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Setting the Standards for Laminate Flooring.

Product Standards

Laminate Flooring: Specifications and Test Methods

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NALFA Standards Publication LF 01-2003

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Foreword

The North American Laminate Flooring Association has prepared this Standards Publication for use by manufacturers, suppliers, distributors, dealers, and consumers of laminate flooring. The performance values and test methods presented have been related as closely as possible to end-use applications, and consumer needs have been considered throughout.

The purpose of this Standards Publication is to provide minimum performance requirements for laminate flooring using standard test methods. Such performance requirements include but are not limited to static load, thickness swell, impact resistance, light resistance, cleanability/stain resistance, wear resistance, dimensional tolerances and castor chair resistance. The requirement of this standard applies to laminate flooring upon manufacturer's completion and proper storage until first placed into service.

The Technical Committee works closely with trade organizations, consumers, manufacturers, and appropriate government agencies in the periodic review and revision of these standards. In this 2003 publication for Laminate Flooring, effort has been made to relate this Standard closely to the expected performance in application. During laminate flooring installation, the fabrication method and technique employed will have a definite bearing on product performance and service. Consult individual laminate flooring manufacturers for specific installation criteria.

Metric values for the test procedures and performance standards are regarded as the standard. This standard is periodically reviewed by the Technical Committee for any revisions necessary to keep them up to date with advancing technology. Proposed or recommended revisions should be submitted to:

Technical Director
North American Laminate Flooring Association
Webster, Chamberlain, & Bean
1747 Pennsylvania Avenue, NW Suite 1000
Washington, DC 20006
(202) 785-9500

Section 1: GENERAL

1.1 SCOPE

This product standard shall apply to the performance of laminate flooring. The standard will be useful in guiding manufacturers and educating consumers about minimum requirements of laminate flooring.

The precision of all the specified tests methods is not known. For those methods where interlaboratory testing has been completed, an appropriate precision statement has been made. When the interlaboratory data becomes available for the remaining test methods, the precision statements for those methods will be added in subsequent revisions.

1.2 REFERENCED STANDARDS

In this publication, reference is made to the standards listed below. Copies are available from the indicated sources:

Swedish Standards Institution

Box 490 44

SE-100 28 Stockholm, Sweden

SIS 21824

I. P. Poster

Technical Association of the Pulp & Paper Industry Technology Park

P. O. Box 105113

Atlanta, GA 30348

(770) 446-1400

TAPPI T-564

Size Estimation Chart

1.3 FIRE RATING

Appendix A lists specific test methods which are typically used in determining the fire ratings which have been established by code-developing and specifying agencies such as National Fire Protection Association, International Code Council, and other local, state, and federal agencies. When fire ratings are required by specific code, the manufacturer of the product being specified should be consulted.

1.4 VISUAL INSPECTION

The inspector shall have normal vision, corrected if necessary. No magnification shall be used when viewing the specimens.

1.5 CONDITIONING

For the purpose of test method standardization, it is recommended that a laminate flooring sample or specimen prior to evaluation shall be conditioned to constant weight (less than 0.1% deviation per 24 hours) in a conditioning chamber unless denoted otherwise in the method. The chamber shall be maintained at temperature of $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$ ($73^{\circ}\text{F} \pm 5^{\circ}\text{F}$) and $50\% \pm 5\%$ relative humidity. If there is any departure from this recommended conditioning, it shall be stated in the test report.

1.6 DEFINITIONS

1.6.1 Backer:

A material bonded to the back of the substrate.

1.6.2 Décor Layer:

The layer of laminate flooring providing visual aesthetic properties.

1.6.3 Laminate Flooring:

A rigid floor covering with a surface layer consisting of one or more thin sheets of a fibrous material (usually paper), impregnated with aminoplastic thermosetting resins (usually melamine), pressed or bonded on a substrate, normally finished with a backer.

1.6.4 Substrate:

The core material of the laminate flooring.

Section 2: PERFORMANCE PROPERTIES AND VALUES

2.1 PERFORMANCE PROPERTIES

Table 2-1 Performance Properties and Values

		MINIMUM PERFORMANCE VALUES		
Usage Level		Residential	Light Commercial	Commercial
Certification Level		1	2	3
LF-01 TEST METHOD	PROPERTY			
3.1	Static Load	≥ 6 MPa (870 psi)	≥ 6 MPa (870 psi)	≥ 8 MPa (1160 p
3.2	Thickness Swell	≤ 20%	≤ 16%	≤ 16%
3.3	Light Resistance	No Effect	No Effect	No Effect
3.4	Cleanability/ Stain Resistance	Score < 20 No Effect	Score < 20 No Effect	Score < 20 No Effect
3.5	Large Ball Impact Resistance	> 800 mm (31.5 in)	> 1000 mm (39.4 in)	> 1400 mm (55.1 in)
3.6	Small Ball Impact Resistance	> 200 mm (7.9 in)	> 200 mm (7.9 in)	> 500 mm (19.7 in)
3.7	Wear Resistance	IP ³ 1800 cycles	IP ³ 2500 cycles	IP ³ 4000 cycle
3.8	Dimensional Tolerances (maximum)	Length: 0.50 mm (0.020 in) Width: 0.20 mm (0.008 in) Thickness: 0.50 mm (0.020 in) Squareness: 0.20 mm (0.008 in) Straightness: 0.30 mm (0.012 in)	Length: 0.50 mm (0.020 in) Width: 0.20 mm (0.008 in) Thickness: 0.50 mm (0.020 in) Squareness: 0.20 mm (0.008 in) Straightness: 0.30 mm (0.012 in)	Length: 0.50 m (0.020 in) Width: 0.20 m (0.008 in) Thickness: 0.50 (0.020 in) Squareness: 0.20 (0.008 in) Straightness: 0.30 (0.012 in)
3.9	Castor Chair Resistance	25000 cycles No Effect	25000 cycles No Effect	25000 cycles No Effect

Section 3: TEST METHODS

3.1 STATIC LOAD

3.1.1 Scope

This test measures the ability of laminate flooring to resist residual indentation resulting from a static load.

3.1.2 Test Apparatus

3.1.2.1 Karol-Warner load frame modified for a 20:1 lever arm ratio or equivalent. See Photo 3-1.

3.1.2.2 Environmental chamber maintained at 23 °C ± 3 °C (73 °F ± 5 °F) and 50% ± 5% relative humidity.

3.1.2.3 Indenter plate (see Figure 3-1)

3.1.2.4 One inch micrometer with foot/anvil diameters of 6.35 mm ± 2.54 mm (0.250 in ±

0.10 in).

Photo 3-1

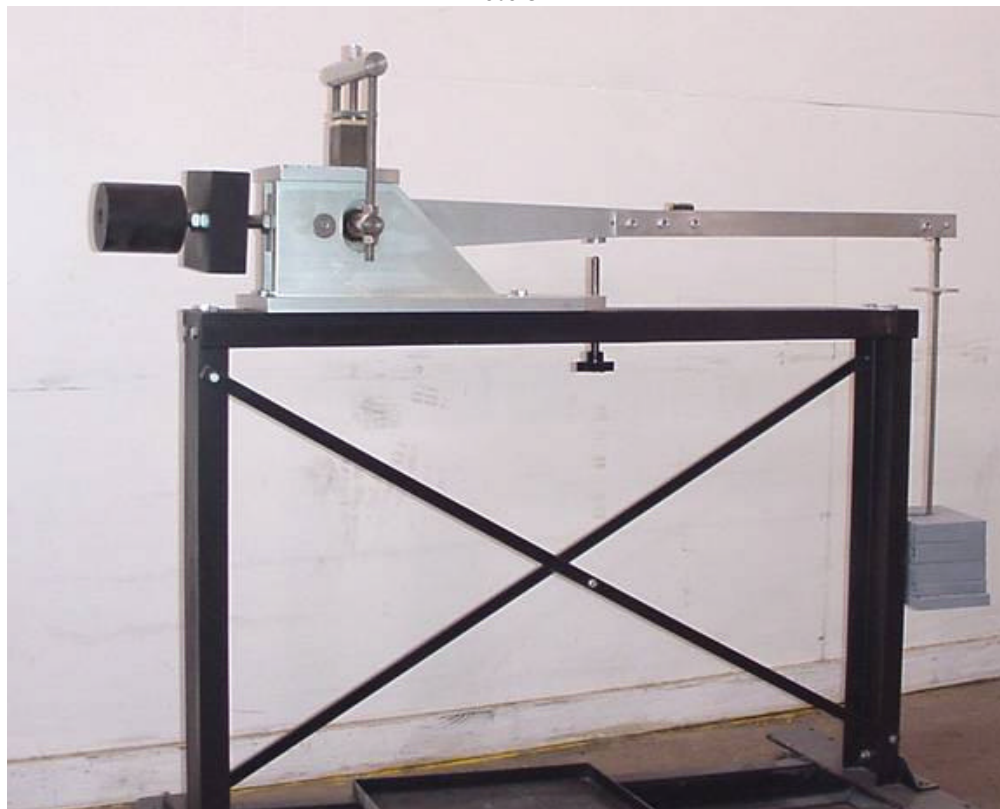
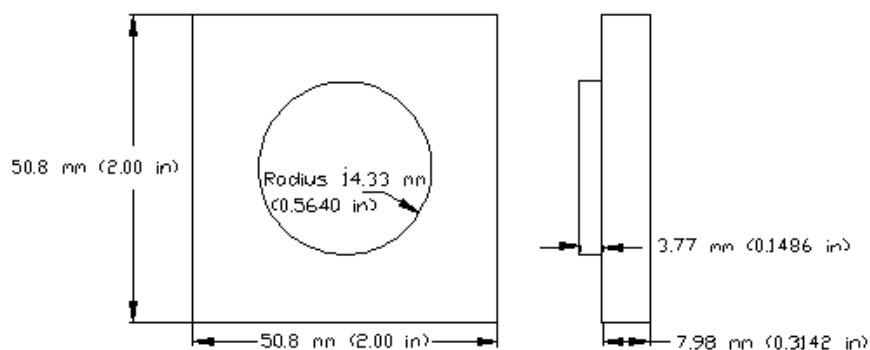


Figure 3-1



3.1.3 Specimens

3.1.3.1 Test specimen shall measure 50 mm x 50 mm x thickness (2 in x 2 in x thickness).

3.1.4 Procedure

3.1.4.1 Condition the specimens to constant weight (less than 0.1% deviation per 24 hours) in a conditioning chamber unless denoted otherwise in the method.

