Designation: G198 – 17

Standard Test Method for Determining the Relative Corrosion Performance of Driven Fasteners in Contact with Treated Wood[1]

This standard is issued under the fixed designation G198; 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 covers and focuses on the corrosion resistance of metal, metal-coated, and nonmetallic-coated smooth and deformed shank driven fasteners in contact with treated wood in exterior or high moisture exposure applications using comparative tests with control fastener specimens of standardized benchmarks. This test method may be used for preservative-treated wood.

1.2 This test method describes the apparatus, procedure, and conditions required to maintain test environments for the Cyclic Fog Test and the Steady State Moisture Test.

1.3 This test method describes the types of test samples, lists exposure periods, and gives guidance on interpretation of results.

1.4 Until experience is gained comparing laboratory-to-laboratory results with this test method, comparisons of fasteners, coatings, materials, or preservatives shall be made only within the results of the same test.

1.5 The values stated in SI units are to be regarded as standard. The values 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.*

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

A90/A90M Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings

A153/A153M Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

B117 Practice for Operating Salt Spray (Fog) Apparatus

B487 Test Method for Measurement of Metal and Oxide Coating Thickness by Microscopical Examination of Cross Section

B499 Test Method for Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals

B504 Test Method for Measurement of Thickness of Metallic Coatings by the Coulometric Method

D610 Practice for Evaluating Degree of Rusting on Painted Steel Surfaces

D1165 Nomenclature of Commercial Hardwoods and Softwoods

D1193 Specification for Reagent Water

D4442 Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials

D4444 Test Method for Laboratory Standardization and Calibration of Hand-Held Moisture Meters

E376 Practice for Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Testing Methods

G1 Practice for Preparing, Cleaning, and Evaluating Corrosion Test Specimens

G60 Practice for Conducting Cyclic Humidity Exposures

G85 Practice for Modified Salt Spray (Fog) Testing

G193 Terminology and Acronyms Relating to Corrosion

2.2 *American Wood Protection Association:*[3]

U1-09 Use Category System: Use Specification for Treated Wood

[1] This test method is under the jurisdiction of ASTM Committee G01 on Corrosion of Metals and is the direct responsibility of Subcommittee G01.14 on Corrosion of Metals in Construction Materials.

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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] Available from American Wood Protection Association (AWPA), P.O. Box 361784, Birmingham, AL 35236-1784, http://www.awpa.com.

***A Summary of Changes section appears at the end of this standard**

3. Terminology

3.1 *Definitions*—Terminology G193 contains other terms and definitions relating to corrosion and corrosion testing. Terminology D1165 contains other terms and definitions relating to wood and wood testing.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *bright, adj*—uncoated steel.

3.2.2 *fastener, n*—metallic, metal-coated, or nonmetallic-coated smooth or deformed shank driven fastener.

3.2.3 *test sample, n*—combination of fasteners installed into a treated wood specimen.

3.2.4 *wood specimen, n*—section of wood into which fasteners are driven to form test samples. Specimens may be treated for testing of materials, coatings, or chemicals or may be untreated for use as controls.

3.2.4.1 *Discussion*—Wood cross-sectional dimensions are given in exact numbers for SI units and nominal numbers for inch-pound units.

4. Summary of Test Method

4.1 This test method covers the preparation, testing and evaluation of metal, metal-coated, or nonmetallic-coated smooth or deformed shank driven fasteners installed in treated wood. Control specimens tested in the same conditions shall be hot-dip galvanized fasteners that are coated as described in Specification A153/A153M or bright fasteners with no coatings. The fasteners are installed in the treated wood specimen before testing so that the chemicals in the wood are in direct contact with the metal or coating. Test samples are then tested in Steady State Moisture Tests or Cyclic Fog Tests. For each type of sample, separate groups of test samples shall be tested under either or both of the two test conditions. Procedures for conducting tests in two environmental conditions, Steady State Moisture Tests and Cyclic Fog Tests, are described as well as position of the samples and measurement techniques for determining the degree of corrosion. Guidance is given for methods of exposure and inspection of corroded fasteners in the two environmental conditions.

5. Significance and Use

5.1 This test method provides controlled environments which are utilized to produce corrosion of metal, metal-coated, or nonmetallic-coated smooth or deformed shank driven fasteners in contact with treated wood exposed to the given test environments. The test method provides information that can be used to evaluate the corrosion resistance of metal, metal-coated, or nonmetallic-coated smooth or deformed shank driven fasteners in contact with different chemical wood treatments.

5.2 The results shall be used for comparative purposes only and they shall not be correlated to exposure time in natural environments.

