SAE International™

SURFACE VEHICLE STANDARD

SAE J315

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Fiberboard Test Procedure

1. Scope

This SAE Standard provides test methods for determining the critical characteristics of basic or finished fiberboard products. Where applicable, methods of test developed by SAE and ASTM have been referenced.

2. References

2.1 Applicable Publications

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J361—Procedure for Visual Evaluation of Interior and Exterior Automotive Trim
SAE J365—Method of Testing Resistance to Scuffing of Trim Materials
SAE J369—Flammability of Polymeric Interior Materials—Horizontal Test Method
SAE J912—Test Method for Determining Blocking Resistance and Associated Characteristics of Automotive Trim Materials
SAE J913—Test Method for Wicking of Automotive Fabrics and Fibrous Materials
SAE J947—Glossary of Fiberboard Terminology
SAE J948—Test Method for Determining Resistance to Abrasion of Automotive Bodycloth, Vinyl, and Leather, and the Snagging of Automotive Bodycloth
SAE J949—Test Method for Determining Stiffness (Modulus of Bending) of Fiberboards
SAE J1885—Accelerated Exposure of Automotive Interior Trim Components Using a Controlled Irradiance Water Cooled Xenon-Arc Apparatus
SAE J2412—Accelerated Exposure of Automotive Interior Trim Components Using a Controlled Irradiance Xenon-Arc Apparatus

2.1.2 ASTM PUBLICATIONS

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM D 95—Method of Test for Water in Petroleum Products and Other Bituminous Materials
ASTM D 644—Method of Test for Moisture in Paper
ASTM D 645—STM for Thickness of Paper and Paperboards
ASTM D 747—Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam
ASTM D 774—Method of Test for Bursting Strength of Paper
ASTM D 5420—Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight
ASTM D 5628—Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Dart

3. Fiberboard Terminology

See SAE J947.

4. Recommendations

Fiberboard fabrication and finishing techniques, such as crease bending, scoring, forming, perforating, and the application of barrier coatings or paints, will modify the characteristics of the producer's basic material. Consequently, it is recommended that separate but related specifications be established for (1) the properties of the basic product and (2) the finished processed material.

5. Conditioning

Tests for material classification and for arbitration purposes shall be made on material conditioned to a constant weight in a controlled atmosphere of 21 °C ± 1 °C (70 °F ± 2 °F) and 50 or 65% relative humidity (as specified by the user). Quality control tests can be conducted on unconditioned specimens unless otherwise specified by the user.

6. Thickness

Thickness shall be measured by a micrometer having two plane, parallel faces, the smaller of which should be circular and 161 - 212 mm^2 (0.25 - 0.33 in^2) in area. When the specimen is clamped between the faces, it should be under a steady pressure of 48.23 - 62.0 kPa (7.0 - 9.0 psi). The graduations of the dial face should be such as to permit estimating the thickness to at least 0.013 mm (0.0005 in).

The sample should be comprised of at least three representative specimens, each of which should be tested in four separate places. The test should be made by placing the specimen between the jaws of the micrometer and lowering the pressure foot gently upon the surface of the specimen, taking care that the edge of the foot is at least 0.25 in (6.3 mm) from the edge of the specimen. The average thickness should be reported in decimals of an inch (millimeter) to the nearest 0.013 mm (0.0005 in) and may be supplemented by maximum and minimum readings.

Fundamental technique and apparatus used shall be similar to those of ASTM D 645.

NOTE—Specimens cut for dimensional stability tests are satisfactory for these measurements.

7. Weight

The weight shall be determined by weighing 305 x 305 mm (1 x 1 ft) of material to the nearest 0.10 g. Dimensions shall be measured accurately to the nearest 0.25 mm (0.01 in). Three representative specimens shall be weighed and the average computed and reported in pounds per 1000 ft^2 or grams per square meter.

8. Density

Density in pounds per cubic foot (kilograms per cubic meter) shall be computed using data obtained from the average thickness and weight report.

9. Bursting Strength

The bursting strength shall be determined using the conventional power-driven hydraulic type machine. The average value to the nearest 34.5 kPa (5 psi) obtained by making five bursts on each side of three specimens is to be reported. Fundamental technique and apparatus used shall conform to ASTM D 774, Method of Test for Bursting Strength of Paper.