3.1.4.2 Measure the thickness of the test specimen at the center of the face to be tested with the micrometer. Record the measurement as the initial thickness.

3.1.4.3 Place the specimen on the load rack platform with the circular face of the indenter against the face of the specimen.

3.1.4.4 Additional specimens and indenters may be added to the stack as allowed by equipment design.

3.1.4.5 Using the counterbalance of the load arm, tare the arm so that the arm rests freely in a horizontal position.

3.1.4.6 Adjust the arm pin so that the pin touches the top indenter plate when the arm is horizontal.

3.1.4.7 Adjust the support pin such that the specimen(s) are not impacted as weights are added to the arm.

3.1.4.8 Place weights on the arm so that the load to be applied to the specimen is 10.0 MPa

± 0.1 MPa (1450 psi \pm 14.5 psi).

3.1.4.9 Release the support pin to load the specimen(s) to the designated weight.

3.1.4.10 Allow the specimen(s) to remain under load for 24 hours \pm 0.25 hours.

3.1.4.11 Remove the load from the frame.

3.1.4.12 Remove the specimen(s) from the frame and allow to recover 24 \pm 0.25 hours.

3.1.4.13 Measure the thickness of the specimen at the same location as the initial measurement was obtained using the one inch micrometer. Record this measurement as the final thickness.

3.1.4.14 Calculate the measured indentation as explained in 3.1.5.

3.1.4.15 If residual indentation measurement is less than 0.025 mm (0.001 in), the load used shall be reported. If the residual indentation is greater than 0.025 mm (0.001 in), decrease the load by 1.7 MPa (250 psi) and repeat steps 3.1.4.1 through 3.1.4.13 with a new specimen.

3.1.5 Calculations

3.1.5.1 Subtract the final thickness measurement from the initial thickness measurement. The difference is the residual indentation.

3.1.6 Report

The test report shall include the following

3.1.6.1 Reference to this standard.

3.1.6.2 Description of the material under test.

3.1.6.3 The value of the maximum load applied which produces residual indentation of less 0.025 mm (0.001 in).

3.1.6.4 Any deviation from the specified test method

3.1.6.5 Date of the test

3.1.7 Precision & Bias

3.1.7.1 Test method precision and bias have not been established at this time. It is currently under consideration of the NALFA Technical Committee.

3.2 THICKNESS SWELL

3.2.1 Scope

This test measures the ability of laminate flooring to resist increase in thickness after being exposed to water.

3.2.2 Test Apparatus

3.2.2.1 Pan or other suitable apparatus for submerging specimens.

3.2.2.2 One inch micrometer with foot/anvil diameters of 6.35 mm \pm 2.54 mm (0.250 in \pm 0.10 in).

3.2.2.3 Distilled or deionized water maintained at 20 °C \pm 1 °C (68 °F \pm 2 °F).

3.2.2.4 Ruler

3.2.3 Specimens

3.2.3.1 A test specimen shall measure 150 mm x 150 mm x thickness (6 in x 6 in x thickness). Two specimens shall be collected for each test. Each specimen shall be taken from opposite ends of a tile. Specimen edges shall be smooth and squarely trimmed. They shall not be preconditioned.

3.2.4 Procedure

3.2.4.1 Measure the thickness of each test specimen at the edge of the middle point of the four sides (see Figure 3-2). Record the measurements as the initial thickness.

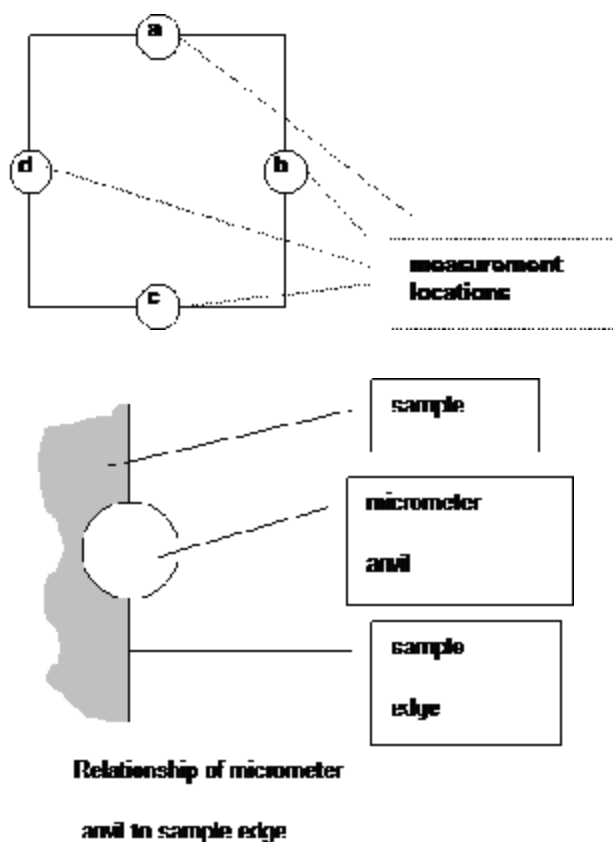
3.2.4.2 Submerge each specimen under the water so that the top face of each specimen is 25.4 mm \pm 2.54 mm (1 in \pm 0.1 in) from the surface of the water. Specimen faces shall not rest against a flat surface as this impedes water circulation and absorption.

3.2.4.3 Specimens shall remain submerged for a total of 24 hours \pm 0.25 hours.

3.2.4.4 At the end of the 24 hours, remove the specimens from the water.

3.2.4.5 Repeat the measurements outlined in step 3.2.4.1 within 15 minutes of removal from the water. Record the measurements as the final thickness.

Figure 3-2



3.2.5 Calculations

3.2.5.1 Express the thickness swell as the average percentage increase in thickness. It is calculated for each edge as: $((\text{final thickness} - \text{initial thickness}) / \text{initial thickness}) \times 100$

3.2.5.2 The eight percentage results are then averaged to obtain the thickness swell result.

3.2.6 Report

3.2.6.1 Reference to this standard.

3.2.6.2 Description of the material under test.

3.2.6.3 The average of the thickness measurements.

3.2.6.4 The thickness swell value.

3.2.6.5 Any deviation from the specified test method.

3.2.6.6 Date of the test.

3.2.7 Precision & Bias

3.2.7.1 Table 3-1 is based on interlaboratory studies conducted in 1999 involving three replicate tests of nine materials tested by nine laboratories.

Table 3.1

<i>Material</i>	<i>Mean</i>	<i>Sr</i>	<i>SR</i>	<i>Ir</i>	<i>IR</i>
A	5.32%	0.30%	0.91%	0.84%	2.57%
B	6.87%	0.33%	1.08%	0.94%	3.05%
C	8.05%	0.32%	1.18%	0.89%	3.34%
D	8.08%	0.30%	1.87%	0.83%	5.26%
E	10.79%	0.54%	2.76%	1.53%	7.79%
F	11.77%	0.41%	1.38%	1.15%	3.90%
G	13.53%	0.57%	3.01%	1.61%	8.49%
H	14.55%	0.49%	2.23%	1.38%	6.28%
I	14.68%	0.47%	2.87%	1.31%	8.10%

- 3.2.7.2 In Table 3-1, for the materials indicated:
 - 3.2.7.2.1 Mean is the average of test results for all replicates from all labs.
 - 3.2.7.2.2 S_r is the within-laboratory standard deviation of the mean and $I_r = 2.83S_r$ (see 3.2.7.2.4 for application of I_r).
 - 3.2.7.2.3 S_R is the between-laboratory standard deviation of the mean and $I_R = 2.83S_R$ (see 3.2.7.2.5 for application of I_R).
 - 3.2.7.2.4 Repeatability - In comparing two mean values for the same material obtained by the same operator using the same equipment on the same day, the means should be judged not equivalent if they differ by more than the I_r value for that material and condition.
 - 3.2.7.2.5 Reproducibility - In comparing two mean values for the same material obtained by different operators using different equipment on different days, the means should be judged not equivalent if they differ by more than the I_R value for that material and condition. (This applies between different laboratories or between different equipment within the same laboratory.)
 - 3.2.7.3 The judgments per 3.2.7.2.4 and 3.2.7.2.5 will have an approximate 95% (0.95) probability of being correct.
 - 3.2.7.4 Other materials may give somewhat different results.

3.3 LIGHT RESISTANCE

3.3.1 Scope

This test measures the ability of laminate flooring to retain its color when exposed to a light source having a frequency range approximating sunlight through window glass. It is not intended to show the resistance to continuous exposure to outdoor weathering conditions.

3.3.2 Test Apparatus

- 3.3.2.1 Xenon-arc light source capable of providing electromagnetic energy approximating sunlight with a spectral bandpass of approximately 280 nm to 800 nm with filtering appropriate to simulate sunlight through a window.
- 3.3.2.2 Environmental Chamber maintained at $23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ ($73\text{ }^{\circ}\text{F} \pm 5\text{ }^{\circ}\text{F}$) and relative humidity of $50\% \pm 5\%$.
- 3.3.2.3 Overhead lighting consisting of cool white fluorescent light with the bulbs positioned parallel to the line of sight and providing an intensity of 800 lux to 1100 lux (75 foot-candles to 100 foot-candles) at the specimen surface when examined.

3.3.3 Specimens

- 3.3.3.1 The test specimen shall be of the size required by the sample holder of the Xenon-arc test apparatus.

