance

8.4.1 The exposure method for determining the resistance of detectable warning/directional surfaces when exposed to chemical reagents, is described in the Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents, ASTM D 543.

8.4.2 This exposure method is intended to evaluate the resistance of the detectable warning/directional surface to chemicals, which may be encountered during service.

8.4.3 The apparatus shall be in accordance with ASTM D 543.

8.4.4 The duration of exposure shall be 24 hours. The following chemical reagents are to be used on all surfaces.

a) Hydrochloric acid (10 percent),

b) Ammonium hydroxide (10 percent),

c) Soap solution (1 percent pure white soap flakes in water), and

d) Turpentine.

e) Urea (5 percent)

f) Fuel, Diesel

8.4.5 The detectable warning/directional surface may be exposed to additional chemicals as deemed necessary depending on the conditions that the particular product may encounter in service.

8.4.6 Prior to testing, samples should be conditioned at 48 hours at 23ºC ±2ºC, with a relative humidity of 50 ±5 percent.

8.5 Accelerated Weathering

8.5.1 Specimens are to be exposed to ultraviolet light and water spray using a Xenon-arc in accordance with the Standard Practice for Exposing Nonmetallic Materials in Accelerated Test Devices That Use Laboratory Light Sources, ASTM G 151, and the Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Nonmetallic Materials, ASTM G 155. The spectral power distribution of the xenon lamp shall conform to the requirement in Table 1 in ASTM G 155 for a xenon lamp with daylight filters. A programmed cycle of 120 minutes consisting of a 102-minute light exposure and an 18-minute exposure to water spray with light shall be used. The apparatus is to operate with a spectral irradiance of 0.35 W/m^2 nm at 340 nm and black-panel temperature of 63 ±3°C (145 ±5°F).

8.5.2 This exposure method is intended to evaluate the resistance of the detectable warning/directional surface to ultraviolet radiation.

8.5.3 Materials intended for outdoor use are to be subjected to 3000 hours of xenon-arc ultraviolet light and water exposure.

8.5.4 Materials intended for indoor use are to be subjected to 1000 hours of xenon-arc ultraviolet light and water exposure.

8.5.5 Prior to testing, samples are to be conditioned for 48 hours at 23ºC ±2ºC, with a relative humidity of 50 ±5 percent.

TESTING FOR SHAPE

9 Abrasion Resistance

9.1 General

9.1.1 The test method for determination of abrasion resistance is to be as described in the Standard Test Method for Granule Adhesion to Mineral Surfaced Roofing by Abrasion, ANSI/ASTM D 4977 [a].

9.1.2 This method is intended to evaluate the abrasion resistance of the surface of the detectable warning/directional surface. The results of the test program can be used to determine how well the sample retains its shape over its useful service life.

9.2 Apparatus

9.2.1 A calibrated testing machine is to be used, in accordance with ASTM D 4977.

9.3 Specimens

9.3.1 Two samples approximately 50.8 by 229 mm (2 by 9 inches), including as least two truncated domes or directional bars, centrally located along the length of the specimen, are to be prepared. In the case of directional bars, the bars should be perpendicular to the major axis of the specimen.

9.4 Conditioning

9.4.1 One set of specimens is to be conditioned as in 8.2.

9.4.2 One set of specimens is to be conditioned as in 8.3.

9.4.3 One set of specimens is to be conditioned as in 8.4.

9.4.4 One set of specimens is to be conditioned as in 8.5.

9.4.5 One set of specimens is to be conditioned as specified in the Standard Test Method for Granule Adhesion to Mineral Surfaced Roofing by Abrasion, ASTM D 4977.

9.5 Procedure

9.5.1 The test method specified in ASTM D 4977 is to be used, with the exception of number of cycles and sample dimension measurement.

9.5.2 Samples are to be measured as follows for truncated domes, before and after testing:

a) Dome height,

b) Dome width at base,

c) Dome width at top of truncation,

d) Overall specimen thickness at base, and

e) Overall specimen thickness at dome center

9.5.3 Samples are to be measured as follows for directional surfaces before and after testing:

a) Bar height,

b) Bar width at base,

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c) Bar width at top of truncation,

d) Overall specimen thickness at base, and

e) Overall specimen thickness at bar center.

