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## Standard Practice for Determination of Graffiti Resistance<sup>1</sup>

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### 1. Scope

1.1 This practice covers a basic method for evaluating graffiti resistance of coatings, and use of this practice to evaluate graffiti resistance of coatings after outdoor or laboratory accelerated exposure. Graffiti resistance is based on how a defined set of markings is removed by a defined set of cleaning agents.

1.2 A procedure for evaluating graffiti removal by alternate cleaning agents is included in a mandatory annex.

1.3 This practice also defines procedures to evaluate graffiti removal after remarking with subsequent re-cleaning. It does not address recoatability after a coating is no longer graffiti resistant.

1.4 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.5 *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:* <http://www.astm.org/catalog/standards/sist/84c97a6a-6>
- D 523 Test Method for Specular Gloss<sup>2</sup>
  - D 740 Specification for Methyl Ethyl Ketone<sup>3</sup>
  - D 5402 Practice for Assessing the Solvent Resistance of Organic Coatings Using Solvent Rubs<sup>4</sup>
  - E 1347 Test Method for Color and Color-Difference Measurement by Tristimulus (Filter) Colorimetry<sup>2</sup>
  - E 1349 Test Method for Reflectance Factor and Color by Spectrophotometry Using Bidirectional Geometry<sup>2</sup>
  - G 7 Practice for Atmospheric Environmental Exposure of Nonmetallic Materials<sup>5</sup>

<sup>1</sup> This practice is under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.46 on Industrial Protective Coatings.

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 06.01.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 06.04.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 06.02.

<sup>5</sup> *Annual Book of ASTM Standards*, Vol 14.04.

- G 113 Terminology Relating to Natural and Artificial Weathering Tests of Nonmetallic Materials<sup>5</sup>
- G 147 Practice for Conditioning and Handling of Nonmetallic Materials for Natural and Artificial Weathering Tests<sup>5</sup>
- G 154 Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials<sup>5</sup>

### 3. Terminology

3.1 The definitions given in Terminology G 113 are applicable to this practice.

3.2 *Definitions of Terms Specific to This Practice:*

3.2.1 *graffiti resistance*—The property of coatings to be resistant to the application of graffiti or exhibiting easy removal of graffiti without surface damage.

3.2.2 *repellent*—The property of coatings that prevents materials commonly used as graffiti markings, from forming a continuous film upon application.

### 4. Summary of Practice

4.1 A series of materials typically used as graffiti markings is applied to test panels of the surface being evaluated. The graffiti markings are removed using a series of procedures that begin with wiping with a dry cloth and end with cleaning the surface with an aggressive cleaner. The graffiti resistance is reported as a cleanability level based on the first method, which completely removes the graffiti marking.

### 5. Significance and Use

5.1 Graffiti on building and structures is an ongoing and increasing problem. A number of coatings have been produced that are intended to be resistant to the application of a graffiti marking, or to provide a surface from which such markings can be easily removed. The procedures described in this practice provide a standard set of conditions that can be used to evaluate the graffiti resistance of a surface.

5.2 Graffiti resistance determined according to this practice is applicable to smooth surfaces. Graffiti resistance of the same coatings applied to a rough or textured surface may be lower.

5.3 Graffiti resistance of materials determined after natural or laboratory accelerated weathering conducted according to this practice, is considered as having more weight than graffiti resistance of the same material determined using freshly applied graffiti on surfaces, that have not been weathered.

Graffiti resistance of materials determined after natural weathering should be considered as having more weight than graffiti resistance determined after laboratory accelerated weathering.

## 6. Apparatus

6.1 *Aluminum Panels*, sized to fit the washability apparatus used unless otherwise specified. A minimum of 15 panels will be needed for each surface being tested for graffiti resistance.

6.2 *Straight-line Washability Apparatus*, capable of a moving a sponge/holder assembly over the marked area of a test panel at a speed of  $37 \pm 1$  cycles per min. The travel of the sponge/holder assembly shall be at least 203 mm (8 in.) in each direction.

6.2.1 *Cellulose Sponge*, coarse pore grade meeting Federal Specification L-S-626, Type II. The thickness of the sponge shall be such that when compressed between the holder and test panel, there is at least 3 mm ( $\frac{1}{8}$  in.) between the test panel surface and the bottom of the sponge holder.

6.2.2 *Sponge Holder and Weights*. The total dry weight of the holder plus weights shall be  $1500 \pm 10$  g.

6.2.3 *Stainless Steel Pan*.

6.2.4 *“C” Clamps*.

6.2.5 *Lint-free Cloth or Paper Towels*, for cleaning apparatus.

6.3 *Graffiti Marking Material*:

6.3.1 *Solvent-Based Ink Marker*, blue,<sup>6</sup>

6.3.2 *Solvent-Based Spray Paint*, red,<sup>6</sup>

6.3.3 *Wax Crayon*, blue or black.