5.3 The reproducibility of results in these types of tests is highly dependent on the type of samples tested and the evaluation criteria selected, as well as the control of the operating variables.

6. Apparatus

6.1 *Steady State Moisture Test*—The apparatus required for steady state moisture tests shall consist of a test chamber, provisions for heating the chamber, a humidifying tower, a supply of compressed air, sample supports, and necessary means of control.

6.1.1 There are no size or construction requirements other than those needed to meet the requirements of the test method.

6.1.2 A schematic diagram of a typical apparatus is shown in Practice G60, Figure 1.

6.1.3 The apparatus shall be capable of providing a relative humidity of 95 % for 24 h a day for a period of at least 120 days.

6.1.4 The apparatus shall be capable of providing a constant temperature of 32 ± 2°C (90 ± 3°F).

6.2 *Cyclic Fog Test*—The cyclic fog test shall consist of a fog chamber with a solution reservoir, a supply of suitably conditioned compressed air, one or more atomizing nozzles, specimen supports, provisions for heating the chamber and necessary means of controlling fog spray and heating cycles and means of purging fog with fresh air prior to heat cycles for a period of at least 120 days. The material of construction shall be such that it will not affect the corrosiveness of the fog. Similar tests are described in Practice B117 and Practice G85 with the exception that these practices use salt solutions during the testing.

6.2.1 Drops of solution which accumulate on the ceiling or cover of the chamber shall not be permitted to fall on the samples being exposed and shall not be returned to the reservoir for respraying.

6.2.2 Drops of solution which fall from the samples shall not be returned to the solution reservoir for respraying.

7. Reagents and Materials

7.1 Water used for this test method shall conform to Type IV water as described in Specification D1193 and shall be referred to as purified water.

8. Air Supply

8.1 The compressed air supply shall be free of water, grease, oil and dirt.

NOTE 1—The air supply may be freed from oil and dust by passing it through a suitable oil/water extractor (that is commercially available) to stop any oil from emerging. Many oil/water extractors have an expiration indicator; proper preventive maintenance intervals should take these into account.

9. Sampling, Test Specimens, and Test Units

9.1 *Fastener Specimens:*

9.1.1 A minimum of 65 fasteners shall be used for complete evaluation per this test method using both test conditions on any type of sample fastener; metal, metal-coated, or nonmetallic-coated. Multiple fastener types may be tested in the same cycle of testing with one set of control fasteners. Different fastener lengths may require different wood sizes to accommodate the length of the fasteners.

9.1.2 *Initial Cleaning of Metal, Metal-Coated, or Nonmetallic-Coated Smooth or Deformed Shank Driven*

Fasteners—Initial cleaning of fastener shall be done by rinsing with purified water and drying with forced hot air, air temperature shall be between 40 to 60°C (104 to 140°F).

9.1.3 *Coating Mass*—Five randomly selected fasteners shall be taken from the cleaned group of fasteners and shall be stripped of coating and weighed to determine the average coating mass. Stripping and weighing of zinc and zinc-alloy products shall be in accordance Test Method A90/A90M. The mass for an individual fastener shall be determined to the nearest 0.001 g (0.000032 oz). Coatings other than zinc shall be stripped using an appropriate method to measure coating mass of the corrosion-resistant layer(s). Coatings other than zinc and zinc-alloys shall have their mass or coating thickness determined by one of the following methods; Test Method B487, Test Method B499, Test Method B504, or Practice E376.

9.1.4 *Fastener Diameter*—The sample group of five random fasteners from 9.1.3 shall be used to measure the core diameter of the fastener. The diameter shall be measured at mid-length, ±10 mm (±0.4 in.), on the shank of each fastener and is the minimum diameter measurement at the selected cross section. For deformed shank fasteners the measurement shall be made at a portion of the shank that has not been deformed, if such a surface is available. Portions of nail shanks with gripper marks shall also be avoided, if possible. The diameter shall be measured to the nearest 0.025 mm (0.001 in.) The five sample diameter measurements shall be averaged to obtain the group fastener diameter.

9.1.5 *Control Fastener Group*—There shall be a group of hot-dip galvanized fasteners that are galvanized to Specification A153/A153M. When testing some coated fasteners, the more appropriate control fastener group will be bright fasteners rather than galvanized fasteners. Fasteners in the control samples shall be of the same nominal diameter and length as the fasteners that are being tested and shall have similar geometry to the fasteners that are being tested.

9.2 *Treated Wood Specimens:*

9.2.1 Each treated wood specimen used in this procedure shall be weighed using a balance or scale to the nearest 0.5 g (0.001 lb). Wood for this test method shall be Southern Pine sapwood. The sapwood of other wood species may be added to the testing program and details of the additional wood species shall be provided in the final test report.