9.5.4 Samples shall be subject to 500 cycles (each cycle consisting of one stroke back and forth horizontally across the specimen). Measurements are to be made after every 100 cycles.

9.6 Calculations

9.6.1 The weight of displaced materials is to be calculated as follows:

Initial weight – Final weight = Weight of displaced material

(Initial – Final) / Initial = percent loss

9.6.2 The dimensional change of the samples is to be calculated as follows:

a) Initial dome/bar height – final dome/bar height = Change in dome/bar height

b) Initial dome/bar width at base – final dome/bar width at base = Change in dome/bar width

c) Initial dome/bar width at top – final dome/bar width at top = Change in dome/bar width at top

d) Initial overall specimen thickness at dome/bar center – Final overall thickness at dome/bar center = Change in overall thickness at dome/bar center

e) Initial overall thickness at base – Final overall thickness at base = Change in overall thickness at base.

9.6.3 Percentage change for each measurement (a) – (d) are to be calculated as follows:

(Initial Value – Final Value) / Initial Value = Percent Dimensional Change

9.7 Report

9.7.1 The report on each test is to include each of the following items:

a) Description of the material, including the type, source, manufacturer's code numbers, or equivalent identification method.

b) Type and dimensions of specimens.

c) Temperature, humidity, and length of conditioning period.

d) Cycle rate of test apparatus brush.

e) Downward force applied to specimen

f) Any further information or observations that might be considered pertinent.

g) A brief, identifying description of the testing apparatus.

10 Impact Resistance

10.1 General

10.1.1 The test method for determination of impact resistance is described in the Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimens by Means of a Striker Impacted Falling Weight, ASTM D 5420 [a].

10.1.2 The test method in ASTM D 5420 is intended to evaluate the impact resistance of the surface of the detectable warning/directional surface by measuring the energy required to break the specimens by impacting the specimen with a falling weight.

10.2 Apparatus

10.2.1 A calibrated test machine is to be used, in accordance with ASTM D 5420.

10.2.2 The striker shall conform to geometry "GE" as noted in the standard. The test apparatus support shall consist of a flat surface capable of supporting the test specimen.

10.3 Specimens

10.3.1 Samples measuring approximately 305 by 305 mm (12 by 12 inches) installed in a Portland cement substrate having a thickness of at least one inch, are to be utilized.

10.4 Conditioning

10.4.1 Three specimens are to be conditioned as in 8.2.

10.4.2 Three specimens are to be conditioned as in 8.3.

10.4.3 Three specimens are to be conditioned as in 8.4.

10.4.4 Three specimens are to be conditioned as in 8.5.

10.4.5 Twenty-six specimens are to be conditioned at 23 ± 2°C and 50 ± 5% relative humidity for not less than 40 hours prior to test.

10.5 Test Procedure

10.5.1 The twenty-six specimens noted in 10.4.5 are subjected to a test sequence whereby the mean failure height is determined (described in ASTM D 5420, Section 11). The first six specimens are used to determine an appropriate starting point of the test. If the approximate mean-failure height is known, testing of these six samples may be omitted.

10.5.2 The mean failure height shall be determined for both a high point of the specimen (top of truncated dome or directional bar) and a low point of the specimen (valley between truncated dome or directional bar). The same specimens may be tested for both determinations, so long as the targeted impact points are separated by at least 4 inches

10.5.3 The test method for the determination of the mean failure height and the mean failure energy is described in the Standard Test Method of Impact Resistance of Flat, Rigid Plastic Specimens by Means of a Striker Impacted Falling Weight, ASTM D 5420.

10.5.4 Once the mean failure height and mean failure energy have been determined for both the high and low points of the specimen, the drop height which will result in an impact energy of 90% of the mean failure energy is calculated for each.

10.5.5 The specimens noted in 10.4.1, 10.4.2, 10.4.3, and 10.4.4 are subjected to impact from the heights calculated in 10.5.4, then examined visually for failure.

10.6 Report

10.6.1 The report is to include each of the following:

a) Description of the material, including the type, source, manufacturer's code numbers, or equivalent identification code.

b) Type and dimensions of specimens, striker and strike plate.

c) Temperature, humidity, and length of conditioning period.

d) Calculated mean failure energy.

e) Number of specimens utilized to determine mean failure height.

f) Type(s) of failure observed for as received specimens

g) 90 percent mean failure energy and respective height

h) Types of failure for conditioned specimens

i) Any further information that might be considered pertinent, particularly with reference to unexpected behavior.

j) A brief, identifying description of the testing apparatus.