3.3.4 Procedure

- 3.3.4.1 Condition the specimen for at least 48 hours prior to the test at a temperature of $23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ ($73\text{ }^{\circ}\text{F} \pm 5\text{ }^{\circ}\text{F}$) and relative humidity of $50\% \pm 5\%$.
- 3.3.4.2 Mount the specimen in a masked holder such that approximately $\frac{1}{2}$ of the sample face to be tested is covered and the other half is exposed to the light source.
- 3.3.4.3 Operating set points for the exposure shall be as follows:
 - 3.3.4.3.1 Black Panel Temperature: $70\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ ($158\text{ }^{\circ}\text{F} \pm 5\text{ }^{\circ}\text{F}$)
 - 3.3.4.3.2 Dry Bulb Temperature*: $50\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ ($122\text{ }^{\circ}\text{F} \pm 5\text{ }^{\circ}\text{F}$)
 - 3.3.4.3.3 Wet Bulb Temperature: $39\text{ }^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C}$ ($102\text{ }^{\circ}\text{F} \pm 2\text{ }^{\circ}\text{F}$) to maintain $50\% (\pm 5\%)$ Relative Humidity
 - 3.3.4.3.4 Conditioning Water: $20\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ ($68\text{ }^{\circ}\text{F} \pm 5\text{ }^{\circ}\text{F}$)
 - 3.3.4.3.5 Duration of Exposure: 72 hours ± 0.5 hour
 - 3.3.4.3.6 Calibration wavelength: 420 nm
 - 3.3.4.3.7 Rate of Irradiance: $1.10\text{ W/m}^2 \pm 0.03\text{ W/m}^2$
 - 3.3.4.3.8 Total Irradiance: $285.12\text{ kJ/m}^2 \pm 2.00\text{ kJ/m}^2$
 - 3.3.4.3.9 Automatic control of power to the light source to maintain a constant irradiance level and accommodate for aging effect of light sources and solarization of filters.

*Note: The Black Panel Temperature is the primary controlled temperature and the Dry Bulb Temperature is secondary control.

- 3.3.4.4 Expose the specimen to the light source as outlined in 3.3.4.3.
- 3.3.4.5 At the conclusion of the exposure period, remove the specimen from the holder and allow to recover for 24 hours ± 1 hour without exposure to light at a temperature of $23\text{ }^{\circ}\text{C} \pm 3$

°C (73 °F \pm 5 °F) and relative humidity of 50% \pm 5%.

3.3.4.6 At the conclusion of the recovery period, examine the specimen by placing it, without preinspection, on a horizontal surface having the illumination as outlined in 3.3.2.3 and then viewing the specimen at an eye-to-specimen distance of approximately 750 mm to 900 mm (30 in to 36 in) and at an angle of approximately 45° to 75° from the horizontal plane. The specimen shall be rotated in the horizontal plane and viewed from all directions. Light sources other than that outlined in 3.3.2.3, which can accentuate or minimize effects, shall be avoided.

3.3.4.7 Grade the specimen as follows:

- No effect - no change in color or surface finish.
- Slight effect - a change in color or surface finish visible only at certain angles and directions.
- Moderate effect - a change in color or surface finish visible at all angles and directions but does not notably alter the original condition of the specimen.
- Severe effect - a change in color or surface finish which markedly alters the original condition of the specimen.

3.3.5 Report

3.3.5.1 Reference to this standard.

3.3.5.2 Description of the material under test.

3.3.5.3 The light resistance.

3.3.5.4 Any deviation from the specified test method.

3.3.5.5 Date of the test.

3.3.6 Precision & Bias

3.3.6.1 Because the measurement outcome for this test is a discrete result and subjective in nature, precision and bias cannot be determined.

3.4 CLEANABILITY AND STAIN RESISTANCE

3.4.1 Scope

This test measures both the ease of cleanability and stain resistance of laminate flooring to common household substances.

3.4.2 Test Apparatus

3.4.2.1 Concave glass covers, 25 mm (1 in) in diameter with fire-polished rims.

3.4.2.2 Overhead lighting consisting of cool white fluorescent light with the bulbs positioned parallel to the line of sight and providing an intensity of 800 lux to 1100 lux (75 foot-candles to 100 foot-candles) at the specimen surface when examined.

3.4.2.3 Nylon bristle brush.

3.4.2.4 One kilogram mass.

3.4.2.5 Cellulose sponge measuring 75 mm x 100 mm x 50 mm (3 in x 4 in x 2 in).

3.4.2.6 Clean, soft cloth.

3.4.2.7 Cotton balls.

3.4.2.8 Commercially available cleaner that is non-abrasive and contains approximately 4% butyl cellosolve.

3.4.2.9 A 5.0% \pm 0.5% solution of sodium hypochlorite.

3.4.2.10 Baking soda (as a mild abrasive household cleaner).

3.4.2.11 Water.

3.4.2.12 Acetone.

3.4.2.13 Test Reagents as specified in Table 3-2:

Table 3.2

<i>Reagent #</i>	<i>Reagent</i>	<i>Preparation</i>	<i>Application</i>
1	Distilled water	As received	Apply 2 drop (5 mm spot) a cover with w glass
2	Ethanol Solution	Solution: 50% ethanol; 15% water	Same as above
3	Acetone	As received	As above
	Household		

4	ammonia	As received (non-sudsing type)	As above
5	10% Citric acid	A solution of 10% citric acid in distilled water	As above
6	Vegetable oil	As received	As above
7	Coffee	1 teaspoon instant coffee per 180 ml distilled water	As above
8	Tea	Brew 1 tea bag per 120 ml distilled boiling water for 2 minutes	As above
9	Catsup	As received	As above
10	Mustard	As received	As above
11	10% Povidone iodine	As received	As above
12	Black permanent marker	As received	Mark 6 mm square, do not cover
13	#2 pencil	As received	As above
14	Wax crayon	As received	As above
15	Black paste shoe polish	As received	As above

3.4.3 Specimens

3.4.3.1 The test specimen shall have an area sufficient to permit placement of all test reagents on the surface in two lines. Individual reagents shall be placed about 50 mm (2 in) apart but in no circumstances less than 25 mm (1 in) apart. A specimen that measures 100 mm x 400 mm x thickness (4 in x 16 in x thickness) is adequate.

3.4.4 Procedure

3.4.4.1 Using the commercial cleaner in 3.4.2.8, clean the surface of the specimen with a soft cloth. Rinse the specimen with water and dry with a clean, soft, cloth. Allow the specimen to dry thoroughly at a temperature of $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$ ($73^{\circ}\text{F} \pm 5^{\circ}\text{F}$).

3.4.4.2 Position the specimen horizontally to minimize movement of stain reagents after application.

3.4.4.3 Mark the specimen so that the location of each reagent can be identified.

3.4.4.4 Place a 6 mm (1/4 in) spot of each reagent upon the surface of the specimen.

3.4.4.5 Place a watch glass, concave side down, over each reagent as indicated in 3.4.2.13. Move each watch glass such that the covered reagent comes in contact with the glass rim and the reagent is both covered and uncovered where the watch glass sits. The entire rim of the watch glass shall be wetted with the stain reagent in question. Stain reagents shall not be allowed to contact each other or any surface identification marking.

3.4.4.6 Allow the specimen to stand undisturbed for a period of 16 hours to 24 hours at room temperature.

3.4.4.7 At the end of the test period, remove the watch glass covers and clean the specimen as follows.

3.4.4.8 After each of the following steps in the cleaning procedure observe the specimen by placing it, without preinspection, on a horizontal surface having the illumination as outlined in 3.4.2.2 and then viewing the specimen at an eye-to-specimen distance of approximately 750 mm to 900 mm (30 in to 36 in) and at an angle of approximately 45° to 75° from the horizontal plane. The specimen shall be rotated in the horizontal plane and viewed from all directions. Light sources other than that outlined in 3.3.2.3, which can accentuate or minimize effects, shall be avoided.

3.4.4.9 Cleaning Procedures:

3.4.4.9.1 Flush the surface with tap water and wipe gently with a sponge moistened with water. Blot the surface with a clean, soft cloth. If the test reagent is removed by this step it shall be graded a "0". If a stain remains for a reagent, proceed to the next step.

3.4.4.9.2 Wet the test specimen surface with the commercial cleaner. Moisten the cellulose sponge with commercial cleaner and place a 1 kg (2.20 lb) weight on its top. Push the weighted sponge back and forth without downward pressure for 25 cycles. Rinse the test

specimen with water and wipe dry using a clean, soft cloth. If the test reagent is removed by this step, it shall be graded "1". If any stains remain, proceed to the next step.

3.4.4.9.3 Wet the test specimen surface with the commercial cleaner and add baking soda to achieve a paste consistency. Using a stiff nylon bristle brush, scrub the remaining areas where staining reagents can still be observed for 25 cycles. The specimen shall not be rubbed so as to permanently mar the surface finish. Rinse the test specimen with water and wipe dry using a clean, soft cloth. If the test reagent is removed by this procedure, it shall be graded "2". If any stains remain, proceed to the next step.

3.4.4.9.4 Using a cotton ball saturated with the acetone, rub the stain gently for up to two minutes. Rinse the specimen with water and wipe dry using a clean, soft cloth. If the test reagent is removed by this procedure, it shall be graded "3". If any stains remain, proceed to the next step.

3.4.4.9.5 Place a cotton ball saturated with hypochlorite bleach on the stain, and allow it to remain in contact for a period of two minutes. Rinse the specimen with water and wipe dry using a clean, soft cloth. If the test reagent is removed by this procedure, it shall be graded "4".

3.4.4.9.6 If any test reagent remains visible after 3.4.4.9.5, the specimen shall receive a grade of "5".

3.4.5 Calculations

3.4.5.1 Total the grades received for each of the stain reagents. The possible range is 0 to 75. This becomes the Cleanability score.

3.4.5.2 For each reagent that received a grade of "5", evaluate the remaining stain as follows:

- Slight effect - a change in color or surface finish visible only at certain angles and directions.
- Moderate effect - a change in color or surface finish visible at all angles and a direction but does not notably alter the original condition of the specimen.
- Severe effect - a change in color or surface finish which markedly alters the original condition of the specimen.

3.4.6 Report

3.4.6.1 Reference to this standard.

3.4.6.2 Description of the material under test.

3.4.6.3 The Cleanability score.

3.4.6.4 All reagents which caused a Slight, Moderate, or Severe Effect.

3.4.6.5 Any deviation from the specified test method.

3.4.6.6 Date of the test.

3.4.7 Precision & Bias

3.4.7.1 Because the measurement outcome for this test is a discrete result and subjective in nature, precision and bias cannot be determined.

