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Standard Practice for Staining of Poly(Vinyl Chloride) Compositions by Rubber Compounding Ingredients[1]

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1. Scope

1.1 This practice measures the tendency for staining of a poly(vinyl chloride) composition to occur due to migration into the plastic of a staining antioxidant (or other compounding additive) from rubber with which it is in intimate contact.

1.2 This practice may be used to determine relative staining resistance of vinyl compounds by testing them against a single standard rubber composition (Note 1). It may also be used to compare relative staining tendencies of two or more rubber compositions by testing them against a single standard poly-(vinyl chloride) composition.

1.3 The values stated in SI units are to be regarded as the standard.

NOTE 1—The preparation of suggested standard compositions is described in the Appendix X1. This procedure may also be applicable to determine stain resistance of plastic materials other than poly(vinyl chloride) in contact with rubber.

NOTE 2—There is no similar or equivalent ISO standard.

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

2. Referenced Documents

2.1 *ASTM Standards:*

D 925 Test Methods for Rubber Property—Staining of Surfaces (Contact, Migration and Diffusion)[2]

D 1249 Specification for Octyl Ortho-Phthalate Ester Plasticizers[3]

D 1712 Practice for Resistance of Plastics to Sulfide Staining[3]

D 1755 Specification for Poly(Vinyl Chloride) Resins[3]

D 1898 Practice for Sampling of Plastics[3]

D 3186 Test Method for Rubber—Evaluation of SBR (Styrene-Butadiene Rubber) Mixed with Carbon Black or Carbon Black and Oil[2]

G 23 Practice for Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials[4]

3. Significance and Use

3.1 Compounding ingredients used in the manufacture of rubber can migrate into some vinyl compositions in contact with the rubber. These materials can then cause staining of the vinyl either immediately, or under the action of ultraviolet light. This latter behavior is especially likely when certain antioxidants migrate into the vinyl. Although they may be relatively colorless in their pure state, the action of light can transform these antioxidants into chromophoric agents.

NOTE 3—Vinyl compositions containing lead, cadmium, mercury, or antimony compounds may stain when in contact with rubber due to the formation of colored sulfides. This type of stain is due to chemical interaction between ingredients in the rubber and the vinyl compounds. Sulfide stain tendencies of vinyl compositions can be determined by Practice D 1712.

4. Apparatus

4.1 *For Test Specimen Preparation*—A mill, a press, and other auxiliary equipment for the preparation of test specimens.

4.2 *Oven*—An oven of the forced-air or convection type, having the following characteristics:

4.2.1 Control the oven by an accurate thermoregulator, maintaining set point within ±0.5°C (0.9°F) or better.

4.2.2 Equip the oven with a calibrated ASTM thermometer, and the proper stem correction shall be applied to the temperature measurement.

4.2.3 Maintain the oven at the temperature of test for at least 1 h prior to insertion of the test specimens.

4.2.4 Determine the uniformity of temperature over the area on which the specimens are to be aged by means of thermocouple readings prior to the start of the test.

4.3 *Weights*—Weights (for example, lead shot in a suitable flat-bottom container) to exert a pressure of 10 g/cm^2 on the test specimens.

4.4 *Light Source*—Intense light sources such as those described in Practice G 23 shall be used.

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[1] This practice is under the jurisdiction of ASTM Committee D-20 on Plastics and is the direct responsibility of Subcommittee D-20.15 on Thermoplastic Materials.

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This edition contains changes in Sections 1 and 10 to include an ISO equivalency statement and Keywords.

[2] *Annual Book of ASTM Standards*, Vol 09.01.

[3] *Annual Book of ASTM Standards*, Vol 08.01.

[4] *Annual Book of ASTM Standards*, Vol 14.02.

5. Sampling

5.1 Sampling shall be in accordance with the pertinent considerations outlined in Practice D 1898.

6. Test Specimens

6.1 The test specimen of the desired rubber composition should preferably be approximately 25 by 13 mm (1.0 by 0.5 in.) (Note 4). A useful thickness is 2 mm (0.075 in.). The preparation of suitable rubber compositions is described in the Appendix. The composition to be specified should be designated A, B, or C, depending upon whether the antioxidant is known to be nonstaining, semi-staining, or staining, respectively.