11 Cold Impact

11.1 This test method is intended to determine if a minimum impact strength is maintained when the specimens are evaluated at low temperatures.

11.2 Each of three samples of the detectable warning or directional surface, measuring approximately 305 by 305 mm (12 by 12 inches) and installed in a Portland cement substrate having a thickness of at least one inch, shall be cooled to a temperature of minus 35.0±2.0°C and maintained at that temperature for 3 hours.

11.3 While the specimen is still cold, within one minute of removal from the conditioning chamber, it is to be subjected to a 6.8 joule (5 ft-lb) impact, achieved by dropping a 50.8 mm (2 inch) diameter steel ball weighing 0.535 kg (1.18 lb) from a height of 1.3 meters (4.25 ft).

11.4 Each specimen is to be permitted to return to room temperature, then examined visually for cracks and/or separation from the substrate.

12 Water Absorption

12.1 General

12.1.1 The test method for determination of water absorption is described in the Standard Test Method for Water Absorption of Plastics, ASTM D 570.

12.1.2 The test method in ASTM D 570 is intended to evaluate the relative rate of absorption of water by materials when immersed in water. The dimensional change of the materials is also to be determined.

12.2 Apparatus

12.2.1 Apparatus includes those specified in ASTM D 570.

12.3 Specimens

12.3.1 Three samples, approximately 101.6 by 101.6 mm (4 by 4 inches) are to be utilized.

12.4 Conditioning

12.4.1 One set of specimens are to be conditioned as in 8.2.

12.4.2 One set of specimens are to be conditioned as in 8.3.

12.4.3 One set of specimens are to be conditioned as in 8.4.

12.4.4 One set of specimens are to be conditioned as in 8.5.

12.4.5 One set of specimens (the “As Received” set) are to be conditioned at 23 ± 2°C and 50 ± 5% relative humidity for not less than 40 hours.

12.5 Test Procedure

12.5.1 The samples are to be measured as follows for truncated domes, before and after testing:

a) Sample weight,

- b) Dome height,

c) Dome width at base,

d) Dome width at top of truncation,

e) Sample length and width,

a) f) Overall specimen thickness at base, and

g) Overall specimen thickness at dome center.

12.5.2 Samples are to be measured as follows for directional surfaces before and after testing:

a) Sample weight,

b) Bar height,

c) Bar width at base,

d) Bar width at top of truncation,

e) Sample length and width,

f) Overall specimen thickness at base, and

g) Overall specimen thickness at bar center.

12.5.3 After conditioning, the specimen is to be immersed at 23ºC ±1ºC for 24 hours. An additional set of samples shall also be immersed under the same conditions for 168 hours.

12.5.4 After the specified immersion time, specimens are to be weighed measured as noted in 11.5.1 or 11.5.2, as applicable.

12.6 Report

12.6.1 The report is to include each of the following:

a) Description of the material, including the type, source, manufacturer's code numbers, etc.

b) Type and dimensions of specimens.

c) Temperature, humidity, and length of conditioning period.

d) Immersion procedure and duration used.

e) Calculated percentage increase in weight after immersion.

f) Any change in dimension as a result of absorption.

g) Any observation of warping, cracking or change in appearance.

h) A brief, identifying description of the testing apparatus.

13 Ball Pressure

13.1 General

13.1.1 The test method for determination of Ball Pressure is described in IEC 695-10-2.

13.1.2 This method is intended to evaluate polymeric materials for softening at a temperature of 75°C in order to confirm that they will not soften under severe service conditions.

13.2 Apparatus

13.2.1 An apparatus in accordance with IEC 695-10-2 is to be used.

13.3 Specimens

13.3.1 Three samples approximately 3 inches square are to be prepared. If the thickness of the polymeric portion of the material is greater than 2.5 mm, then the polymeric portion may be tested on its own. Otherwise, the specimens should be installed in 1 inch of Portland cement according to the manufacturer's instructions.