3.5 LARGE BALL IMPACT RESISTANCE

3.5.1 Scope

This test measures the ability of laminate flooring to resist fracture due to impact by a large diameter ball.

3.5.2 Test Apparatus

3.5.2.1 Impact apparatus as shown in Figure 3-3 or equivalent

3.5.2.2 Polished stainless steel ball weighing $224 \text{ g} \pm 3 \text{ g}$ ($7.90 \text{ oz} \pm 0.11 \text{ oz}$), measuring 38.1 mm ($1\frac{1}{2} \text{ inches}$) in diameter. The spherical surface shall have no damaged or flattened surface.

3.5.2.3 Clamping jig capable of holding the test specimen flat. See Figure 3-4, or the equivalent.

3.5.2.4 Underlayment foam as a closed-cell foam with a thickness of $2.0 \text{ mm} \pm 0.5 \text{ mm}$ ($0.08 \text{ in} \pm 0.02 \text{ in}$) and a density of $35 \text{ kg/m}^3 \pm 5 \text{ kg/m}^3$ ($2.2 \text{ lb/ft}^3 \pm 0.3 \text{ lb/ft}^3$) or equivalent.

3.5.2.5 Environmental Chamber maintained at $23 \text{ }^\circ\text{C} \pm 3 \text{ }^\circ\text{C}$ ($73 \text{ }^\circ\text{F} \pm 5 \text{ }^\circ\text{F}$) and relative humidity of $50\% \pm 5\%$.

3.5.2.6 Black, water washable marking pen (suitable for overhead transparencies).

3.5.2.7 A clean, damp, soft cloth.

3.5.2.8 Overhead lighting consisting of cool white fluorescent light with the bulbs positioned parallel to the line of sight and providing an intensity of 800 lux to 1100 lux (75 foot-candles to 100 foot-candles) at the specimen surface when examined.

3.5.3 Specimens

3.5.3.1 Specimens shall be 300 mm x 300 mm x thickness (12 in x 12 in x thickness). In cases where material is less than 300 mm (12 in) in one dimension of the face, the specimen shall measure 300 mm x nominal width x nominal thickness (12 in x nominal width x nominal thickness).

3.5.4 Procedure

3.5.4.1 Condition the samples for at least 48 hours prior to the test at a temperature of 23 °C \pm 3 °C (73 °F \pm 5 °F) and a relative humidity of 50% \pm 5%.

3.5.4.2 Place the specimen on underlayment foam of similar size as the specimen and place the assembly on the clamping base of the apparatus.

3.5.4.3 Loosely clamp the specimen/foam assembly to the base to immobilize the specimen but not compress the foam underlayment.

3.5.4.4 Adjust the measurement scale so that it touches the surface of the specimen.

3.5.4.5 Position the electromagnet at any arbitrary height above the test specimen.

3.5.4.6 Place the ball on the electromagnet and drop the ball. Catch the ball on the first rebound so that multiple impacts do not occur. Impact positions shall be at least 50 mm (2 in) apart and 50 mm (2 in) from any edge of the specimen.

3.5.4.7 Use the marking pen to ink over impact points caused by the ball. Use the clean, damp, soft cloth to wipe each impact point. Fractures may appear as hairline cracks, concentric circles, or chips.

Figure 3-3

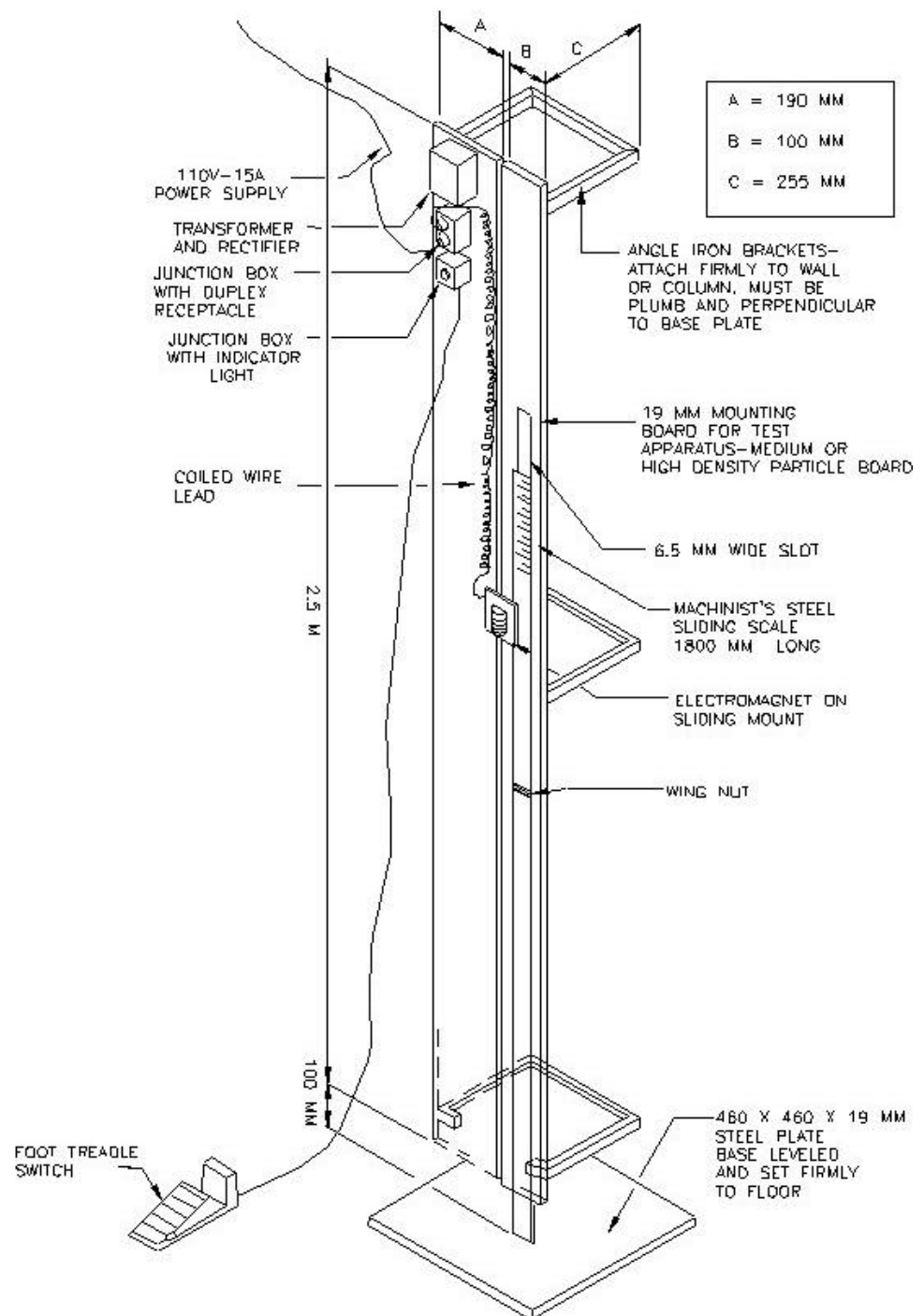
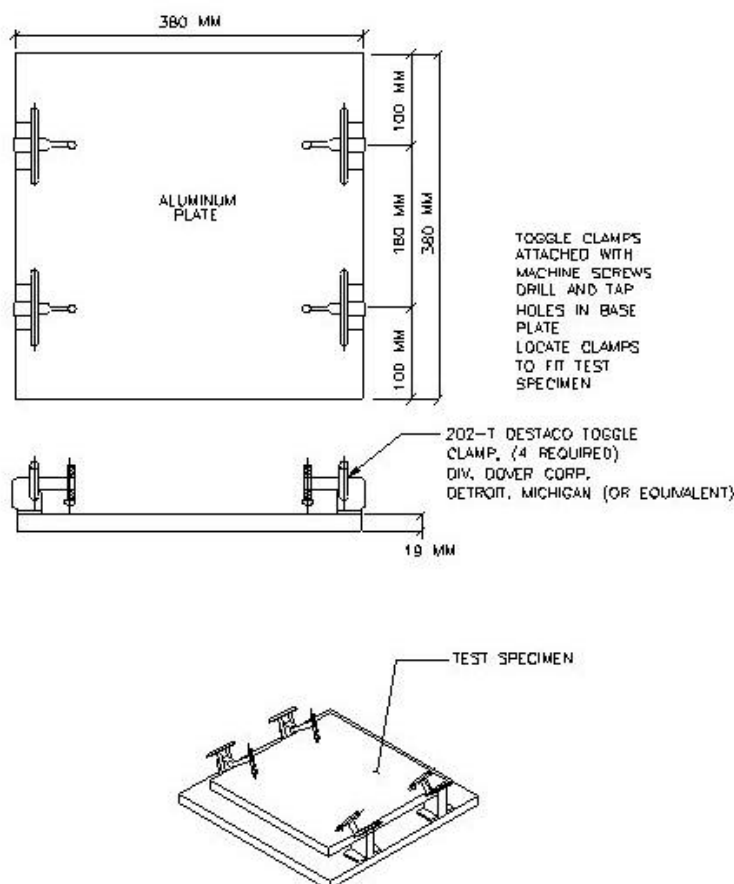


Figure 3.4



- 3.5.4.1 Examine the impact spot for cracks and fractures to determine the result.
- 3.5.4.2 Raise or lower the electromagnet height as necessary and repeat steps 3.5.4.6 through 3.5.4.8 until the maximum height at which no cracks or fractures occur is determined.
- 3.5.4.3 Drop the ball from the height determined in step 3.5.4.9 two additional times in different locations on the test specimen. If either drop fails, reduce the height by 25 mm (1 in) and continue testing until a total of three successful results have been obtained at that height.

3.5.5 Report

- 3.5.5.1 Reference to this standard.
- 3.5.5.2 Description of the material under test.
- 3.5.5.3 Maximum height (mm) achieved in three replicate impacts without a visible crack on laminate flooring surface.
- 3.5.5.4 Any deviation from the specified test method.
- 3.5.5.5 Date of the test.