10. Cohesive Strength

This test is designed to measure the force required to rupture a sample of paperboard at the weakest layer.

10.1 Apparatus

Jumbo Mullen Tester (Figure 1):

a. Brass disks, 1.6 mm (0.063 in) thick and 60.71 mm (2.390 in) diameter
b. Annular brass disks, 1.6 mm (0.063 in) thick, 76 mm (3 in) outer diameter, and 34.93 mm (1.375 in) inner diameter
c. Steel sleeve, approximately 69.9 mm (2.75 in) inside diameter, 13 mm (0.5 in) high, and 3.18 mm (0.125 in) thick
d. Means of cleanly cutting an annular sample of 60.71 mm (2.390 in) outer diameter and 34.93 mm (1.375 in) inner diameter

10.2 Procedure

Cut a 356 x 76 mm (14 x 3 in) sample of the board to be tested. Cover each side with a strip of 76 mm (3 in) double-face, pressure-sensitive tape or equivalent without peeling the protective liner, and die cut four annular specimens for testing. Peel one of the protective liners from each sample and press lightly to one of the solid disks; then peel the other liner and place an annular disk on the other side, using the hole in each for alignment.

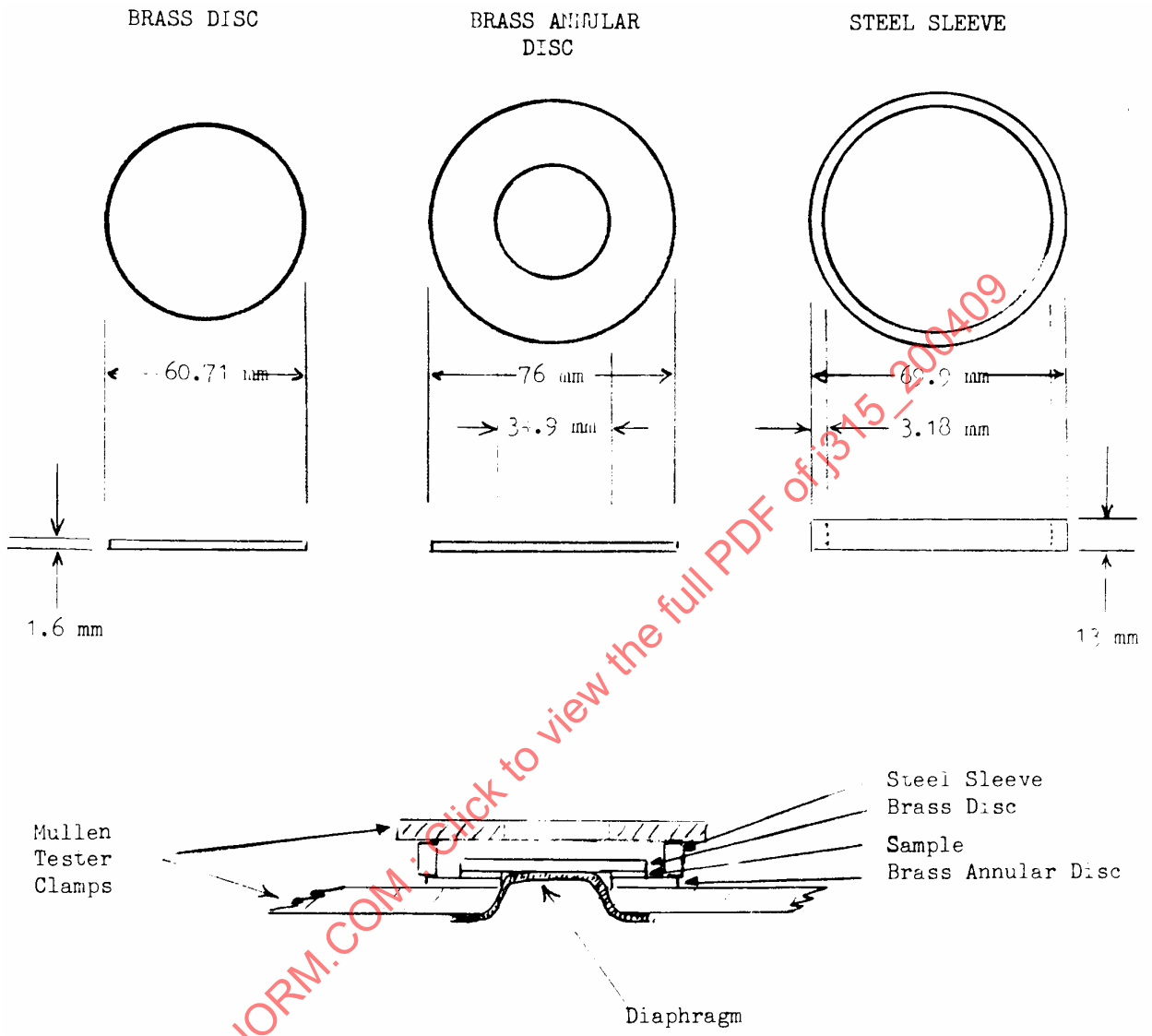

FIGURE 1

Press the sample between the disks under about 690 kPa (100 psi). This can be done using the sample clamp of the Mullen tester itself. A pile of a dozen samples may be pressed at one time.

Place one sample on the lower platen of the Mullen tester with the annular disk down and centrally located so that the hole in the disk is aligned with the hole in the platen. Place the steel sleeve upon the annular disk and clamp in place with the upper platen. Operate the tester until the expansion of the diaphragm against the solid disk ruptures the sample. Use the 0 - 1380 kPa (0 - 200 psi) scale.

Record the maximum pressure and note the location of the rupture. Failure of the tape bond invalidates a test.

Since the area of contact between diaphragm and solid disk varies according to the pressure, do not calculate the pressure per square inch of sample, but report the results as gage readings, in kPa (psi). However, the area of the sample is exactly 19.4 cm^2 (3 in^2) if the user desires to calculate kPa (psi).

11. Moisture Content