13.4 Procedure

13.4.1 The Ball Pressure test method described in IEC 695-10-2 is to be used except as noted below.

13.4.2 Instead of testing at many temperatures to determine what temperature results in a penetration of 2 mm, as is generally indicated in IEC 695-10-2, the test shall be conducted at 75°C.

13.4.3 The diameter of the impression shall be measured following the required conditioning and application of the test force for the prescribed duration. To comply with this test, the impression shall be 2.0 ± 0.1mm or less. Surface texture is to be disregarded when making this measurement.

TESTING FOR RESILIENCE

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14 Coefficient of Restitution (COR)

14.1 The test method for the determination of coefficient of restitution is described in Ceramic Tiles – Part 5: Determination of impact resistance by measurement of coefficient of restitution, ISO 10545-5.

14.2 Specimens shall be in accordance with ISO 10545-5, but the detectable warning/directional surface should be applied to the concrete substrate following the manufacturer's recommended installation method.

14.3 The test should be conducted such that the steel ball impacts a flat portion of the specimen between truncated domes/directional bars.

14.4 From the data obtained, the coefficient of restitution can be determined.

TESTING FOR ATTACHMENT

15 Bond Strength

15.1 The test method for the determination of bond strength is described in the Standard Test Method for Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method), ASTM C1583.

15.2 Specimens shall be in accordance with ASTM C1583, but need only measure 12 inches by 12 inches. The detectable warning/directional surface should be attached to a concrete substrate 2 inches thick, unless the material itself already exceeds 2 inches. Three specimens are to be evaluated for each required condition.

15.3 The test should be conducted such that the 2-inch diameter steel disk is attached to a portion of the sample, which includes at least one truncated dome, or a portion of a directional bar. (NOTE: We may wish to allow for testing on a flat portion when the dome/bar is continuous with the flat surface and not attached separately).

15.4 When the product being tested is intended for perimeter installation, the test specimen should be prepared such that the junction of two units is observed in the center of the specimen (the test area). The 2 inch diameter steel disk should be attached centered on the junction of the two units.

15.4 From the data obtained, the tensile load at failure and the failure mode can be determined.

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16 60° Load Test

16.1 General

16.1.1 This test method is intended to evaluate the durability of the truncated domes on detectable warnings or raised bars on directional surfaces.

16.2 Apparatus

16.2.1 The basic components of the test apparatus are to consist of the following:

a) A testing machine, properly calibrated, that can be operated at constant rates of crosshead motion, and in which the error in the load measuring system shall not exceed ±1% of maximum load expected to be measured. The load indicating mechanism shall be essentially free from inertial lag at the crosshead rate used.

b) A steel specimen support designed to support a specimen at a 60° angle from horizontal (See fig. 1) NOTE: Figure 1 is forthcoming

c) A steel blade of 6.35 mm (0.25 inch) thickness, 25.4 mm (1 inch) wide with a beveled edge, installed in the testing machine to apply a load to the specimen.

16.3 Specimens

16.3.1 Three specimens approximately 76 mm by 127 mm (3 inches by 5 inches) are to be prepared. In the case of directional bars, the bars should be aligned with the long edge of the specimen.

16.4 Conditioning

16.4.1 Three specimens are to be conditioned as in 8.2.

16.4.2 Three specimens are to be conditioned as in 8.3.

16.4.3 Three specimens are to be conditioned as in 8.4.

16.4.4 Three specimens are to be conditioned as in 8.5.

16.4.5 Three specimens are to be conditioned at 23 ± 2°C and 50 ± 5% relative humidity for not less than 40 hours prior to test.

16.5 Test Procedure

16.5.1 The sample is to be loaded into the fixture and the blade positioned such that the leading edge contacts the center of a truncated dome or directional bar 2 mm (0.078 inches) above the field surface of the specimen.

16.5.2 The blade is lowered with a crosshead speed of X until the load can not be sustained (yield). The maximum load at yield is recorded.

16.6 Report

16.6.1 The report is to include each of the following:

a) Description of the material, including the type, source, manufacturer's code numbers or equivalent identification code.

b) Type and dimensions of specimens

c) Temperature, humidity, and length of conditioning period.

d) Maximum load at yield

e) Any further information or observations that might be considered pertinent, particularly with reference to unexpected behavior

f) A brief, identifying description of the testing apparatus, including the type of testing machine and dimensions of the blade.