3.5.6 Precision & Bias

- 3.5.6.1 Table 3-3 is based on interlaboratory studies conducted in 1999 involving three replicate tests of nine materials tested by six laboratories.

Table 3-3

<i>Material</i>	<i>Mean</i>	<i>Sr</i>	<i>SR</i>	<i>Ir</i>	<i>IR</i>
A	1172	58	260	164	732
B	1268	52	355	147	1001
C	1437	130	404	366	1138
D	1573	79	422	223	1191
E	1575	156	309	440	873
F	1784	74	451	209	1271
G	1977	136	377	382	1064
H	2020	75	75	211	982

I	2087	145	469	409	1324
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3.5.6.2 In Table 3-3, for the materials indicated:

3.5.6.2.1 Mean is the average of test results for all replicates from all labs.

3.5.6.2.2 S_r is the within-laboratory standard deviation of the mean and $I_r = 2.83S_r$ (see 3.5.7.2.4 for application of I_r).

3.5.6.2.3 S_R is the between-laboratory standard deviation of the mean and $I_R = 2.83S_R$ (see 3.5.7.2.5 for application of I_R).

3.5.6.2.4 Repeatability - In comparing two mean values for the same material obtained by the same operator using the same equipment on the same day, the means should be judged not equivalent if they differ by more than the I_r value for that material and condition.

3.5.6.2.5 Reproducibility - In comparing two mean values for the same material obtained by different operators using different equipment on different days, the means should be judged not equivalent if they differ by more than the I_R value for that material and condition. (This applies between different laboratories or between different equipment within the same laboratory.)

3.5.6.3 The judgments per 3.5.6.2.4 and 3.5.6.2.5 will have an approximate 95% (0.95) probability of being correct.

3.5.6.4 Other materials may give somewhat different results.

3.6 SMALL BALL IMPACT RESISTANCE

3.6.1 Scope

This test measures the ability of laminate flooring to resist fracture due to impact by a small diameter ball.

3.6.2 Test Apparatus

3.6.2.1 Impact apparatus as shown in Figure 3-5.

3.6.2.2 Impact dart weighing $25.0 \text{ g} \pm 0.5 \text{ g}$ ($0.88 \text{ oz} \pm 0.02 \text{ oz}$). It shall consist of a steel or brass dart tipped with a 5 mm (0.197 in) diameter steel ball. The spherical surface of the ball shall have no damaged or flattened surface. See Figure 3-5.

3.6.2.3 Dry graphite lubricant.

3.6.2.4 Overhead lighting consisting of cool white fluorescent light with the bulbs positioned parallel to the line of sight and providing an intensity of 800 lux to 1100 lux (75 foot-candles to 100 foot-candles) at the specimen surface when examined.

3.6.2.5 Black, water washable marking pen (suitable for overhead transparencies).

3.6.2.6 Underlayment foam as a closed-cell foam with a thickness of $2.0 \text{ mm} \pm 0.5 \text{ mm}$ ($0.08 \text{ in} \pm 0.02 \text{ in}$) and a density of $35 \text{ kg/m}^3 \pm 5 \text{ kg/m}^3$ ($2.2 \text{ lb/ft}^3 \pm 0.3 \text{ lb/ft}^3$) or equivalent.

3.6.2.7 Environmental Chamber maintained at $23^\circ\text{C} \pm 3^\circ\text{C}$ ($73^\circ\text{F} \pm 5^\circ\text{F}$) and relative humidity of $50\% \pm 5\%$.

3.6.2.8 Clean, soft cloth.

3.6.3 Specimens

3.6.3.1 Specimens shall be 200 mm x 200 mm x thickness (8 in x 8 in x thickness). In cases where material is less than 200 mm (8 in) in one dimension of the face, the specimen shall measure 200 mm x nominal width x nominal thickness (8 in x nominal width x nominal thickness).

3.6.4 Procedure

3.6.4.1 Condition the samples for at least 48 hours prior to the test at a temperature of $23^\circ\text{C} \pm 3^\circ\text{C}$ ($73^\circ\text{F} \pm 5^\circ\text{F}$) and a relative humidity of $50\% \pm 5\%$.

3.6.4.2 Lubricate the inside diameter of the tube assembly with the dry graphite lubricant to minimize friction with the dart.

3.6.4.3 Place the specimen face up, on underlayment foam of similar size as the specimen.

3.6.4.4 Place the specimen/underlayment assembly face up on a rigid horizontal surface.

3.6.4.5 Place the impact apparatus on the decorative surface of the specimen so that the edge of the round base is tangent to two edges of the specimen at one corner. The bottom of the circular base shall be flush against the face of the specimen.

3.6.4.6 Position the dart at a height of 125 mm (5 in).

3.6.4.7 Release the dart and impact the face of the specimen. Catch the dart when it rebounds so that multiple impacts do not occur.

3.6.4.8 Move the dart to the right 15 mm (5/8 in) while keeping the edge of the circular

base tangent to one edge of the specimen. See Figure 3-6.

3.6.4.9 Position the dart at a height of 150 mm (6 in).

3.6.4.10 Release the dart and impact the face of the specimen. Catch the dart when it rebounds so that multiple impacts do not occur.

3.6.4.11 Repeat steps 3.6.4.9 and 3.6.4.10 while increasing the dart release height by 25 mm (1 in) with each impact along the first edge of the specimen.

3.6.4.12 Use the marking pen to ink the impact points.

3.6.4.13 Wipe the impact points with a clean, soft cloth to remove excess ink.

3.6.4.14 Cracks and fractures may appear as hairline cracks, concentric circles, or chips. Dents without breaking the surface do not indicate failure.

3.6.4.15 Beginning with the impact point of lowest height, follow the impact point path of increasing impacts heights until 3 consecutive failures occur. If three consecutive failures are not observed, continue with steps 3.6.4.11 through 3.6.4.14 along edge two of the specimen.

3.6.4.16 Edge three and edge four may be used as needed until failure is noted or the highest impact release point is achieved without failure.

3.6.4.17 The impact resistance is the height value immediately preceding the series of three consecutive failures.

3.6.5 Report

3.6.5.1 Reference to this standard.

3.6.5.2 Description of the material under test.

3.6.5.3 Impact resistance as determined in 3.6.4.17.

3.6.5.4 Any deviation from the specified test method.

3.6.5.5 Date of the test.

Figure 3-6

3.6.6 Precision & Bias

3.6.6.1 Table 3-4 is based on interlaboratory studies conducted in 2001 involving three replicate tests of twelve materials tested by six laboratories.

Table 3-4

<i>Material</i>	<i>Mean</i>	<i>Sr</i>	<i>SR</i>	<i>Ir</i>	<i>IR</i>
A	165	37	37	104	104
B	182	24	47	68	132
C	189	31	37	87	104
D	211	18	18	49	49
E	225	30	45	84	127
F	240	48	49	135	136
G	271	39	39	109	109
H	279	26	34	74	96
I	282	37	50	104	139
J	299	27	71	76	198
K	379	62	135	173	378
L	426	76	86	213	240

3.6.6.2 In Table 3-4, for the materials indicated:

3.6.6.2.1 Mean is the average of test results for all replicates from all labs.

3.6.6.2.2 *Sr* is the within-laboratory standard deviation of the mean and $Ir = 2.83Sr$ (see 3.6.6.2.4 for application of *Ir*).

3.6.6.2.3 *SR* is the between-laboratory standard deviation of the mean and $IR = 2.83SR$ (see 3.6.6.2.5 for application of *IR*).

3.6.6.2.4 Repeatability - In comparing two mean values for the same material obtained by the same operator using the same equipment on the same day, the means should be judged not equivalent if they differ by more than the *Ir* value for that material and condition.

3.6.6.2.5 Reproducibility - In comparing two mean values for the same material obtained by different operators using different equipment on different days, the means should be judged not equivalent if they differ by more than the *IR* value for that material and condition. (This applies between different laboratories or between different equipment within the same

laboratory.)

3.6.6.3 The judgments per 3.6.6.2.4 and 3.6.6.2.5 will have an approximate 95% (0.95) probability of being correct.

3.6.6.4 Other materials may give somewhat different results.

3.7 WEAR RESISTANCE

3.7.1 Scope

This test measures the ability of the surface of laminate flooring to resist abrasive wear through the décor layer.

3.7.2 Test Apparatus

3.7.2.1 Abrasion apparatus. Taber model 5130 or equivalent.

3.7.2.2 Abrasion wheels. Taber model S-32 or equivalent.

3.7.2.3 Zinc plate. Taber model S-34 or equivalent.

3.7.2.4 Sandpaper shall be 180 grit aluminum oxide in an open coat with a glue bond on "A" weight finishing paper. It shall measure 12.7 mm x 158.7 mm (0.50 in x 6.25 in). Taber model S-42 or equivalent.

3.7.2.5 Double-faced adhesive tape 12.7 mm (0.50 in) wide.

3.7.2.6 Analytical balance with resolution and accuracy to 0.001g.

3.7.2.7 Environmental Chamber maintained at $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$ ($73^{\circ}\text{F} \pm 5^{\circ}\text{F}$) and relative humidity of $50\% \pm 5\%$.

3.7.2.8 Isopropyl alcohol.

3.7.2.9 Powdered talc.

3.7.2.10 Clean, soft cloth.

3.7.2.11 TAPPI Size Estimation Chart.

3.7.2.12 Swedish Standards Institution Article No. 21824

3.7.3 Specimens

3.7.3.1 For each test two specimens shall be randomly selected from the manufactured lot. No two specimens shall be selected from the same tile. Each specimen shall measure 100 mm x 100 mm x nominal thickness (4 in x 4 in x nominal thickness).

3.7.4 Calibration

3.7.4.1 The sandpaper strips shall be conditioned and stored at $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$ ($73^{\circ}\text{F} \pm 5^{\circ}\text{F}$) and a relative humidity of $50\% \pm 5\%$. They shall be maintained in this environment for at least 48 hours prior to use.

