



Standard Practice for Determination of Graffiti Resistance¹

This standard is issued under the fixed designation D6578/D6578M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

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 (either prior to or after graffiti is applied). Graffiti resistance is based on how a defined set of markings is removed by a defined set of cleaning agents.

1.2 This practice also defines procedures (optional) to evaluate graffiti removal after re-marking with subsequent re-cleaning. It does not address recoatability after a coating is no longer graffiti resistant.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the 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:²

D523 Test Method for Specular Gloss

D4587 Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings

D6695 Practice for Xenon-Arc Exposures of Paint and Related Coatings

E1347 Test Method for Color and Color-Difference Measurement by Tristimulus Colorimetry

E1349 Test Method for Reflectance Factor and Color by

Spectrophotometry Using Bidirectional (45°:0° or 0°:45°) Geometry

G7 Practice for Atmospheric Environmental Exposure Testing of Nonmetallic Materials

G113 Terminology Relating to Natural and Artificial Weathering Tests of Nonmetallic Materials

3. Terminology

3.1 The definitions given in Terminology G113 are applicable to this practice.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *cleaning agent, n*—a material used to remove a marking material from the coating surface.

3.2.2 *graffiti resistance, n*—the property of coatings to be resistant to the application of graffiti or exhibiting removal of graffiti without surface damage.

3.2.3 *marking material, n*—a material that can be used to produce graffiti.

3.2.4 *recleanability, n*—the ability of a coating to withstand multiple cycles of marking with subsequent cleaning while maintaining its original characteristics.

3.2.5 *repellent, n*—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. Test specimens may be exposed to outdoor or accelerated exposures (either before or after markings have been applied). 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. After the best attempt has been made to remove markings, specimens are evaluated visually, or alternatively, by gloss and color change measurements to determine cleanliness. The graffiti resistance is reported as a cleanability level based on the mildest cleaning agent that completely removes the graffiti marking without damaging the coating.

5. Significance and Use

5.1 Graffiti on building and structures is an ongoing and increasing problem. A number of coatings have been produced

¹ 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.

Current edition approved Nov. 1, 2013. Published December 2013. Originally approved in 2000. Last previous edition approved in 2008 as D6578 – 08. DOI: 10.1520/D6578_D6578M-13.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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 coatings determined after natural or laboratory accelerated weathering, either before or after marking, conducted according to this practice, is considered as having more weight than graffiti resistance of the same coating determined without weathering. Graffiti resistance of coatings determined after natural weathering should be considered as having more weight than graffiti resistance determined after laboratory accelerated weathering.

6. Apparatus

6.1 *15 by 30 cm [6 by 12 in.] panels* representing the intended substrate.

6.2 *Lint-Free Cotton Cloth.*

6.3 *Graffiti Marking Material:*

6.3.1 *Solvent-Based Permanent Ink Marker*, blue,

6.3.2 *Solvent-Based Acrylic Spray Paint*, red,

6.3.3 *Solvent-Based Alkyd Spray Paint*, red,

6.3.4 *Wax Crayon*, blue or black,

6.3.5 *Ballpoint Ink*,

6.3.6 *Water-based Ink Marker*, black,

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

6.4 *15 by 30 cm [6 by 12 in.] Template*, with 25 by 25 mm [1 by 1 in.] square holes used to define area where graffiti marking material will be applied. The number of holes should be equal to the number of marking materials, should be spread apart from each other as much as possible, and should have a 13 mm (0.5 in.) margin along the perimeter.

6.5 *Cleaning Agents:*

6.5.1 *Dry, Lint-Free Cotton Cloth*,

6.5.2 *Mild Detergent*, as agreed upon between purchaser and seller (a solution of 5 % sodium phosphate is recommended),

6.5.3 *Isopropyl Alcohol*,

6.5.4 *Mineral Spirits*,

6.5.5 *Xylene*,

6.5.6 *Methyl Ethyl Ketone (MEK)*.

6.6 *For Outdoor Exposures—Outdoor Exposure Rack*, meeting the requirements of Practice G7 for open backed exposures.

6.7 *For Laboratory Accelerated Exposures—*

6.7.1 *Fluorescent UV Exposure Device*, equipped with fluorescent UVA lamps with peak emission at 343 nm, and operated in accordance with Practice D4587.

6.7.2 *Xenon Arc Exposure Device*, equipped with xenon arc(s) with daylight filter(s) and operated in accordance with Practice D6695, cycle 6.

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

6.9 *Glossmeter*, 60°, (for Evaluation Method B only).