TESTING FOR COLOR FASTNESS

17 Color Fastness

17.1 General

17.1.1 The test method for the determination of Color Fastness is described by the Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates, ASTM D2244.

17.1.2 The test method in ASTM D2244 is intended to determine the difference in color between two specimens through the use of tristimulus data of the two specimens in combination with a known white object.

17.2 Apparatus

17.2.1 The apparatus shall consist of a Colorimetric Spectrometer capable of measuring CIE tristimulus values under standard illuminant D_{65}. (and/or C)

17.2.2 A 16 mm aperture is recommended, though other sizes may be used so long as consistency is maintained within a sample set.

17.3 Specimens

17.2 Specimens shall be approximately 4 inches by 4 inches and need not be embedded in substrate.

17.4 Conditioning

17.4.1 One specimen is to be conditioned as in 8.2

17.4.2 One specimen is to be conditioned as in 8.3

17.4.3 One specimen is to be conditioned as in 8.4

17.4.4 One specimen is to be conditioned as in 8.5

17.4.5 One set of specimens are to be conditioned at 23 ± 2°C and 50 ± 5% relative humidity for not less than 40 hours.

17.5 Test Procedure

17.5.1 The test should be conducted on a relatively flat portion of the specimen between truncated domes or bars if possible. If the sample configuration does not allow for testing between domes or bars, then the test should be conducted at the peak of the dome or bar. The test locations must be consistent between samples subjected to different conditions.

17.5.2 The apparatus shall consist of a photo spectrometer utilizing the 10° (2°) observer and standard D65 (or C) illuminate. A 16 mm aperture is recommended, though other sizes may be used so long as consistency is maintained within a sample set.

17.5.3 At least three color measurements shall be taken from each sample to determine CIELAB values for a given specimen. Testing of the reference sample (as received) shall be performed at the same time that the conditioned specimens.

17.6 Report

17.6.1 The report is to include each of the following:

a) Description of the material, including the type, source, manufacturer's code numbers, or equivalent identification code.

b) The CIELAB values for the reference specimen and each conditioned specimen along with temperature, humidity, and length of conditioning period.

c) The total color difference from the reference (ΔE^*_{ab})shall be calculated for each conditioned sample

d) The portion of the specimen tested (valley, peak of dome, peak of bar, etc)

e) A brief, identifying description of the testing apparatus, including aperture size.

TESTING FOR ACOUSTIC QUALITY

18 Acoustic Quality

18.1 General

18.1.1 This method is intended to approximate sound on cane acoustic quality of a given detectable warning product or directional surface. The results of the test program can be used to determine if a given product retains a significant difference in acoustic response from materials which typically surround the product in the field.

18.2 Apparatus

18.2.1 The basic components of the test apparatus are to consist of the following:

a) A striker, consisting of a nylon 6/6 ball having a diameter of 19 mm (¾ inches).

b) A microphone having a sensitivity/frequency response of at least ???

c) A computer equipped with audio hardware capable of recording digital audio at a sample rate of 44.1Khz and 16 bit resolution.

d) Software capable of rendering a sound spectrograph in the audible frequency range

18.3 Specimens

18.3.1 Samples measuring approximately 12 by 12 inches, installed in a Portland cement substrate having a thickness of at least two inches, are to be utilized.

18.4 Conditioning

18.4.1 One specimen is to be conditioned as in 8.2.

18.4.2 One specimen is to be conditioned as in 8.3.

18.4.3 One specimen is to be conditioned as in 8.4.

18.4.4 One specimen is to be conditioned as in 8.5.

18.4.5 One specimen is to be evaluated in the as received condition.

18.4.6 All specimens are to be conditioned at 23 +/- 2°C and 50 +/- 5% relative humidity for not less than 40 hours prior to testing.

18.5 Test Procedure

18.5.1 Each sample is to be placed on a hard surface, with the microphone situated in an appropriate position to capture the sound of impact.

18.5.2 The striker should be dropped onto the sample from a height of 3 feet, and the resulting sound of impact recorded. Care should be taken to minimize the amount of ambient noise in the test area.

18.5.3 If possible, the resulting sound file should be cropped to include only the first impact. Subsequent impacts caused by bouncing of the striker should be discarded, unless the time between impacts is so small that the sounds overlap.