The moisture content shall be determined by observing the loss in weight of a 100 x 100 mm (4 x 4 in) specimen (the test specimen may be delaminated to facilitate moisture removal), upon drying in an air circulating oven maintained at 102 °C ± 3 °C) 215 °F ± 5 °F until a constant weight is obtained. The weight loss shall be expressed as percent moisture on the basis of the initial weight of the specimen. For reference purposes, see ASTM D 644, Method of Test for Moisture in Paper. In cases where appreciable volatile material other than water is known to exist, the Dean and Stark apparatus may be used. See ASTM D 95, Method of Test for Water in Petroleum Products and Other Bituminous Materials.

12. Water Absorption

The percent of water absorption shall be determined by observing the gain in weight of each of three 100 x 100 mm (4 x 4 in) specimens upon immersion in distilled or deionized water. The test specimens shall be cut with a paper cutter or band saw to prevent delamination of the edges. The specimens shall be weighed to the nearest 0.01 g and then submerged horizontally under 25 mm (1 in) of water maintained at 21 °C ± 1 °C (70 °F ± 2 °F) and at a pH of 7.0 ± 0.5. The samples were removed after periods of 2.5 and 24 h, ± 5% and visible surface water is removed by wiping or blotting. The specimens shall be immediately reweighed to the nearest 0.01 g. The weight of absorbed water shall be calculated and the water absorption expressed as percent by weight based on the initial weight. The average value for each time period is reported.

13. Thickness Swell

The thickness shall be determined to the nearest 0.025 mm (0.001 in) by averaging four readings taken at the center of each side of the water absorption specimen and 25 mm (1 in) from the edge. The caliper reading shall be taken using the same apparatus as described in Section 6 The specimen shall be soaked and treated in the same manner as established in Section 12 Immediately following the tests, the specimen shall be recalipered in the same location and manner, and the average reading established for each soaked specimen. The following formula shall be used when calculating the percent of swelling:

$$S = \left[\frac{T_2 - T_1}{T_1}\right] 100 \qquad \text{(Eq. 1)}$$

where:

S = swelling, %
T_1 = average thickness before soaking, mm (in)
T_2 = average thickness after soaking, mm (in)

14. Warpage

The original, wet, and dry warpage shall be determined by the following test methods:

14.1 Original Warpage

Prepare three test specimens 305 x 305 mm (12 x 12 in) from three different samples of fiberboard which are representative of a shipment.