9.2.2 The treated wood specimens used in this procedure require a conditioning period prior to installation or contact with the fasteners to be evaluated.

9.2.2.1 The conditioning of the treated wood specimens shall be accomplished in an environmental chamber at a relative humidity of 95 % with a tolerance for the controller measurement device of ±3 % and a temperature of 32°C (90°F) with a tolerance on the temperature controller measurement of ±2°C (3°F). The treated wood specimens shall be held in the chamber in these conditions until the treated wood specimens reach equilibrium. Equilibrium is defined as no more than a ±0.2 % change in a 24-h period of the average mass of ten randomly selected treated wood specimens. These measurements shall be conducted every 24 h, and mass shall be recorded and the change calculated until such equilibrium is achieved. Conditions for treated wood specimen conditioning shall be the same as the Steady State Moisture Test conditions.

9.2.2.2 Moisture content of the treated wood specimen shall be determined on one of the treated wood specimens. The beginning and final moisture content of the treated wood specimen shall be determined using calibrated meters in accordance with Test Method D4444 for samples with a known moisture adjustment for the preservative or by oven drying methods in accordance with Test Method D4442 for any sample.

9.3 *Test Samples:*

9.3.1 When preparation of the fastener specimens and the treated wood specimens are complete, the fastener specimens shall be installed in contact with the treated wood specimens.

9.3.2 The evaluation of the fasteners shall be conducted by installing them into the treated wood specimen as done in application, that is, by hand driving or power driving with no pre-drilled pilot holes. When the test objective is the comparison of wood treatments, the use of pilot holes is permitted to reduce variables associated with fastener installation. Fastener heads shall be installed such that the bottom of the fastener head is in contact with the surface of the treated wood specimen and shall not be installed so deep that the top of the fastener head is below the surface of the treated wood specimen. Fastener placement shall avoid knots in the wood. Fasteners shall not be installed into sections of the wood that contain heartwood as this wood does not accept a uniform chemical treatment. A test sample shall no longer be considered valid if the fasteners cause a split that exceeds two fastener diameters in length. A test sample that has any observable splitting around more than one fastener shall not be used in environmental condition tests.

9.3.3 Fastener center-to-center spacing shall be a minimum of ten times the fastener diameter from the closest nearby fastener, with a clear zone (containing no fasteners) of 38 mm (1.5 in.) from the ends of the treated wood specimen in Fig. 1, which shows an example of a test sample for nails with a maximum diameter of 3.3 mm (0.131 in.). The end grain of the treated wood specimen shall be left open.

9.3.4 To avoid splitting, the location of fastener entry points into the treated wood specimen shall be staggered, with fasteners alternately driven on opposite sides of an imaginary straight line located along the longitudinal centerline of the treated wood specimen. Fasteners shall be placed on alternate sides and within 9 mm (⅜ in.) of the longitudinal centerline.

9.3.5 Each treated wood specimen in the test group shall include fasteners from each control fastener group and from each type of fastener to be evaluated.

9.3.6 *Placement of Fasteners*—To minimize variations that result from variability of pressure treatment retention in the treated wood specimens, each group of fasteners containing control fasteners and test fasteners shall be alternately placed in the appropriate size treated wood specimen. Each treated wood specimen shall consist of a 38 by 89 by 305 mm (nominal 2 by 4 by 12 in.) piece of treated wood or other appropriate size depending on the size of the fasteners being tested. Fig. 1 shows the arrangement of fasteners in a treated wood specimen.

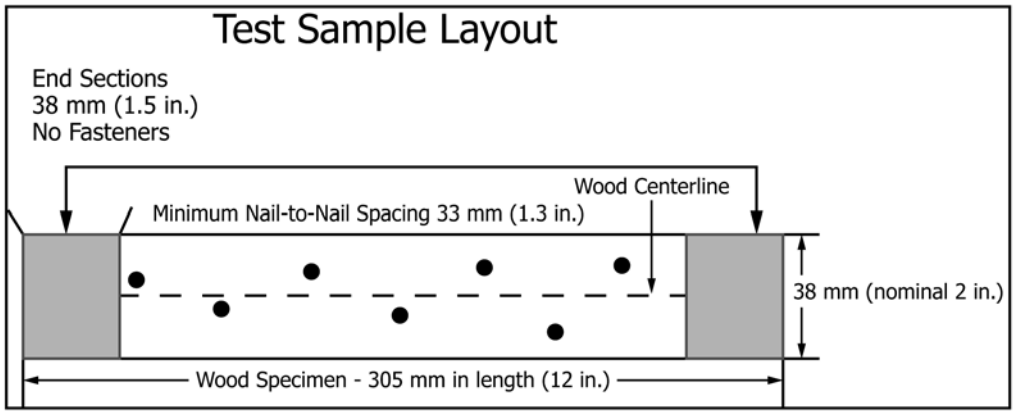

FIG. 1 Layout of Fasteners on Treated Wood Specimen

9.4 *Control Specimen:*

9.4.1 *Fastener Testing:*

9.4.1.1 Unless otherwise specified, when testing is for structural acceptance, the fastener control shall be bright fasteners and fasteners that are hot-dip galvanized to Specification A153/A153M, as appropriate.