3.7.4.2 Attach the S-32 wheels, the 500 gram weights, and the vacuum. The vacuum shall be set to 90% capacity. The vacuum head should always be approximately 6 mm (1/4 in) from the surface that is being abraded.

3.7.4.3 Dust the S-32 wheels with powdered talc.

3.7.4.4 Apply a sandpaper strip to the periphery of each of the two S-32 wheels. Butt join the ends to avoid overlap of the ends and/or contamination of the grit.

3.7.4.5 Attach a zinc plate to the apparatus and lower the two wheels to the surface of the plate.

3.7.4.6 Set the abrader for 500 cycles and turn it on.

3.7.4.7 At the end of 500 cycles, raise the wheels and remove the zinc plate.

3.7.4.8 Clean the plate with isopropyl alcohol and a clean soft cloth. Allow the plate to dry.

3.7.4.9 Weigh the plate to the nearest 0.001 g and record as W1.

3.7.4.10 Return the plate to the abrader.

3.7.4.11 Remove the old sandpaper and apply fresh sandpaper.

3.7.4.12 Lower the abrader wheels and set the abrader to run an additional 500 cycles.

3.7.4.13 Repeat steps 3.7.4.6 through 3.7.4.9. Record the second weight as W2.

3.7.4.14 Repeat 3.7.4.13 to obtain W3.

3.7.4.15 (W1 - W2) and (W2 - W3) must be $110 \text{ mg} \pm 30 \text{ mg}$. If either difference is out of the range, disregard those values and repeat the calibration as outlined above. If the second set of weight differences is also out of range, reject the lot of sandpaper and replace with another lot.

3.7.4.16 Calculate a correction factor for a lot of sandpaper as follows:

$$\text{Correction Factor} = \frac{(W1 - W2) + (W2 - W3)}{2}$$

2 x 110

3.7.5 Procedure

3.7.5.1 Clean the surface of the specimen with isopropyl alcohol and a clean soft cloth. Allow the specimen to dry.

3.7.5.2 Attach the specimen to the abrader.

3.7.5.3 Dust the abrader wheels with powdered talc and apply fresh sandpaper to the wheels. Reset the counter to 0.

3.7.5.4 Start the abrader and inspect the specimen every 200 cycles. Replace the sandpaper every 200 cycles.

3.7.5.5 Continue until the initial point begins to show for the specimen. Continue the test and inspect every 50 cycles. Compare the wear areas with a TAPPI Size Estimation Chart. Initial point is defined as the following: Initial wear point is a visible spot greater than or equal to 0.60 mm² (0.0009 in²) where the décor design has been removed from the surface wear layer and the base paper is exposed. At the point of initial wear in one quadrant, inspect the sample every 25 cycles until the initial wear point in three quadrants is achieved. Refer to the Swedish Standards Institution Article No. 21824 for a more complete visual explanation of the initial point. Once an initial point in three quadrants has been reached the test is terminated and the total cycles for the specimen are recorded as the specimen's initial point.

3.7.6 Calculations

3.7.6.1 Multiply the number of cycles required to reach an initial point for each sample by the correction factor.

3.7.6.2 Average the two corrected results.

3.7.6.3 Round the average to the nearest 50 cycles.

3.7.6.4 Wear Resistance is the average of the two corrected initial points rounded to the nearest 50 cycles.

3.7.7 Report

3.7.7.1 Reference to this standard.

3.7.7.2 Description of the material under test.

3.7.7.3 Wear resistance.

3.7.7.4 Any deviation from the specified test method.

3.7.7.5 Date of the test.

3.7.8 Precision & Bias

3.7.8.1 Table 3-5 is based on interlaboratory studies conducted in 1999 involving three replicate tests of nine materials tested by six laboratories.

Table 3-4

<i>Material</i>	<i>Mean</i>	<i>Sr</i>	<i>SR</i>	<i>Ir</i>	<i>IR</i>
A	2117	282	395	795	1115
B	2214	117	458	329	1293
C	2283	107	338	303	953
D	2289	100	291	282	821
E	2797	109	287	306	810
F	2922	205	548	578	1544
G	2997	169	371	477	1045
H	3147	165	472	465	1332
I	3814	147	338	415	952

3.7.8.2 In Table 3-5, for the materials indicated:

3.7.8.2.1 Mean is the average of test results for all replicates from all labs.

3.7.8.2.2 *Sr* is the within-laboratory standard deviation of the mean and *Ir* = 2.83*Sr* (see 3.7.8.2.4 for application of *Ir*).

3.7.8.2.3 *SR* is the between-laboratory standard deviation of the mean and *IR* = 2.83*SR* (see 3.7.8.2.5 for application of *IR*).

3.7.8.2.4 Repeatability - In comparing two mean values for the same material obtained by the same operator using the same equipment on the same day, the means should be judged not equivalent if they differ by more than the *Ir* value for that material and condition.

3.7.8.2.5 Reproducibility - In comparing two mean values for the same material obtained by

different operators using different equipment on different days, the means should be judged not equivalent if they differ by more than the IR value for that material and condition. (This applies between different laboratories or between different equipment within the same laboratory.)

3.7.8.3 The judgments per 3.7.8.2.4 and 3.7.8.2.5 will have an approximate 95% (0.95) probability of being correct.

3.7.8.4 Other materials may give somewhat different results.

3.8 DIMENSIONAL TOLERANCES

3.8.1 Scope

This test measures the dimensional variance between tiles of laminate flooring in a manufactured free-standing (unrestricted) shape in respect to thickness, length, width, straightness, and squareness.

3.8.2 Definitions

3.8.2.1 Test material shall be defined by the following orientation:

- Length X = Axis of the greater length along the decorative face of the product.
- Width Y = Axis of the lesser length along the decorative face of the product.
- Thickness Z = Axis of the specimen from decorative face to back.
- (Note: For products with the decorative face in a square format (all edges of equal nominal length), the X and Y axes are arbitrarily chosen from the orthogonal axis parallel to the edges of the product.)

3.8.2.2 Straightness: The freedom of an edge from curves, bends, angles, or irregularities.

3.8.2.3 Squareness: Conformance of a corner and the two adjacent edges in question to a right (90°) angle.

3.8.3 Test Apparatus

3.8.3.1 Straight edge of length greater than the long axis (X-axis dimension) of the specimen and having maximum straightness deviation of 0.05 mm/m (0.0006 in/ft).

3.8.3.2 A flat horizontal surface of dimensions greater than the specimen.

3.8.3.3 A caliper of jaw capacity suitable for measuring the length (X-axis dimension) and width (Y-axis dimension) giving an accuracy of 0.05 mm (0.002 in).

3.8.3.4 A micrometer suitable for measuring thickness (Z-axis dimension) having flat and parallel circular measuring surfaces of 6.34 mm (0.25 in) diameter and an accuracy of 0.01 mm (0.0004 in).

3.8.3.5 Feeler gauge with thickness leaves in increments of 0.05 mm (0.002 in) and total range of 0.05 mm to 1.0 mm (0.002 in to 0.040 in).

3.8.3.6 The instruments utilized in this method shall have current NIST traceable certificates available to assure current calibration of the equipment.

Note: Feeler gauges cannot be certified.

3.8.4 Specimens

3.8.4.1 Test specimens shall be of the nominal size as produced by the manufacturer. The specimens shall not be restricted from movement during the tests (i.e. bonded to other materials). A set shall consist of 5 specimens.

3.8.4.2 Five (5) specimens shall constitute a set for purposes of dimensional testing.

3.8.5 Procedure

3.8.5.1 Condition the samples for at least 48 hours prior to the test at a temperature of 23 °C ± 3 °C (73 °F ± 5 °F) and a relative humidity of 50% ± 5%.

3.8.5.2 The specimen under test must be a single sample of nominal manufactured size.

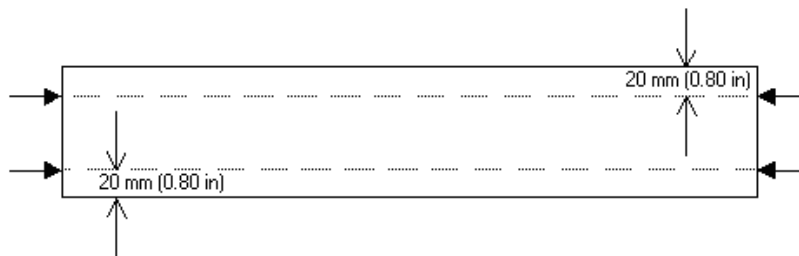
3.8.5.3 The surfaces of the specimen must be free from foreign bodies and any protrusions from the face and edges of the specimen. These materials must be removed prior to the start of the test.

3.8.5.4 Proceed to the subsequent section of the method titled in the dimensional area for which tests are to be conducted. In the case of multiple parameters to be checked, the order of the tests is modeled after the order of this specification.

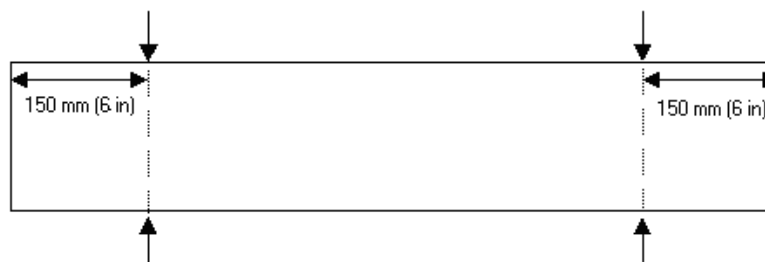
3.8.5.5 Length (X axis dimension)

3.8.5.5.1 Using a suitable caliper, close the jaws gently onto the edge of the decorative surface between which the length is to be determined. Do not force the instrument. (See Figure 3-7 for location of measurements).