Lay a specimen on a flat horizontal surface, and hold a straight edge so that it bridges the specimen in the area of maximum bow. Do not allow the weight of the straight edge to bear on the specimen.

Using a steel scale, graduated in 0.25 mm (0.01 in), measure the distance x at the midpoint of the straight edge bridging the bow. This distance must be measured on a perpendicular line to the straight edge. (See Figure 2.)

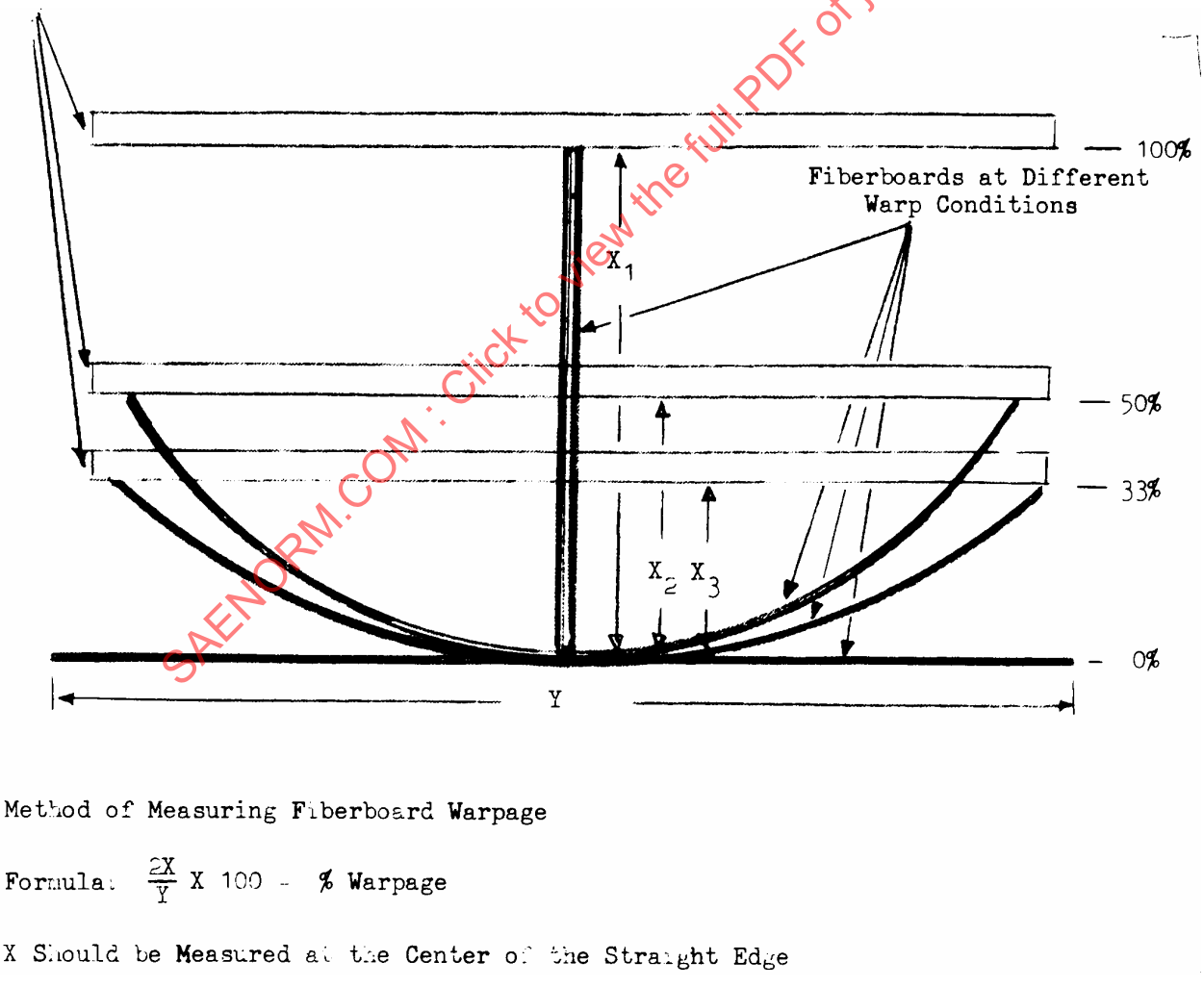

FIGURE 2

Calculate the original warpage by substituting in the following equation:

$$\frac{2X}{Y} \times 100 = \%\text{warpage} \qquad \text{(Eq. 2)}$$

where:

X = the dimensions in inches (millimeters) as measured previously
Y = the dimensions in inches (millimeters) of the specimen before warpage (The measurement for Y must be in the exact same line in which the straight edge was laid to measure X.)

14.2 Wet Warpage

Expose specimen(s) horizontally on a sheet of perforated metal[1] so that air can contact specimen(s) on both sides for 24 h at 38 °C ± 1 °C (100 °F ± 2 °F) and 98% ± 2% RH.

Remove conditioned specimen(s) and perforated metal sheet and allow specimen(s) to remain on perforated metal surface to dry for 30 min at room temperature. Calculate wet warpage as in 15.1.

14.3 Dry Warpage

Allow specimen(s) to dry 24 h on the flat perforated metal surface under conditions described in Section 5. Calculate dry warpage as in 15.1.

15. Dimensional Stability

The linear expansion and contraction shall be determined in the following manner:

Cut three 305 x 305 mm (12 x 12 in) test specimens from three different samples of fiberboard which are representative of a shipment.

Inscribe a 254 x 254 mm (10 X 10 in) square on one side of each test specimen. Follow Method A and/or Method B, as required by the material specification, followed by Method C. Method C may also be used individually as a drying test. At the end of the specified exposure period the test specimen shall be removed and the gage lines measured to the nearest 0.25 mm (0.01 in) both with machine direction and across machine direction. Calculate and report the average percent expansion or contraction of the three specimens.

15.1 Method A—Expansion

Hang the test specimen(s) in a vertical position in a humidity cabinet maintained at a temperature of 38 °C ± 1 °C (100 °F ± 2 °F) and a relative humidity of 98% ± 2% for a period of 24 h. On highly water resistant board, the exposure period may be continued to 7 days.

[1] "Perfex" perforated metal—40% open area or equivalent.

NOTE—The test specimens shall be protected from condensation water droplets by a slanted rustproof metal shield.

15.2 Method B—Expansion

Place each test specimen between two 305 x 305 mm (12 x 12 in) fine mesh stainless steel screens. Then immerse the specimen(s) horizontally in a tank 25 mm (1 in) below the surface of water maintained at 21 °C ± 1 °C (70 °F ± 2 °F) for periods of 2.5 and 24 h. On highly water resistant boards, the immersion may be continued to 48 h.

15.3 Method C—Contraction

Place the three test specimens in an air circulating oven maintained at 88 °C ± 3 °C (190 °F ± 5 °F) for 24 h.

At the end of the specified exposure period, the test specimen shall be removed and the gage lines measured to the nearest 0.25 mm (0.01 in) in both with-machine direction and across-machine direction. Calculate and report the average percent expansion or contraction of the three specimens.

16. Spew Test

Two test methods are used to evaluate the tendency of colored extractable materials to stain automotive trim when such trim is cleaned.

16.1 Method A—Solvent Extractable Discoloration

A 25 x 50 mm (1.0 x 2.0 in) specimen of the fiberboard is completely immersed for 10 min in a petri dish (approximately 97 x 13 mm) containing sufficient naphtha solvent (HI-Flash VM and P—distillation range 116—149°C) using 6.35 mm (0.25 in) hardware cloth both below and above the test specimen to assure wetting on both sides. Remove the test specimen from the solvent allowing excess solvent to drip off. Then sandwich the test specimen between two sheets of No. 40, 11 cm Whitman Filter Paper. Place test specimen and filter paper between two clean glass plates and apply a pressure of 6.9 kPa (1 psi) including weight of top glass plate, for 5 min.

Separate glass plates and place filter paper on flat, clean surface to dry at room temperature. Examine white filter paper for color stain. It may be rated using AATCC Gray Scale for Evaluating Staining[2], or in accord with mutually acceptable standards between producer and user.