9.4.1.2 When testing for rate of corrosion of fasteners in treated wood, control samples of bright steel are not required.

9.4.2 *Testing for Retention Levels in Treated Wood:*

9.4.2.1 Controls for treated wood shall include Southern Pine sapwood, in accordance with Terminology D1165, in the untreated form.

9.4.2.2 Treated wood shall be from commercially available treated Southern Pine sapwood treated to the highest retention level as described in American Wood Protection Association (AWPA) U1-09 or the manufacturer's evaluation service report for the intended use of the fasteners.

9.4.2.3 Tests for preservative in treated wood shall be performed in accordance with the appropriate (AWPA) test method based upon the type of preservative being used.

9.5 *Statistical Population:*

9.5.1 *Control Specimen Population*—For each test, Steady State Moisture Test and Cyclic Fog Test, 30 control specimens shall be tested.

9.5.2 *Fastener Population*—For each material, metallic coating, or nonmetallic coating there shall be a minimum of 30 fasteners in each environmental test, Steady State Moisture Test and Cyclic Fog Test.

10. Test Procedure

Steady State Moisture Test

10.1 *Position of Test Samples During Exposure*—The position of test samples for the steady state moisture tests shall be such that the following conditions are met:

10.1.1 Test samples shall be placed on trays with sufficient openings in the bottom to allow air flow around all of the test samples.

10.1.2 Test samples shall be placed with the fastener heads positioned at the top of the test sample and oriented so the side with the fastener heads showing is visible when looking down at the test sample.

10.1.3 Test samples shall not be in contact with each other during the test.

10.2 *Exposure Conditions*—The environmental chamber shall be maintained at a relative humidity of 95 % with a tolerance for the controller measurement device of ±3 % and a temperature of 32°C (90°F) with a tolerance on the temperature controller measurement of ±2°C (±3°F).

10.3 *Continuity of Test*—Unless otherwise specified, the test shall be allowed to run continuously for the required duration as specified in 10.5. The chamber shall be closed except for interruptions of less than 10 min to inspect or rearrange test samples. Frequency of interruptions should not exceed one per day.

10.4 *Visual Inspection*—At any time during the test duration, visual examination of the heads of the fasteners may be performed and details shall be recorded.

10.5 *Test Duration*—The test shall run for 120 days. Extra samples may be placed in the test chamber with the purpose of removing these samples at specific time intervals before the completion of the test.

Cyclic Fog Test

10.6 The position of the test samples for the cyclic moisture tests shall be such that the following conditions are met:

10.6.1 Unless otherwise specified, the test samples shall be supported between 15° and 30° from the vertical and preferably parallel to the principal direction of the horizontal flow of fog through the chamber, based upon the dominant surface being tested. The test samples shall be aligned so that the heads of the fasteners are in-line with the flow direction of the fog through the chamber.

10.6.2 There shall be no contact between test samples, between any metallic materials or between any materials that can act as a wick.

10.6.3 Each test sample shall be placed to permit free settling of fog on test samples.

10.6.4 Water from one test sample shall not be allowed to drip onto fasteners from another test sample.

10.6.5 Test samples of different fasteners shall be placed randomly throughout the test chamber to avoid possible bias caused by differences in spray patterns.

10.7 *Exposure Conditions:*

10.7.1 *Wet/Dry Cycle*—The wet/dry cycle shall consist of 48 h of fog, followed by a minimum of 72 h and a maximum of 120 h of drying time.

NOTE 2—The drying time is intended to be 72 h as a standard with the allowance of an extra 48 h for weekends and holidays.

10.7.2 *Wet Bottom*—The bottom of the chamber shall contain a minimum of 25 mm (1 in.) of water during the fog portion of the test. The bottom of the chamber shall dry naturally during the dry cycle.