6.10 *Colormeter*, capable of D65, CIE LAB measurements meeting Test Method E1347 or Test Method E1349 (for Evaluation Method B only).

7. Test Specimen

7.1 Apply the coating to be evaluated for graffiti resistance to the 15 by 30 cm [6 by 12 in.] test panels according to the manufacturer's instructions, following any relevant procedures for surface preparation prior to application.

7.2 Prepare at least three specimens of each coating being evaluated.

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

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

NOTE 1—It may be useful to prepare several sets of panels for each coating and allow the different sets to cure for different periods. The purpose would be to determine the point at which optimum graffiti resistance occurs.

7.5 Measure and record initial 60° gloss in accordance with Test Method D523 and color in accordance with Test Method E1347 or Test Method E1349 (using a D65 illuminant, CIE LAB calculations) on coated test specimens (for Evaluation Method B only).

7.6 Place the template described in 6.4 over the prepared test panel and apply the entire complement of marking materials prescribed in 6.3 so that each panel is marked with a 25 by 25 mm [1 by 1 in.] square of all graffiti materials (one marking material for each space in the template).

7.6.1 Be careful not to cross-contaminate one marking material with another. Remove template. Store the marked panels at room temperature for at least 24 h before beginning to evaluate for removal.

7.7 If the graffiti marking material does not uniformly cover the test area of the panel, or resists adhering to it, the test surface is considered "repellent." In this case, beading of the marking material might occur. In this case, the appearance of the dried marking may be very irregular.

8. Graffiti Removal Procedure

8.1 Attempt to remove each marking material from the panel with a cotton cloth alone, then by using a cotton cloth that has been wetted with the following cleaning agents, working through them in the order listed (increasing strength).

(a) mild detergent

(b) isopropyl alcohol (IPA)

(c) mineral spirits

(d) xylene

(e) methyl ethyl ketone (MEK)

The area of the cotton cloth that is wetted should be well saturated, but not dripping.



8.2 Rub each marking vigorously until it is completely cleaned off, or until it is visually evident that no more of the mark can be removed.

8.3 Reposition and re-wet the cotton cloth between markings as necessary, working through the entire panel with one cleaning agent at a time.

8.4 Use a different cotton cloth with each cleaning agent.

NOTE 2—As cleaning agents of increasing strength are used, some of the markings will probably be cleanable, whereas others will not. Exercise care so that areas that have been cleaned are not contaminated with stronger agents that are being used to clean other marks.

9. Evaluation of Cleanability

9.1 Method A, Visual:

9.1.1 After the best attempt has been made to clean a mark, visually examine it and note any trace of the mark, that is, a color change (shadow) or a loss of gloss.

9.1.2 If the spot has returned to its original condition before marking, note which cleaning agent was used to remove the mark. The mark will be considered to be cleanable with this agent.

9.2 Method B, Instrumentally:

9.2.1 *Retention of 60° Gloss*—After the graffiti marking has been removed, measure the 60° gloss. 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 0.90.

9.2.2 *Color Shift*—After the graffiti marking has been removed, measure color in the area where the graffiti was removed. 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 2.

9.2.3 Note the cleaning agent. The mark will be considered to be cleanable with this agent if the criteria in 9.2.1 and 9.2.2 are met.

10. Confirmation of Cleanability

10.1 Repeat procedures in Sections 8 and 9 (using either Method A or B for Section 9) on the other two replicates, only begin with the next weakest cleaning agent that removed each mark from the first replicate of each system rather than beginning all removal attempts with a dry cotton cloth. If it does not remove the mark move to the next strongest agent (the one that removed the mark the previous time). Although unlikely, it may be that this does not remove the mark. If this occurs, work up through the cleaning agents in order of strength. If a particular mark was not removed from the first replicate with MEK, begin with xylene on subsequent replicates.

10.2 If it is not possible to completely remove the spot without adversely affecting the film, it is considered to be not cleanable.

10.3 Based upon the average of the results of the 3 replicate trials, use the following rating scale for cleanability for each coating.

Cleanable with a dry rag = 10
Cleanable with detergent = 9
Cleanable with IPA = 8
Cleanable with mineral spirits = 7
Cleanable with xylene = 6
Cleanable with MEK = 5
Not cleanable, gloss loss = 4
Not cleanable, slight shadow = 3
Not cleanable, heavy shadow = 2
Not cleanable, shadow and gloss loss = 1

11. Recleanability Procedure (Optional)

11.1 In some cases, it is necessary to evaluate whether a graffiti resistant material will show the same level of cleanability after it has been cleaned and remarked with graffiti.