16.2 Method B—Aqueous Extractable Discoloration

Method A of Spew Test is repeated except use a 1% water solution, by volume, of isocotyl phenyl polyethoxy ethanol[3] (Triton X-100, 100%), and evaluate as in Method A.

[2] AATCC (American Assoc. of Textile Chemists and Colorists), P.O. Box 11215, Research Triangle Park, NC 27709.
[3] "Perfex" perforated metal—40% open area or equivalent.

17. Odor in Fiberboard

Odors are evaluated only by means of the human nose. No instrumentation has been devised to measure intensity or enable a classification of odor. Objectionable odors are best determined by obtaining a consensus of opinion by a panel of people.

18. Stiffness of Fiberboard

For test procedure, refer to SAE J949 or ASTM D 747.

19. Impact Resistance

For test procedure, refer to ASTM D 5420 and ASTM D 5628.

20. Wicking

For test procedure, refer to SAE J913.

21. Blocking Resistance

For test procedure, refer to SAE J912.

22. Burning Rate

For test procedure, refer to SAE J369.

23. Color Matching

For test procedure, refer to SAE J361.

24. Coated Fiberboard

In many instances, fiberboards are grained, painted, and/or printed for decorative interior automotive trim applications. The test methods for fade, scuff, wear, and top coat adhesion generally rely on visual appearance rather than numerical values for determination of the acceptability of the decorated surfaces. Consequently, it is recommended that an appearance master sample be established by the consumer as a control for each color, pattern, grain, and finish desired.

24.1 Resistance to Fading, Cracking and Crazing, or Discoloration

24.1.1 METHOD A

The coated fiberboard shall be exposed to ultraviolet light produced by a carbon arc in a suitable machine such as a Fadeometer (or equivalent). The time of exposure shall be 150 standard fade hours (SFH) unless otherwise specified. The temperature shall be controlled to maintain a black panel temperature exposed in the specimen mounting rack. The rack must be kept fully loaded at all times to maintain the specified temperature properly, even if dummy specimens must be used. After exposure for the specified number of hours the specimen shall be allowed to cool to room temperature and shall then be examined closely for fading, discoloring, crazing, tackiness, cracking, or other detrimental change.

24.1.2 METHOD B

The coated fiberboard shall be exposed to continuous ultraviolet light produced by a carbon arc, and to a direct water spray 9 min out of each hour, in a suitable machine such as a Weatherometer (or equivalent). This test is recommended in addition to Method A because some pigments and/or dyes are more susceptible to fading under high humidity conditions. Paint and fiberboard surface crazing or cracking failures also are more likely to be predicted by this test, especially on formed fiberboard parts. The time of exposure shall be 100 SFH unless otherwise specified. The machine used shall be controlled to maintain a black panel temperature of 63 - 71 °C (145 - 160 °F), during the period in which no water is spraying. The temperature shall be measured with a black panel thermometer exposed in the specimen mounting rack. The rack shall be kept fully loaded at all times to maintain the specified temperature properly even if dummy specimens must be used. After exposure for the specified number of hours, the specimen shall be allowed to cool to room temperature and shall then be examined closely for fading, discoloring, crazing, cracking, or other detrimental change.

NOTE—A Xenon Arc Weatherometer may be used in place of a Carbon Arc Weatherometer Specified in Method A and Method B using SAE J1885 as the operating parameters when approved for used by contractual parties.

24.2 Scuff Resistance

For detailed test information, see SAE J365.

24.3 Abrasion Resistance

Visual acceptability of the abrasion resistance of coated fiberboards shall be determined on a Taber Abrader[4] (or equivalent) employing CS 10 wheels or equivalent with a specified load for a specified number of cycles. Products of abrasion shall be continuously removed during test with vacuum attachment. For further procedural information for running test, see SAE J948.

[4] **Equipment which meets the requirements of this test can be obtained from the Taber Instrument Corp., North Tonawanda, NY. The equipment and abrasive wheels shall be maintained and operated in accordance with the manufacturer's instructions. The wheels shall be refaced every 1000 cycles or after each test, whichever occurs first.**