Designation: D6137 – 97 (Reapproved 2012)

Standard Test Method for Sulfuric Acid Resistance of Polymer Linings for Flue Gas Desulfurization Systems[1]

This standard is issued under the fixed designation D6137; 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 test method is intended to evaluate the sulfuric acid resistance at elevated temperatures of polymer linings applied to carbon steel substrates subject to sulfuric acid attack.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 *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]

A36/A36M Specification for Carbon Structural Steel

C868 Test Method for Chemical Resistance of Protective Linings

D660 Test Method for Evaluating Degree of Checking of Exterior Paints

D661 Test Method for Evaluating Degree of Cracking of Exterior Paints

D714 Test Method for Evaluating Degree of Blistering of Paints

D772 Test Method for Evaluating Degree of Flaking (Scaling) of Exterior Paints

D1186 Test Methods for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to a Ferrous Base (Withdrawn 2006)[3]

D1474 Test Methods for Indentation Hardness of Organic Coatings

D4138 Practices for Measurement of Dry Film Thickness of Protective Coating Systems by Destructive, Cross-Sectioning Means

D4417 Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel

D5162 Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates

2.2 *Steel Structures Painting Council Standards*[4]

SSPC VIS 1–89 Visual Standard

SSPC No. SP5 Blast Cleaning to White Metal

3. Significance and Use

3.1 The results obtained by this test method can be used in combination with other test methods for the selection of a lining for surfaces in flue gas desulfurization (FGD) systems that will be exposed to hot unscrubbed flue gas or to scrubbed gas that has been reheated well above the water dew point.

3.1.1 This test method does not evaluate or correlate to areas within the scrubber or scrubbed gas streams at temperatures at or below the water dew point.

3.2 This test method is intended to evaluate the combined effects of heat and exposure to sulfuric acid upon a lining system as applied to a carbon steel substrate. It does not produce the thermal gradient through the lining that may exist in actual applications. Actual lining performance may also be affected by concurrent physical or mechanical effects and other chemicals that may be present in the flue gas.

3.3 This test method evaluates major failure modes of linings applied to square test panels that are cycled from room temperature to a designated elevated temperature.

3.4 The recommended test temperatures of 200°F (93°C) and 350°F (177°C) are based on typical maximum operating zone temperatures in flue gas desulfurizations systems. Other temperatures may be evaluated as desired. Cycling to lower temperatures, including freezing, may be considered if applicable.

[1] This test method is under the jurisdiction of ASTM Committee D33 on Protective Coating and Lining Work for Power Generation Facilities and is the direct responsibility of Subcommittee D33.09 on Protective Lining for FGD Systems.

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[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.

[3] The last approved version of this historical standard is referenced on www.astm.org.

[4] Available from Society for Protective Coatings (SSPC), 40 24th St., 6th Floor, Pittsburgh, PA 15222-4656, http://www.sspc.org.

3.5 The standard acid concentration for all tests is 20 %, recognizing that the concentration will quickly rise to the equilibrium at the selected test temperature.

4. Apparatus

4.1 *Forced Air Circulation Oven,* capable of maintaining the selected test temperature ±4 F° (2C°). Note that acid fumes may damage the oven and a drip pan and protective shroud may be needed.

4.2 *Rack or Stand,* to support the test panels vertically in the oven while maintaining a distance of at least 1 in. (25 mm) between the panels and between the panels and oven walls.

5. Test Specimen

5.1 *Substrate:*

5.1.1 Test panels shall be new commercial quality, carbon steel conforming to Specification A36/A36M. Panels shall be a minimum of ¼-in. (6-mm) thick, and 8-in. (200-mm) square, and shall have their edges broken or radiused if the lining is to be wrapped over the edges of the panel.

5.1.2 These test panels are large enough and rigid enough for linings and coatings up to ¼-in. thick. For thicker linings, the test panels shall be at least 32 times the lining thickness in height and width.

5.1.3 Two control test panels shall be prepared for each lining system tested. One shall be cycled between the selected temperatures without exposure to acid. The second shall be maintained at laboratory conditions without exposure to either elevated temperature or acid.

5.2 *Preparation:*

5.2.1 Prepare one side of each panel in accordance with Steel Structures Painting Council SSPC No. SP 5 to the degree of cleanliness represented in SPC VIS 1–89 . Clean, new, angular abrasive shall be used. The surface profile shall be as recommended by the lining manufacturer. Determine and record the average profile depth in accordance with Practice D4417, Method A using a visual surface profile comparator or method B. using a tape replica.

5.2.2 Apply the lining to the prepared surface of the test panels in a manner as closely simulating field application as possible and in accordance with the manufacturer's recommendations. Record the manufacturer's batch numbers, manufacturing dates, mixing method, mixing time, and method of application.

5.2.3 The lining may be terminated at the edges of the panel or may be wrapped around the panel edges.

5.2.4 The lining thickness shall be as specified by the manufacturer.

5.2.5 The lined surface of the panel may be scribed or scored to form a vertical "v" groove down to the steel substrate. The groove, if used, shall be 2-in. (50-cm.) long and centered on the panel and shall be done as soon as practical without damage to the lining.