11.2 Re-mark the areas on the panels in the same locations that they were marked prior to cleaning with the same marking materials and allow the markings to cure for at least 24 hours.

11.3 Attempt to remove the mark using procedures in Sections 8 and 9.

11.4 If the marking is completely removed, repeat steps 11.2 and 11.3 until the marking cannot be completely removed without damaging the coating. The recleanability is classified as the number of cycles performed until the marking is no longer cleanable.

12. Graffiti Removal From Panels That Have Been Subjected To Outdoor Exposure

12.1 *Method A*—Removal of freshly applied graffiti markings from coatings that have been subjected to outdoor exposure:

12.1.1 Prepare a set of specimens to be evaluated in accordance with 7.1 – 7.4.

12.1.2 Engrave or indent each of the panels so that they can be identified upon return from exposure.

12.1.3 Unless otherwise specified, expose this set of panels in accordance with Practice G7 on an open backed rack that faces the Equator and oriented at an angle of 45° to the horizontal for 24 months. Note general atmospheric conditions, geographical location, and dates of exposure.

NOTE 3—Conditions will vary among geographic locations, which could produce different results. South Florida and Arizona desert are commonly used locations.

12.1.4 Remove from exposure and apply graffiti markings in accordance with 7.5 – 7.7.

NOTE 4—The purchaser and seller shall agree upon whether or not the panels should be washed (or to what extent the panels should be washed) before marking.

12.1.5 Determine cleanability of marked panels in accordance with Sections 8 – 10.

12.1.6 Determine recleanability in accordance with Section 11 (optional).

12.2 *Method B*—Removal of graffiti markings after the marked panel has been subjected to outdoor exposure:

12.2.1 Apply the coating and mark with materials in accordance with 7.1 – 7.7.

12.2.2 Expose panels per 12.1.3.

12.2.3 Determine cleanability of the marked, exposed panels in accordance with Sections 8 – 10.



12.2.4 Determine recleanability in accordance with Section 11 (optional).

13. Graffiti Removal From Panels That Have Been Subjected to Laboratory-Accelerated Weathering Exposure

13.1 *Method A*—Removal of freshly applied graffiti markings from coatings that have been subjected to laboratory-accelerated weathering:

13.1.1 Prepare the panels in accordance with 7.1 – 7.4.

13.1.2 Unless otherwise specified, expose this set of panels for 2000 h in accordance with either Practice D4587, cycle 2, or Practice D6695, cycle 6.

NOTE 5—Exposure in accordance with Practice D4587 versus Practice D6695 may produce different results.

13.1.3 If other exposure conditions or times are used, provide a description of the exposure conditions and times in accordance with Practices D4587 or D6695.

13.1.4 Apply graffiti markings in accordance with 7.5 – 7.7.

13.1.5 Evaluate cleanability of marked panels in accordance with Sections 8 – 10.

13.1.6 Evaluate recleanability in accordance with Section 11 (optional).

13.2 *Method B*—Removal of graffiti markings after the marked panel has been subjected to laboratory accelerated weathering:

13.2.1 Apply the coating and mark with materials in accordance with 7.1 – 7.7.

13.2.2 Expose this set of panels in accordance with 13.1.2 and 13.1.3.

13.2.3 Evaluate cleanability of marked panels in accordance with Sections 8 – 10.

13.2.4 Evaluate recleanability in accordance with Section 11 (optional).

NOTE 6—If graffiti markings are successfully removed from specimens that had been marked before being subjected to weathering (either outdoor or in the laboratory), the appearance of the area that had been marked might have higher gloss and color retention than the unmarked areas of the panel due to the mark masking the film from weathering.

14. Report

14.1 Report the following information for each material being evaluated:

14.1.1 Identification of coating being tested,

14.1.2 Identification of marking materials,

14.1.3 Length of time marking materials remained on coating before attempting removal,

14.1.4 Identification of cleaning agents,

14.1.5 Period of cure of the coating being tested,

14.1.6 Type of substrate,

14.1.7 Dry film thickness of surface being tested,

14.1.8 If exposed to accelerated weathering, report conditions of exposure such as type of equipment used, whether Practice D4587 or Practice D6695 was used, length of time, cycle used, total radiant exposure at 340 nm and state whether Method A or Method B was used.

14.1.9 If exposed to outdoor weathering, report geographic location, date range of exposure, general atmospheric conditions, total radiant of exposure at 295 to 385 nm and state whether Method A or Method B was used.