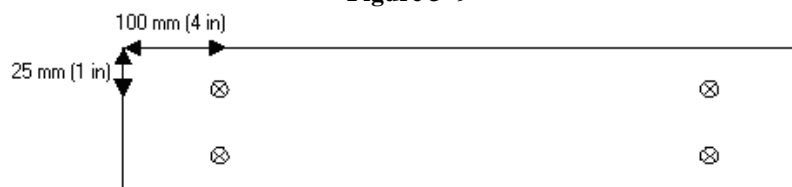
- 3.8.5.5.2 Record the length indicated by the caliper to the nearest 0.05 mm (0.002 in).
 3.8.5.5.3 Two length measurements (L), 20 mm (0.80 in) from each long edge parallel to the X-axis, are to be made on each of the five specimens for a total of ten length measurements.
 3.8.5.5.4 Determine the maximum (Lmax) and minimum (Lmin) of the ten length values. Calculate the range of lengths (Lrange) as $L_{range} = L_{max} - L_{min}$.
 3.8.5.5.5 Report Lrange.

Figure 3-7

- 3.8.5.6 Width (Y axis dimension)
 3.8.5.6.1 Using a suitable caliper, close the jaws gently onto the edge of the decorative surface between which the width is to be determined. Do not force the instrument. See Figure 3-8 for location of measurements.
 3.8.5.6.2 Record the width indicated by the caliper to the nearest 0.05 mm (0.002 in).
 3.8.5.6.3 Two width measurements (W), 150 mm (6 in) from each short edge parallel to the Y axis, are to be made on each of the five specimens for a total of ten width measurements. (Note: On square tiles, the width measurements are made 20 mm (0.80 in) from the two edges not used for length measurements).
 3.8.5.6.4 Determine the maximum (Wmax) and minimum (Wmin) of the ten width values. Calculate the range of widths (Wrange) as $W_{range} = W_{max} - W_{min}$.
 3.8.5.6.5 Report Wrange.

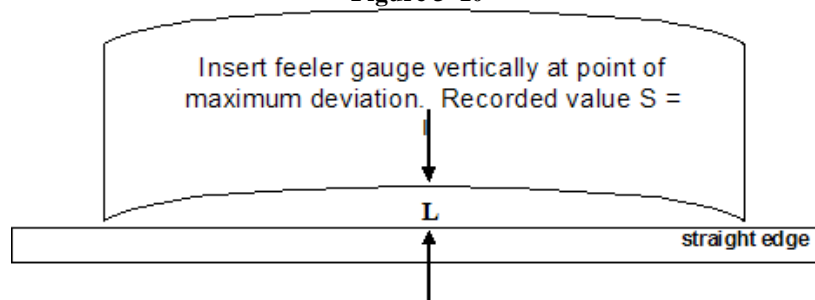
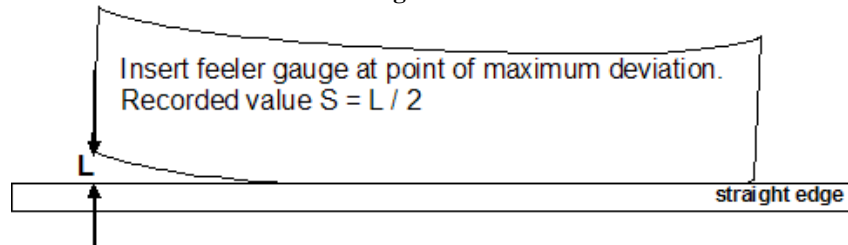
Figure 3-8

- 3.8.5.7 Thickness (Z axis dimension)
 3.8.5.7.1 Using a suitable micrometer, close the jaws gently onto the surfaces between which the thickness is to be determined. Do not force the instrument. See Figure 3-9 for location of measurements.
 3.8.5.7.2 Record the thickness indicated by the micrometer to the nearest 0.025 mm (0.001 in).
 3.8.5.7.3 Four thickness measurements (T), 100 mm (4 in) from each short edge and 25 mm (1 in) from each long edge, are to be made on each of the five specimens for a total of 20 thickness measurements. See Figure 3-9.
 3.8.5.7.4 Determine the maximum (Tmax) and minimum (Tmin) of the 20 thickness values. Calculate the range of thickness (Trange) as $T_{range} = T_{max} - T_{min}$.
 3.8.5.7.5 Report Trange.

Figure 3-9

- 3.8.5.8 Straightness

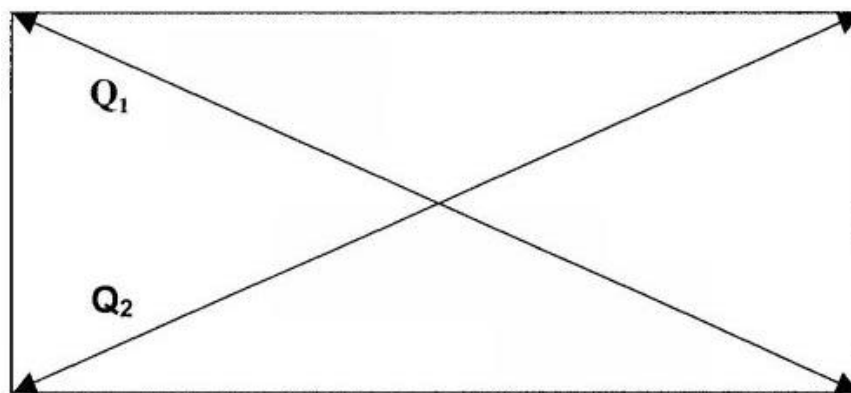
- 3.8.5.8.1 Place the specimen, decorative layer up, on a flat horizontal surface.
- 3.8.5.8.2 Place the straight edge against the edge of the specimen parallel to the X axis so that the straight edge is touching the specimen at the decorative edge.
- 3.8.5.8.3 If a gap is visible, insert vertically a feeler gauge of successive thickness leaves into the gap at the maximum deviation until the largest thickness leaf (L) that will fit without force into the gap is found.
- Note1: If the surface layer demonstrates a concave appearance, measure the gap at the point of maximum deviation and record the measured gap. See Figure 3-10. In this instance $S = L$.
- Note2: If the surface layer demonstrates a convex appearance, place the decorative edge against the straight edge as illustrated in Figure 3-11. Measure the gap at the point of maximum deviation, calculate and record the value of measured gap/2 expressed as $S = L/2$.
- 3.8.5.8.4 Repeat 3.8.5.8.2 to 3.8.5.8.3 for the opposite and adjacent edges for a total of four values per test specimen.
- 3.8.5.8.5 Repeat 3.8.5.8.1 to 3.8.5.8.4 for all 5 samples for a total of 20 values.
- 3.8.5.8.6 Calculate the maximum deviation from straightness (S_{max}) as the maximum of the 20 values determined in 3.8.5.8.5.
- 3.8.5.8.7 Report S_{max} to the nearest 0.05 mm (0.002 in).

Figure 3-10**Concave Edge****Figure 3-11****Convex Edge****3.8.5.9 Squareness**

Note: Specimen must conform to length, width, and straightness tolerances prior to proceeding.

- 3.8.5.9.1 Place the specimen, decorative layer up, on the flat horizontal surface.
- 3.8.5.9.2 Measure the decorative surface of the tile from one corner to the opposing corner and again for the remaining corners to obtain two diagonal measurements (Q_1 and Q_2) as shown in Figure 3-12.
- 3.8.5.9.3 Obtain the maximum absolute value (Q_{dif}) of the difference of the two diagonal measurements as demonstrated by $Q_{dif} = |Q_1 - Q_2|$ for each of the tested specimens.
- 3.8.5.9.4 Report Q_{max} as the maximum Q_{dif} value to the nearest 0.05 mm (0.002 in).

Figure 3-12



3.8.6 Report

- 3.8.6.1 Reference to this standard.
- 3.8.6.2 Description of the material under test.
- 3.8.6.3 Dimensional characteristics as determined by the appropriate section.
- 3.8.6.4 Any deviation from the specified test method.
- 3.8.6.5 Date of the test.

3.8.7 Precision & Bias

- 3.8.7.1 Test method precision and bias have not been established at this time. It is currently under consideration of the NALFA Technical Committee.

3.9 CASTOR CHAIR RESISTANCE

3.9.1 Scope

The test specifies a method for determining the change of appearance and stability of a laminate floor, including joints, under the movement of a castor chair.

3.9.2 Test Apparatus

- 3.9.2.1 Castor chair apparatus - Feingerate Baumberg Model Rollstuhltestgerat Type 28167 or equivalent with weights installed to provide 90kg (198 lbs) load.
- 3.9.2.2 The 3 castors shall be either 1) Single-wheel polyamide with a Shore A hardness of 95 ± 5 or, 2) Type W polyurethane. The castor wheel shall be 50 mm (2 in) diameter and 20 mm (3/4 in) wide.
- 3.9.2.3 Overhead lighting consisting of cool white fluorescent light with the bulbs positioned parallel to the line of sight and providing an intensity of 800 lux to 1100 lux (75 foot-candles to 100 foot-candles) at the specimen surface when examined.
- 3.9.2.4 Denatured alcohol.
- 3.9.2.5 Clean, soft cloth.

3.9.3 Specimens

- 3.9.3.1 Specimens shall be circular with a diameter of 750 mm (29.5 in) x the nominal thickness of the material. Joints in the specimen, if necessary, shall be treated according to the manufacturer's instructions.

3.9.4 Procedure

- 3.9.4.1 Condition the samples for at least 48 hours prior to the test at a temperature of $23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ ($73\text{ }^{\circ}\text{F} \pm 5\text{ }^{\circ}\text{F}$) and a relative humidity of $50\% \pm 5\%$.
- 3.9.4.2 Clean the castors with a soft cloth and alcohol. Inspect and replace if necessary.
- 3.9.4.3 Mount the specimen on the platform.
- 3.9.4.4 Lower the castor base to the surface of the specimen and load weights. Adjust the vacuum head to remove debris.
- 3.9.4.5 Preset the counter for 25,000 revolutions and turn on the apparatus.
- 3.9.4.6 At the end of the test remove the castor base and examine the specimen with standard lighting and viewing distances/angles. Record any damage such as delamination, opening of seams, or crazing. Changes in gloss or sheen are not considered damage and should be ignored.

3.9.5 Report

- 3.9.5.1 Reference to this standard.
- 3.9.5.2 Description of the material under test.
- 3.9.5.3 List the nature of observable damage and the number of revolutions conducted on

the specimen.