5.3 *Specimen Measurements:*

5.3.1 Determine the thickness of the lining material using an appropriate dry-film thickness gage in accordance with Test Methods D1186. Thickness measurements shall be done on a grid of 2 in. in both directions starting at a point 1 in. (2.5 cm.) from the side and 1 in. from the top of the panel. The sixteen individual readings and average thickness shall be recorded.

5.3.2 Test the lined surface for holidays in accordance with Practice D5162. Mark the exact location of any holidays. If the panel will be scribed, perform the holiday test before scribing. Repair the holidays in accordance with the lining manufacturer's recommendations or prepare a new panel.

5.4 *Conditioning of Test Panels:*

5.4.1 Condition test panels for a period of 7 days at 73 ± 4°F (23 ± 2°C). Additional conditioning of test panels, including longer cure times or elevated cure temperature, may be conducted if specified. Conditioning time and temperature shall be recorded and stated in the test report.

6. Procedure

6.1 Preheat the oven to the required test temperature of 200°F (93°C) or 350°F (177°C) unless otherwise specified.

6.2 Immerse the lower portion of the test panel(s) in a 20 % solution (by volume) of sulfuric acid at laboratory temperature of 73 ± 4°F for 1 h. The upper 4 in. (10 cm.) shall remain above the fluid level.

6.3 Remove the test panel(s) and allow to dry for approximately 15 min in a vertical position at laboratory temperature.

6.4 Place the test panel(s) in the preheated oven in a vertical position such that there is a minimum 1-in. (25-mm) space between the panels and between the panels and the oven walls. Panel(s) shall remain in the oven for 16 ± 1 h.

6.5 Remove the panel(s) at the end of each exposure period. Place the panels in a vertical position with a minimum of one inch space between panel(s) and allow them to cool at laboratory temperature for 4 to 6 h.

6.6 Repeat the cycle (6.2 through 6.5).

6.6.1 After 1, 2, 5, 10, 20, and 30 cycles, evaluate the panels in accordance with Section 7 and record the results.

6.6.2 The test may be terminated after 30 cycles or at some other time depending on panel condition and test objectives.

7. Panel Evaluation

7.1 Visually inspect the lining surface of all panels before the test exposure for the presence of voids and cracks, and for blisters or loss of adhesion as described in 7.3.

7.1.1 Any effects related to and limited to the edges of the panel should be so noted, since they may not represent performance in actual applications.

7.2 Measure and record thickness of the lining in accordance with 5.3.1.

7.3 The panel should be examined for the following effects:

7.3.1 Blistering should be evaluated in accordance with Test Method D714 and recorded.

7.3.2 Hardness should be evaluated in accordance with Test Method D1474 and recorded.

7.3.3 Some linings may not give clear visual indication of blisters. Blisters may be detected by lightly tapping the surface of the lining with a fingernail or small metal object. Where a blister or loss of adhesion has occurred, the sound will change from a solid tap to a more hollow sound. The apparent edges of

a blistered or delaminated area or any other heat caused defect such as pinholing or cratering should be recorded as to exact location.

7.3.4 The lining shall be examined for cracking, checking, and flaking, and the results recorded. Test Method D661 for cracking, D660 for checking and D772 for flaking may be referred to for visual ratings.

7.4 For the final evaluation, the lining shall be forcibly removed from an area of the panel approximately 1 by 2 in. (2.5 cm by 50 cm) using a knife or hammer and chisel to qualitatively evaluate adhesion and condition of the substrate. This procedure will also determine whether blistering or loss of adhesion occurred between coats or at the surface of the substrate.

7.4.1 The surface of the lining shall be scored and evaluated in accordance with Test Methods D4138 to determine the apparent depth of discoloration due to acid attack.

7.4.2 In addition, if the panel was scribed, an area of the lining adjacent to the scribe shall be pried or chiseled off to determine the extent of undercutting, both above and below the liquid level.

8. Report

8.1 Report the following information:

8.1.1 Lining manufacturer's name, product designation, batch numbers, and generic type,

8.1.2 Description of panel preparation including the resulting depth of profile and degree of cleanliness,

8.1.3 A description of equipment and procedures used in application of the lining,

8.1.4 Curing/Conditioning procedure,

8.1.5 Results of visual inspections and thickness measurements,

8.1.6 Test temperature,

8.1.7 The results of each interim inspection as outlined in Section 7, and

8.1.8 The final evaluation shall include an appraisal of the adhesion of the lining in accordance with 7.4 and the depth of surface discoloration.

9. Precision and Bias

9.1 This test method is as specific as possible in establishing reproducible methods and procedures. Final test results and report however, depend upon visual observations and subjective evaluation.

10. Keywords

10.1 adhesion; blistering; chemical resistance; cracking; flue gas desulfurization; heat resistance; polymer linings; sulfuric acid; thermal effects