14.1.10 The cleaning agent that removed each particular marking material (if any),

14.1.11 Qualitative observations of any film defects that may have occurred as a result of cleaning, that is, gloss loss, blistering, softness, etc.,

14.1.12 Delta *E* and gloss ratio results, if determined,

14.1.13 Cleanability rating of each mark (using rating scale found in Section 10),

14.1.14 Number of recleanability cycles, if determined,

14.1.15 Qualitative results can be reported in a format as exemplified in Table 1,

14.1.16 A quantitative interpretation of results may be used as exemplified in Table 2,

14.1.17 A “Graffiti Resistance Score” can be reported for each coating system per Table 2, and

14.1.18 Recleanability can be reported as exemplified in Table 3.

TABLE 1 Qualitative Results of Graffiti Resistance (Example)

	Paint System 1	Paint System 2	Paint System 3	Paint System 4
Blue Solvent-Based Marker	Not Cleanable (heavy shadow remained)	Not Cleanable (heavy shadow remained)	Not Cleanable (heavy shadow remained)	Not Cleanable (heavy shadow remained)
Water-Based Marker	Cleanable (with 1 % detergent)	Cleanable (with 1 % detergent)	Not Cleanable (very slight shadow remained)	Cleanable (with mineral spirits)
Ballpoint Ink	Cleanable (with IPA)	Cleanable (with IPA)	Not Cleanable (shadow remained)	Not Cleanable (gloss loss and shadow remained)
Acrylic Spray Paint (Red)	Cleanable (with IPA)	Cleanable (with IPA)	Cleanable (with MEK)	Not Cleanable (gloss loss and shadow remained)
Alkyd Spray Paint (Black)	Cleanable (with IPA)	Cleanable (with IPA)	Cleanable (with IPA)	Not Cleanable (gloss loss and shadow remained)
Black Crayon	Cleanable (day rag)	Cleanable (dry rag)	Cleanable (dry rag)	Not Cleanable (shadow remained)
Lipstick	Cleanable (with IPA)	Cleanable (with IPA)	Cleanable (with IPA)	Not Cleanable (shadow remained)



TABLE 2 Quantitative Interpretation of Graffiti Resistance (Example)

	Paint System 1	Paint System 2	Paint System 3	Paint System 4
Blue Solvent-Based Marker	2	2	2	2
Black Water-Based Marker	9	9	3	7
Ballpoint Ink	8	8	3	1
Acrylic Spray Paint (Red)	8	8	5	1
Alkyd Spray Paint (Black)	8	8	8	1
Black Crayon	10	10	10	2
Lipstick	8	8	8	2
Total	53	53	39	16
Graffiti Resistance Score (Average)	7.6	7.6	5.6	2.3
Rating Scale				
Cleanable with a dry rag = 10				
Cleanable with detergent = 9				
Cleanable with IPA = 8				
Cleanable with mineral spirits = 7				
Cleanable with xylene = 6				
Cleanable with MEK = 5				
Not cleanable, gloss loss = 4				
Not cleanable, slight shadow = 3				
Not cleanable, heavy shadow = 2				
Not cleanable, shadow and gloss loss = 1				

TABLE 3 Re-cleanability of Marking Materials (Example)

	System 1	System 2	System 3	System 4
Blue Solvent-Based Marker	NA (Not Cleanable)	NA (Not Cleanable)	NA (Not Cleanable)	NA (Not Cleanable)
Water-Based Marker	Re-cleanable 3 cycles w/1 % detergent	Re-cleanable 3 cycles w/1 % detergent	Re-cleanable 3 cycles w/1 % detergent	Re-cleanable 2 cycles w/mineral spirits
Ballpoint Ink	Re-cleanable 3 cycles w/IPA	Re-cleanable 3 cycles w/IPA	NA (Not Cleanable)	NA (Not Cleanable)
Acrylic Spray Paint (Red)	Re-cleanable 3 cycles w/IPA	Re-cleanable 1 cycle only w/IPA	Not Re-cleanable (left shadow)	NA (Not Cleanable)
Alkyd Spray Paint (Black)	Re-cleanable 3 cycles w/IPA	Re-cleanable 3 cycles w/IPA	Re-cleanable 3 cycles w/mineral spirits	NA (Not Cleanable)
Black Crayon	Re-cleanable 3 cycles w/dry rag	Re-cleanable 3 cycles w/dry rag	Re-cleanable 3 cycles w/mineral spirits	NA (Not Cleanable)
Lipstick	Re-cleanable 3 cycles w/IPA	Re-cleanable 3 cycles w/IPA) (slight burnishing)	Not Re-cleanable (left shadow)	NA (Not Cleanable)

15. Keywords

15.1 anti-graffiti; cleanability; graffiti; removal

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