18.5.4 A sound spectrograph of the impact is to be generated

18.6 Report

18.6.1 The report is to include each of the following:

a) Description of the material, including the type, source, manufacturer's code numbers, or equivalent identification code.

b) Type and dimensions of the striker

c) Description of conditioning applied to the specimen

d) Sound spectrograph of the specimen being impacted by the striker

e) Any further information that might be considered pertinent, particularly with reference to unexpected behavior.

f) A brief, identifying description of the testing apparatus.

19 Slip Resistance – Static Friction Test

19.1 General (REPLACE WITH UL410, SLIP RESISTANCE OF FLOOR SURFACE MATERIALS – COMMITTEE DISCUSSION)

19.1.1 The average static coefficient of friction for a detectable warning or directional surface shall be at least 0.6 when tested in accordance with the requirements of this section.

19.2 Apparatus

19.2.1 A Portable Articulated Strut Slip Tester (PAST), which measures the static coefficient of friction between the proposed material and a representative foot surface is employed for this test. This apparatus is described in detail in the Standard Test Method for Using a Portable Articulated Strut Slip Tester (PAST), ASTM F1698.

19.2.2 The test sensor used in the slip-resistance tester shall be made of medical grade silicone rubber[1].

19.3 Specimens

19.3.1 Specimens shall be at least 101.6 mm x 101.6 mm (4 inches x 4 inches) and need not be embedded in substrate.

19.3.2 For Detectable Warnings, 6 specimens shall be provided, 3 for testing square to the truncated dome pattern and 3 for testing along the diagonal of the truncated dome pattern.

[1] Silastic 382, available from Dow-Corning Corp, or equivalent, has been found suitable for this purpose.

19.3.3 For Directional Surfaces, 6 specimens shall be provided, 3 for testing performed along the directional surface and 3 for testing against the directional surface.

19.4 Conditioning

19.4.1 All specimens shall be conditioned at 23 ± 2°C and 50 ± 5% relative humidity for not less than 40 hours prior to test.

19.5 Test Procedure

19.5.1 The test shall be conducted on each specimen as described in ASTM F1678

19.4.2 All specimens shall be tested in the presence of water. Enough water shall be applied to the specimen immediately prior to test to thoroughly wet the surface.

19.6 Report

19.6.1 The report is to include each of the following:

a) Description of the material, including the type, source, manufacturer's code numbers, or equivalent identification code.

b) Type and dimensions of the test sensor.

c) The PAST number reported by the instrument for each specimen

d) The calculated Coefficient of Friction for each specimen

e) Any further information that might be considered pertinent, particularly with reference to unexpected behavior

f) A brief, identifying description of the testing apparatus.

TESTING FOR FLAMABILITY

20 Flame Spread

TBD

APPENDIX A

Reference List of Applicable ASTM and ISO Test Procedures

ASTM Standards

ASTM B 117	Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM C 241	Standard Test Method for Abrasion Resistance of Stone Subjected to Foot Traffic
ASTM C 650	Standard Test Method for Resistance of Ceramic Tile to Chemical Substances
ASTM C 902	Standard Specification for Pedestrian and Light Traffic Paving Brick
ASTM C 1026	Standard Test Method for Measuring the Resistance of Ceramic Tile to Freeze-Thaw Cycling
ASTM C 1262	Standard Test Method for Evaluating the Freeze-Thaw Durability of Manufactured Concrete Masonry Units and Related Concrete Units
ASTM C 1583	Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)
ASTM D 543	Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents
ASTM D 570	Standard Test Method for Water Absorption of Plastics
ASTM D 695	Standard Test Method for Compressive Properties of Rigid Plastics
ASTM D 2244	Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
ASTM D 4977	Standard Test Method for Granule Adhesion to Mineral Surfaced Roofing by Abrasion

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ASTM D 5420	Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact)
ASTM F 1698	Standard Test Method for Using a Portable Articulated Strut Slip Tester (PAST)
ASTM G 151	Standard Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources
ASTM G 155	Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials

ISO Standards

ISO 10545-5	Ceramic Tiles – Part 5: Determination of Impact Resistance by Measurement of Coefficient of Restitution

IEC Standards

IEC 695-10-2	Ball Pressure…