NOTE 4—The minimum size specimen is the same as that used in Test Methods D 925.

6.2 The specimen of the vinyl composition under test should be at least 50 by 50 mm (2 by 2 in.) and in all cases larger than the rubber specimen. A useful thickness is 2 mm (0.075 in.). The preparation of one suitable vinyl composition is described in the Appendix X1.

7. Conditioning

7.1 None required.

NOTE 5—In testing to date, no effect of normal atmospheric variations during processing or storage of these compositions has been observed.

8. Procedure

8.1 Place the rubber test specimen on top of the vinyl test specimen. Place the required weight on top of the rubber test specimen.

8.2 Place the test assembly in the oven for 20 h at 70°C (158°F).

8.3 Separate the test assembly, examine the vinyl specimen, and note any signs of discoloration in the area that had been in contact with the rubber. Designate the degree of stain as none, slight, moderate, or severe.

8.4 Simultaneously test a vinyl control specimen without rubber.

8.5 Expose the vinyl samples from 8.3 and 8.4 to the light source (see 4.4) for 4 h in accordance with Practice G 23. The side of the specimen that had been in contact with the rubber shall face the light source.

8.6 Examine the area of the specimen that had been in contact with the rubber and note the type and severity of discoloration, if any. If visual evaluation is used, designate the degree of stain as none, slight, moderate, or severe.

9. Report

9.1 Report the following information:

9.1.1 Complete identification of rubber and plastic composition,

9.1.2 Time and temperature of exposure,

9.1.3 Extent of discoloration, if any, immediately after oven aging, and

9.1.4 Extent of discoloration, if any, after light aging.

10. Keywords

10.1 poly(vinyl chloride) polymer; staining; rubber compounds

APPENDIX

(Nonmandatory Information)

X1. SUGGESTED RUBBER AND VINYL COMPOSITIONS FOR USE IN STAINING TESTS

X1.1 Rubber Composition

X1.1.1 A typical rubber composition for use in staining tests can be prepared by using the procedure described in the Sample Preparation section of Test Method D 3186 with the following recipe:

Ingredient	Parts
GRS-1502	100
Sulfur	2.75
Accelerator[A]	1.5
Accelerator[B]	0.3
Stearic acid	1.5
Zinc oxide	5.0
EPC black (nonstaining)	50
Processing oil[C]	5
Antioxidant	1.5

[A] such as *N*-cyclohexyl benzothiazole sulfonamide.
[B] such as tetramethylthiuram disulfide.
[C] such as naphthenic-type processing oil.

X1.2 Antioxidants

X1.2.1 Staining tendencies of the above will depend upon the specific antioxidant chosen. The following antioxidants are suggested:

X1.2.1.1 *Nonstaining*— 2,2′-methylene bis(6-*tert*-butyl-4-methylphenol).

X1.2.1.2 *Semi-staining*— Alkylated diphenylamine.

X1.2.1.3 *Staining*— Phenyl-beta-naphthylamine.

X1.3 Vinyl Composition

X1.3.1 A typical poly(vinyl chloride) composition for use in evaluating the staining tendencies of various rubber compositions is the following:

Ingredient	Parts
PVC resin GP5-00000 (Specification D 1755)[A]	100
2-Ethyl hexyl phthalate (type I of Specifications D 1249)[A]	50
Dibutyl tin dilaurate	2

[A] These designations refer to the following ASTM Specifications:
D 1249, Spec. for Octyl Ortho-Phthalate Ester Plasticizers, *Annual Book of ASTM Standards,* Vol 08.01.
D 1755, Spec. for Poly(Vinyl Chloride) Resins, *Annual Book of ASTM Standards,* Vol 08.02.

Mix in a stainless steel pan or beaker. Mill to form a sheet on rolls set at 166 ± 6°C (330 ± 10°F) for 3 ± 0.5 min. Mold a convenient flat specimen, such as 150 by 150 by 2 mm (6 by 6 by 0.075 in.).