6.3.4 *Water-based Ink Marker*, black,<sup>6</sup>

6.3.5 Other marking materials based on mutual agreement between all interested parties.

6.4 *Template*, with 51-mm (2-in.) diameter hole used to define area where graffiti marking material will be applied.

6.5 *Cleaning Material*:

6.5.1 *Dry, Lint-Free Cotton Cloth*.

6.5.2 *Mild Detergent*, 1 % aqueous solution.

6.5.3 *Citrus-Based Cleaner*, meeting the following basic composition: 40 to 90 % D-limonene, up to 50 % glycol ether, up to 13 % non-ionic surfactant.

6.5.4 *Isopropyl Alcohol*.

6.5.5 *Methyl Ethyl Ketone (MEK)*, conforming to Specification **D 740**.

6.6 *Pipet or Syringe*, capable of depositing  $10 \pm 1$  mL of cleaning liquid on the test panel.

6.7 *For Outdoor Exposures—Outdoor Exposure Rack*, meeting the requirements of Practice **G 7** for open backed exposures.

6.8 *For Laboratory Accelerated Exposures—Fluorescent UV Exposure Device*, equipped with fluorescent UVA lamps with peak emission at 343 nm, and operated in accordance with Practice **G 154**.

6.9 *Proper Safety Equipment*, as determined from the solvent Material Safety Data sheets (MSDS), for example, solvent resistant gloves, and respirator.

## 7. Test Specimen

7.1 Apply the material to be evaluated for graffiti resistance to the aluminum test panels according to the manufacturer's instructions, following any relevant procedures for surface preparation prior to application.

7.2 Unless otherwise specified, prepare at least three specimens of each material being evaluated for each phase of the procedure described in this practice.

NOTE 1—For the four markings and five cleaning agents specified in this practice, a total of 60 panels would provide three replicates for each marking/cleaner combination.

7.2.1 Prepare also at least one file specimen that can be used for comparison to the unmarked or unexposed materials, or both.

7.3 Unless otherwise specified, allow the coated test specimens to cure for at least 24 h at room temperature before continuing the test.

NOTE 2—Some anti-graffiti coatings may require more than 24 h to achieve optimum graffiti resistance. In such cases, follow the manufacturer's recommendations for curing.

7.4 Measure and record initial 60° gloss on coated test specimen.

7.5 After measuring gloss, place the template over the center of the prepared test panel and apply the following graffiti marking materials uniformly within the outlined area. Do not apply more than one marking material to any test panel. Store the marked panels at room temperature for at least 24 h before beginning to evaluate for removal.

7.5.1 Solvent based ink marker: blue permanent marker<sup>6</sup>,

7.5.2 Solvent based spray paint: red<sup>6</sup>,

7.5.3 Wax crayon: blue or black,

7.5.4 Water Based ink marker: Black<sup>6</sup>, and

7.5.5 Other making materials based on mutual agreement between all interested parties.

7.5.6 If the graffiti marking material does not uniformly wet out the test panel, the test surface is considered “repellent.” Cover as much of the surface as possible. In this case, the appearance of the dried marking may be very irregular.

## 8. Graffiti Removal Procedure Using Washability Tester

8.1 Level the washability apparatus and set it to operate at a speed of  $37 \pm 1$  cycles/min (cpm); each cycle consisting of a complete forward and reverse stroke.

8.2 Center the stainless steel tray and test panel below the path traveled by the sponge/holder and use “C” clamps to securely clamp them in place.

8.3 Wrap a dry, lint-free cotton cloth around the sponge so that there are at least two layers covering the top and bottom surfaces.

8.4 Place the cotton-wrapped sponge in the sponge holder and position on the traveling arm of the washability apparatus.

8.5 Operate the washability apparatus until the wrapped sponge moves across the marked area 50 times (25 complete cycles).

8.5.1 After the panel has been washed for 25 complete cycles, gently wipe it with no more than three complete cycles using a clean, lint-free cotton cloth to remove the last remains of any material.

<sup>6</sup> Solvent-based permanent ink marker, Blue Sharpie<sup>®</sup>, water-based ink marker, Eberhard Faber Black, and solvent-based spray paint, Krylon<sup>®</sup> Red have been found to be suitable marking agents.

8.6 Evaluate the test specimen for removal of graffiti.

8.6.1 Proceed to the next most aggressive cleaner, (see 6.5), if visual inspection shows that it is obvious that the marking has not been removed (8.8).

8.6.2 A marking is considered as completely removed if there is no visual evidence of residual material or “shadow” and the following two criteria are met:

8.6.2.1 *Retention of 60° Gloss*—After the graffiti marking has been removed, measure the 60° gloss according to Test Method D 523 on each specimen. Determine the ratio of the average gloss measured after the marking has been removed, to the average gloss measured on the panels prior to marking. The ratio shall be at least 0.80.

