Designation: D7376 – 10a (Reapproved 2016)

Standard Practice for Outdoor Evaluation of Wet Stack Storage Conditions on Coil-Coated Metals[1]

This standard is issued under the fixed designation D7376; 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 is used to determine the resistance to corrosion and blistering of coil-coated metal products relative to one another when stacked outdoors under direct weathering conditions in which they are wetted by rain and dew.

1.2 The coil-coated product variables evaluated may include, but are not limited to, substrates, pretreatments, primers, topcoats, and backers.

1.3 This test simulates a stacked building panel bundle stored at a job site in wet outdoor conditions. The results from panels tested during the same time period at the same physical location may be used to compare products as an indicator of relative field performance. Environments with higher temperature and moisture levels accelerate corrosion and blistering.

1.4 This standard does not endorse the storage of level (that is, 0° from horizontal) building panels stacks in wet outdoor conditions. Level storage of building panels is not recommended and is used in this standard for evaluation only.

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

1.6 *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]

D610 Practice for Evaluating Degree of Rusting on Painted Steel Surfaces

D714 Test Method for Evaluating Degree of Blistering of Paints

D1654 Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

G7 Practice for Atmospheric Environmental Exposure Testing of Nonmetallic Materials

3. Summary of Practice

3.1 This practice is for the evaluation of relative resistance to wet stack corrosion and blistering of coil-coated metal. The test is to be conducted in an outdoor environment with coil-coated panels placed on a flat surface while allowing exposure to direct weather conditions including rain, dew, and solar radiation.

3.2 It is necessary to expose negative controls in each test run, that is, products with known resistance to corrosion and blistering in this location, at the same time as the test product to determine its resistance relative to controls.

3.3 Panels are evaluated periodically for corrosion and blistering as specified in 6.7.

4. Significance and Use

4.1 This practice provides for periodic testing for resistance to wet conditions during storage to compare the relative performance of specific combinations of coatings, substrates, and/or pretreatments used on coil-coated metal. The results must be considered relative and do not indicate absolute performance.

4.2 When stored improperly, coil-coated building panel stacks can be exposed to rainwater, which flows into gaps between panels by capillary action or gravity, and remains in the gaps because of poor drainage conditions. Such a condition is known as a “wet stack” and may cause blistering and corrosion of the painted surfaces. This practice simulates such improper storage conditions.

4.3 Because the outdoor environment shows year-to-year seasonal and geographic climate variation, the absolute amount of degradation based on corrosion and blistering may vary (see Appendix X1).

[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 D01.53 on Coil Coated Metal.

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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.

4.4 Temperature, rain, humidity, and storage practices are important factors in wet stack corrosion. Corrosion and blistering will accelerate with increased temperature. The preferred test location is south of 27°N latitude in Florida. Other locations may be used, but differences in temperature and moisture must be considered, and the amount of corrosion and blistering are expected to vary considerably with climate. Test sites must have the instrumentation to measure and record ambient temperature and rainfall as in Practice G7.

4.5 This practice is not meant to support the field storage of coil-coated metal in any way other than what is recommended by the manufacturer.

5. Apparatus

5.1 The use of a wooden or plastic pallet to stack the test panels in a horizontal position is one way to ensure rain does not puddle around the panels. Rainwater and condensation flow down the sides of the stacks, and water is drawn between panels by capillary action. Excess water will drain through the slats in the pallet (see Fig. 1).

5.2 The pallet is recommended to be 61 cm to 91 cm (24 in. to 36 in.) from the ground and all foliage should be maintained so that it does not create shade on or contact with the test panels.

5.3 Wooden two by four boards of approximate cross-sectional dimensions, 4 cm by 9 cm (1.5 in by 3.5 in.) and of the required length are placed on top of the stacks (see Fig. 1). The pallets and boards shall be composed of untreated wood to avoid any influence from the treatment.

5.4 The apparatus shall be placed in an unsheltered location that is subject to direct weathering conditions including rain, dew, and solar radiation.

6. Procedure

6.1 A wooden pallet or some flat surface with slats for water drainage is assembled in the required location. See Section 5.

Note—Level position for test purposes only. Level storage of building panels in wet conditions is not recommended.

FIG. 1 Illustration of Wet Stack Test Placed Horizontally (Level) on a Pallet

6.2 Test panels shall be gathered and cut to the required size. A size of at least 15 cm by 15 cm (6 in. by 6 in.) is required. Duplicates of each panel are required to allow contact between the topside and backside of the same sample Panels to be compared must be cut on the same metal shear with edge burrs oriented in the same direction. Edge results may be significantly influenced by burr differences. Corrosion ratings shall include any visible red or white corrosion products.