3.9.5.4 Any deviation from the specified test method.

3.9.5.5 Date of the test.

3.9.6 Precision & Bias

3.9.6.1 Test method precision and bias have not been established at this time. It is currently under consideration of the NALFA Technical Committee.

Section 4: THIRD PARTY CERTIFICATION

4.1 COMPLIANCE

When reference is made to this standard in statements of compliance, the laminate product shall meet all of the requirements in their entirety. Any laminate marked or labeled as being compliant with this standard shall meet all of the requirements of this standard and shall be certified.

4.2 CERTIFICATION

All Certification and testing shall be performed by an independent testing lab. Compliant flooring shall be labeled with the NALFA/ANSI mark and shall be listed. A party seeking certification shall submit its results, as well as identifying information for the test lab, to NALFA for review and verification. Laminate flooring must undergo third party testing at least every five years or whenever a product is substantially changed.

4.3 EFFECTIVE DATE

The certification requirements shall become effective six months after the publication date of this standard.

Appendix A

This appendix is not part of the ANSI/NALFA minimum requirements for laminate flooring but is included for informational purposes only.

Slip Resistance	ASTM F 489 - Standard Test Method for Using a James Machine
Environmental (PPM)	ASTM E 1333 - Standard Test Method for Determining Formaldehyde Leach From Wood Products Under Defined Test Conditions Using a Large Chamber
Sound	ASTM E 90 STC -- Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions ASTM E 413 - Classification for Rating Sound Insulation ASTM E 492 IIC -- Standard Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine
Fire Behavior	ASTM E 648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source ASTM E 662 - Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials
Thermal Conductivity	ASTM C 518 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmissions Properties by Means of the Heat Flow Meter Apparatus

Auto Ignition	ASTM D 1929 - Standard Test Method for Ignition Properties of Plastics
Light Reflectance: Luminance	ASTM E 284 - Standard Terminology of Appearance

Appendix B

This appendix is not part of the ANSI/NALFA minimum requirements for laminate flooring but is included for informational purposes only.

Moisture Content

1.0 Scope

The test measures the moisture content of laminate flooring.

1.1 Method Addendum

1.1.1 The test method shall conform to ASTM D 1037 in Sections 119 through 120 with additional criteria:

1.1.2 Sample size shall consist of two specimens with a size of 75 mm x 75 mm (3 in x 3 in) with smoothly and squarely trimmed edges collected from opposite ends of a sample.

1.1.3 Specimens shall not be preconditioned.

1.1.4 Weigh specimen and place in oven at $103^{\circ}\text{C} \pm 2^{\circ}\text{C}$ Weigh specimen and place in oven ($217^{\circ}\text{F} + 4^{\circ}\text{F}$) for 48 hours.

1.1.5 Reweigh specimen directly after removal from oven.

1.1.6 Calculate moisture content per Section 120.1.

1.2 Test Report

1.2.1 Average moisture content of the two specimens.

Light Reflectance (Luminance)

2.0 Scope

This test measures light reflectance based on the definition of Luminance Factor of laminate flooring.

2.1 Method Addendum

2.1.1 The definition shall conform to ASTM E 284 using the following methodology.

2.1.2 Luminance Factor is defined as the tristimulus value Y.

2.1.3 Values are to be determined by Hunter Lab ColorQuest II? Spectrophotometer or equivalent using C.I.E. system guidelines with cool white fluorescent illuminate, 10-degree observer, spectral reflection included.

2.2 Test Report

2.2.1 Calculated Tristimulus value Y shall be reported.

Appendix C

This appendix is not part of the ANSI/NALFA minimum requirements for laminate flooring but is included for informational purposes only.

Glossary

1. Acclimation: Adaptation of the laminate floor to its installation environment.
2. Acoustical Properties: Absorbance, reflection or transmission of sound waves.
3. Adhesion: A chemical process by which two materials can be joined together.
4. Antistatic: Ability to limit the accumulation of static electricity on a surface.
5. Backer: A material bonded to the back of the substrate.
6. Balanced Construction: A panel construction that has materials of similar properties bonded to both sides of the panel.
7. Bond: Adhesion.
8. Chemical Resistance: The degree to which a material resists visual or physical degradation from exposure to various household and/or industrial chemicals.

9. Colorfastness: The ability of a material to retain its original color upon exposure to light or other source of degradation (i.e., light resistance).
10. Compact Laminate: High Pressure Laminate greater than or equal to 2 mm (0.08 in) in thickness.
11. Continuous Press Laminate (CPL): A manufacturing process where the laminate is formed on a continuous double-belted press.
12. Continuous Laminate Flooring: A product created by permanently bonding a continuous press laminate to a core.
13. Core: The center of a panel (e.g., surface layer, core, and backer).
14. Crook: A specific type of warp when a panel has a curvature from end to end, edgewise, from a straight line (i.e., banana).
15. Crowning: A specific type of warp when a panel assumes the shape of an inverted "U" along the length or width dimensions of the face (i.e., convex).
16. Cupping: A specific type of warp where a panel assumes the shapes of a "U" along the length or width dimensions of the face (i.e. concave).
17. Décor Layer: The layer of laminate flooring providing visual aesthetic properties.
18. Deflection: The bending of a material between supports when a load is applied.
19. Delaminating: Separation of the panel's layer(s).
20. Density: Unit weight per volume of a panel expressed in lb/ft³ or kg/m³.
21. Depression: A dent in the surface of a panel.
22. Dimensional Stability: The ability of a material to resist changes in measured dimensions caused by environmental factors (e.g., moisture or temperature).
23. Direct Laminate Flooring: A product where resin impregnated material layer(s) is permanently bonded to the core.
24. Direct Press Laminate (DPL): A laminating process by where the wear layer and décor surface are bonded directly to the substrate in a single step.
25. Embossing: A process by which the surface of the panel is given a texture.
26. Equilibrium Moisture Content: The moisture content at which the material neither gains nor loses moisture at a given relative humidity.
27. Expansion Gap: A space necessary between fixed objects (i.e. walls of a room, pipes, and cabinets) and between the material itself to allow for the movement of the material.
28. Fiberboard: A core material primarily composed of cellulose fibers combined with synthetic resins or other suitable bonding systems under heat and pressure. The materials are usually designated as low, medium, or high density (e.g., MDF or HDF).
29. Flame Spread: Measurement of the flame propagation along the surface of a material.
30. Floating Floor: Installation method by which the flooring panels are connected together and not attached to the subfloor.
31. High Density Fiberboard (HDF): A fiberboard with density greater than 800 kg/m³ (50 lb/ft³).
32. High Pressure Laminate (HPL): A laminating process where materials are consolidated under heat and pressure exceeding 5.17 MPa (750 psi).
33. High-Pressure Laminate Flooring: A product created by permanently bonding high-pressure decorative laminate to a core.
34. Impact Resistance: Ability to resist fracture or damage from a falling object.
35. Inlay: A decorative effect used in flooring by combining elements of the same material but with different colors or patterns (e.g., borders or feature strips).
36. Laminate: A product made by bonding together two or more layers of material.
37. Laminate Flooring: A rigid floor covering with a surface layer consisting of one or more thin sheets of a fibrous material (usually paper), impregnated with aminoplastic thermosetting resins (usually melamine). These sheets are either pressed as such (HPL, CPL, Compact), and in the case of HPL or CPL bonded on a substrate, or in the case of DPL directly pressed on a substrate. The product is normally finished with a backing primarily used as a balancing material. Its performance values are set by the NALFA/ANSI Standard.
38. Medium Density Fiberboard (MDF): A type of core material primarily composed of lignocellulosic fibers combined with a synthetic resin or other suitable bonding system and bonded together under heat and pressure.
39. Melamine Resin: A thermosetting resin used in the impregnation process of materials used to make laminate flooring.
40. Moisture Content: The amount of water in the material, usually expressed as a

percentage of the dry weight.

41. Moisture Meter: A tool used to measure moisture content.
42. Overlay: A product of paper, plastic, film, metal foil, or other material incorporated into the laminate flooring surface that provides the wear resistance and protection.
43. Panels: Finished sections of the laminate flooring (e.g. planks, tiles, and squares).
44. Particleboard: A core material primarily composed of cellulosic materials (usually wood), generally in the form of discrete pieces or particles, as distinguished from fibers. The cellulosic material is combined with a synthetic resin or other suitable bonding system by a process in which the interparticle bond is created by the bonding system under heat and pressure.
45. Pattern End Matched: When the ends of the flooring panels, typically similar patterns, are matched end to end to yield a continuous linear effect.
46. Peaking: Areas of the laminate flooring at adjoining panel seams that have risen above the intended
47. Plank: A tile approximately five or six times longer than wide.
48. Pressing: A manufacturing process by which material layers are consolidated using pressure.
49. Residual Indentation: The difference between the initial thickness and the final thickness after performing the static load test.
50. Resins: A polymeric material used for impregnating and bonding layers of laminate flooring.
51. Seams: A line or junction where panels are connected together.
52. Stain Resistance: The degree which a material resists permanent discoloration from exposure to household items and/or industrial chemicals.
53. Substrate: The core material of the laminate flooring.
54. Sub-floor: A pre-existing supporting surface in a structure.
55. Surface Layer: The outermost layer of laminate flooring designed to be the visible side when installed (i.e., wear layer).
56. Tile: A panel of geometric shapes (e.g., squares, rectangles, etc).
57. Thermosetting Resins: Resins that cure by chemical reaction to form bonds and do not melt when exposed to heat.
58. Underlayment: A material used between the laminate flooring and the subfloor (e.g., foam padding).
59. Warp: Crowning, cupping, or crook.
60. Wear Resistance: Ability of the laminate flooring surface to resist wear through its décor layer.
61. Wear Layer: Surface layer.

Appendix D

Test Laboratories

This appendix is not part of the ANSI/NALFA minimum requirements for laminate flooring but is included for informational purposes only.

Certain entities have indicated an ability to perform at least portions of the tests outlined within this standard. NALFA assumes no responsibility for these groups and they are included here as a service to the user. Each should be contacted to verify their ability to perform required testing as well as the cost involved. For a list of applicable laboratories, contact NALFA at (202) 785-9500.

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