8.6.2.2 *Color Shift*—For each replicate specimen, measure color in accordance with Test Methods E 1347 or E 1349 in the area where the graffiti was removed, and in an area where no graffiti was applied. Calculate Delta E CIE LAB based on comparison of the average color coordinates for the cleaned surface, and the average color coordinates for the surface prior to marking, or for an unmarked area of the same specimen. For a graffiti marking to be considered as completely removed, the Delta E shall be less than 1.

8.6.2.3 Evaluate and report any other damage that may have occurred during the graffiti removal (for example, blistering, softening, loss of adhesion, etc.) according to relevant standards.

8.7 If the marking is completely removed from all replicate panels after cleaning with the dry cotton cloth according to 8.2-8.6, the test is complete, and the surface can be rated as “Cleanability Level 1.”

8.8 If cleaning with the cotton cloth wrapped sponge does not completely remove the marking, mount a fresh test panel with the graffiti marking in the tray of the washability apparatus according to 8.2. Saturate a clean sponge with a 1 % aqueous solution of mild detergent and place it in the sponge holder assembly. Place 10 mL of the aqueous detergent solution on either side of the marked area and operate the washability apparatus according to 8.5, until the sponge moves across the marked area 50 times (25 complete cycles). Repeat for each replicate panel with the marking being evaluated, and evaluate for graffiti removal according to 8.6. If the marking is completely removed from all replicate panels, the test is complete and the surface can be rated as “Cleanability Level 2.”

8.9 If cleaning with the 1 % aqueous solution of mild detergent does not completely remove the marking, repeat the steps described in 8.8 using the citrus cleaner. If the marking is completely removed from all replicate panels, the test is complete, and the surface can be rated as “Cleanability Level 3.”

8.10 If cleaning with the citrus cleaner according to 8.9 does not completely remove the marking, repeat the steps described in 8.8, using isopropanol. If the marking is completely removed from all replicate panels, the test is complete and the surface can be rated as “Cleanability Level 4.”

8.11 If cleaning with the isopropanol according to 8.10 does not completely remove the marking, repeat the steps described in 8.8 using MEK. If the marking is completely removed from

all replicate panels, the test is complete and the surface can be rated as “Cleanability Level 5.” If the graffiti marking is not completely removed from any of the replicate panels, the test is complete and the surface is rated as “Not Cleanable.”

8.12 If the washability tester does not comply with applicable safety requirements for use of solvents near electrical equipment, evaluate cleanability with isopropanol, MEK, and any other solvents using the manual method described in Section 9.

NOTE 3—Evaluation of other cleaning agents is described in Annex A1 of this practice.

## 9. Graffiti Removal Procedure Using Manual Solvent Rubs

9.1 In some cases, it may not be possible to evaluate graffiti resistance using a washability tester. In these cases, the following manual cleaning procedure may be used if agreed upon between all interested parties.

9.2 Wrap a clean sponge with at least two layers of dry, lint-free cotton cloth and rub across the marked area of a set of marked specimens for 25 complete back and forth cycles, in accordance with Practice D 5402. If it is obvious that the marking has been removed, the rubbing can be stopped before 25 complete cycles.

9.2.1 After the panel has been cleaned for 25 complete cycles, gently wipe it with no more than three complete cycles using a fresh clean, lint-free cotton cloth to remove the last remains of any material, then evaluate for graffiti removal in accordance with 8.6.

9.3 If cleaning with the cotton cloth wrapped sponge does not completely remove the marking, saturate a clean sponge with a 1 % aqueous solution of mild detergent, and rub across the marked area of a set of marked specimens for 25 complete back and forth cycles in accordance with Practice D 5402. If it is obvious that the marking has been removed, the rubbing can be stopped before 25 complete cycles. Repeat for each replicate panel with the marking being evaluated and evaluate for graffiti removal according to 8.6. If the marking is completely removed from all replicate panels, the test is complete, and the surface can be rated as “Cleanability Level 2.”

9.4 If cleaning with the 1 % aqueous solution of mild detergent does not completely remove the marking, repeat the steps described in 9.3 using the citrus cleaner. If the marking is completely removed from all replicate panels, the test is complete, and the surface can be rated as “Cleanability Level 3.”

9.5 If cleaning with the citrus cleaner according to 8.9 does not completely remove the marking, repeat the steps described in 9.3 using isopropanol. If the marking is completely removed from all replicate panels, the test is complete, and the surface can be rated as “Cleanability Level 4.”

9.6 If cleaning with the isopropanol according to 8.10 does not completely remove the marking, repeat the steps described in 9.3 using MEK. If the marking is completely removed from all replicate panels, the test is complete and the surface can be rated as “Cleanability Level 5.” If the graffiti marking is not completely removed from any of the replicate panels, the test is complete, and the surface is rated as “Not Cleanable.”