6.3 A minimum of two extra panels shall be placed at the top and two at the bottom of the stack to act as a barrier to any influences from the wood or water accumulation.

6.4 The test panel numbers shall be recorded along with information such as coil line, paint code, substrate, primer, pretreatment, and date of test initiation.

6.5 The test panels shall be stacked on top of one another with the convex side facing upward against the backer of a duplicate panel to form a panel pair. If available, a duplicate pair of panels is highly recommended. Negative controls are required in order to provide a reference point for test duration.

6.6 Each stack of test panels shall be no greater than 5 cm (2 in.) in height and have no less than 8 panels and shall be weighted down with a single wooden two by four with cross-sectional dimensions, 4 cm by 9 cm (1.5 in. by 3.5 in.) on top of each stack or spanning two or more stacks. The negative control shall be placed near the center of the stack.

6.7 It is recommended that panels be evaluated for corrosion and blistering monthly in accordance with Test Methods D610, D714, and D1654 Procedure B, until the negative control shows blister failure. Longer test times will be required during periods of drought (see Appendix X1.) Evaluation of field corrosion and blistering is considered to be the most appropriate for this test, but edge results may also be assessed.

7. Report

7.1 The report section shall contain the following information when available. In many cases, specific information about the materials used or preparation of the test specimens is not available to commercial testing agencies.

7.1.1 Included in the test reports shall be the location where the test is performed, the start date of the test and the date of the evaluation.

7.1.2 The test report shall include a measurement of total rainfall and number of days with rain during the test period at the test location. A rain day shall be considered any day with 0.8 mm (0.03 in.) or greater of rainfall accumulation.

7.1.3 The test report shall include the average daily maximum temperature and average daily minimum relative humidity during the test period.

7.1.4 The test report shall include the manufacturer of the product and any experimental, raw material, or coating process changes for the product being tested.

7.1.5 The test report shall include the coating paint code, substrate, primer, backer and pretreatment used. Dry film coating thickness (DFT) and pretreatment weight may also be important and should be reported, if available.

7.1.6 Samples shall be evaluated for corrosion and blisters. Any notable changes shall be recorded. Corrosion and blisters,

including any red or white corrosion products, shall be rated in accordance with Test Methods D1654, Procedure B, D610, and D714. The results from duplicate pairs of panels shall be reported separately to illustrate test variability, if any.

7.1.7 A statement of compliance shall be noted and any exceptions to the procedure shall be noted in the report.

8. Keywords

8.1 blistering; coil-coated; corrosion; wet stack

APPENDIX

(Nonmandatory Information)

X1. DETERMINATION OF TEST DURATION

X1.1 Outdoor wet stack testing relies on rainfall to supply water for absorption into the stacked metal by capillary action. To some extent, dew contributes to wetness, but the rain is the primary source of water. Because rainfall plays a major role in outdoor wet stack testing, the seasonal and interannual (year-to-year) variability of rainfall at a given location represents a major influence on test results from run-to-run. Although the standard is concerned with the relative performance of coil-coated samples, and the inclusion of a negative control with known performance is required (see 6.5), the influence of rainfall cannot be ignored, especially during periods of drought when little or no rainfall may occur at a given location. This commentary is intended to provide a benchmark for rainfall in a location where the test has been run successfully.

X1.2 As an example of a preferred location and test period, Fort Myers, Florida is used. It is a location south of 27°N latitude as recommended in Section 4. Based on 30-year rainfall data from Fort Myers Page Field, the six-month period with the greatest rainfall is represented by the months of May through October. During the 30-year time period from 1971 to 2000, the total average rainfall for these six months was 42.16 in. These six months also correspond to the time period of highest average temperature, which is also an influence on the rate of corrosion and blister formation. Hence, the preferred test period is May through October in Florida, south of 27°N latitude, and a benchmark for total rainfall during the test period is 42.16 in. If the test is run in a different climate with different rainfall and temperatures, the time to failure for the negative control is expected to differ accordingly.

X1.3 Because of the spatial variability of rainfall on the kilometer and even sub-kilometer scale, section 4.4 requires that test sites have instrumentation to measure rainfall. A "local" weather reporting station, for example, may be more than 5 kilometers from a test site, and rainfall may differ significantly between the two sites over short time periods. The accuracy of the measurements (for example, in hundredths) are not as critical as the number of days with rainfall in a given time period. Section 7 requires that the total rainfall and number of days with rainfall be recorded for the test period.

X1.4 If the test is to be run at a location other than south Florida where no benchmark for rainfall exists, the use of a negative control to verify failure would be the only means of determining the appropriate test duration. The total test time shall be defined by the time that it takes to observe blistering on the negative control. This would be some minimum level of failure, such as few #8 blisters as defined by Test Method D714.