10.7.3 *Quantity of Fog*—Place at least two clean fog collectors within the exposure zone so that no drops of solution from the test samples or any other source can be collected. Position the collectors in the proximity of the test samples, one nearest any nozzle and the other farthest from all nozzles. Make sure that for each 8000 mm^2 (12 $in.^2$) of horizontal-collecting area, fog accumulates in each collector at a rate between 1.0 to 2.0 mL (0.03 to 0.07 oz) solution per hour, based on an average run of at least 16 h of continuous spray.

10.7.4 *Fog Temperature*—During the fog period, no heating shall be applied to the cabinet. The fog exposure chamber shall be at ambient room temperature. Ambient temperature is defined as 24 ± 3°C (75 ± 6°F).

10.7.5 *Drying Conditions*—The following shall apply to the drying cycle of the fog test:

10.7.5.1 *Drying Temperature*—The temperature throughout the exposure zone shall reach and remain at 35 ± 2°C (95 ± 3°F) within 45 min of switching from the fog period to the dry period.

10.7.5.2 *Drying Time*—Drying off shall be achieved by purging the chamber with air at the drying temperature and a relative humidity of 70 % with a tolerance for the controller measurement device of ±3 %, such that within 45 min, all visible moisture is dried off of all of the test samples. The drying period may be extended over special weekends and holidays so that the samples are dry during these non-tended periods but this drying extension should not be used on a regular basis. The bottom of the chamber shall dry naturally during the dry cycle.

10.7.6 *Saturation Tower*—Humidified air shall not be used in this test procedure. One of the following methods shall be used to avoid humidifying the air:

10.7.6.1 *Method 1*—Empty the saturation tower and ensure that the tower heater is turned off.

10.7.6.2 *Method 2*—Arrange the spray plumbing so that the atomizing air does not go through the saturation tower but goes directly to the spray nozzles.

10.7.7 *Continuity of Test*—Unless otherwise specified, the test shall be allowed to run continuously. The chamber shall be closed except for interruptions of less than 10 min to inspect or rearrange test samples. Frequency of interruptions should not exceed one per day.

10.7.8 *Test Duration*—The test shall run for 120 days. Extra samples may be placed in the test chamber with the purpose of removing these samples at specific time intervals before the completion of the test.

11. Fastener Evaluation

11.1 *Specimen Photography*—Record conditions through photographs of the fasteners and the treated wood specimens before and after removing the fasteners from the treated wood specimens using appropriate identification and numbering.

11.2 *Evaluation:*

11.2.1 *Removal of Fasteners from the Treated Wood Specimens*—After exposure, fasteners that have been embedded in the treated wood specimens shall be removed after visual inspection of the test samples. This is accomplished by splitting the treated wood specimen, exercising care not to damage the fastener.

11.2.2 *Visual Inspection*—Prior to any cleaning, the fasteners shall be visually inspected for signs of corrosion products. Fastener shank, top, and sides of head are to be visually inspected and graded. The grading of percentage of the surface of the fastener covered with corrosion products shall be in accordance with Test Method D610. The proportions of different corrosion products (white, gray, and red) shall be noted. Any fastener damage or pitting shall be reported.

NOTE 3—Visual inspection could be affected by bleeding or drainage of corrosion products away from the corroded area. Inspections should be conducted with attention to the possibility of bleeding or drainage.

11.2.3 *Fastener Cleaning*—Fasteners shall be cleaned in accordance with the procedures described in Practice G1 or alternate cleaning procedures that have been demonstrated to not remove the base coating while cleaning the corrosion products off the surface of the coating. Cleaning processes are validated by including the untested fasteners in the cleaning process and recording the changes in these fasteners from the original inspections before testing. Products of corrosion can result in diameter growth. Inspections shall be conducted with attention to the possibility of buildup of such products. Such products shall be removed before measuring diameter. For corrosion products that are tightly adhering to the fastener, cleaning by mechanically abrading the surface before chemical cleaning will help remove the adherent corrosion products. Vigorous mechanical cleaning can result in the removal of some base metal: therefore, care shall be exercised when using mechanical cleaning techniques. Mechanical cleaning shall be used only when other methods have failed to provide adequate removal of corrosion products on the fasteners.

11.2.4 *Fastener Diameter*—Diameter measurements of the fastener steel (structural) core, free of residual corrosion products, shall be taken. The smallest diameter reading shall be used to calculate the area reduction. The measurement method selected shall have an accuracy of ±0.025 mm (0.001 in.) or better.

NOTE 4—For difficult to remove barrier coatings and localized pitting corrosion evaluation, diameter measurements can be taken under high magnification on a metallographically prepared sample of the fastener.

12. Report

12.1 Data for the exposed fasteners shall include physical dimensions, corrosion-protection system, surface preparation, condition of the test chamber during Fog Test, condition of the test chamber during Steady State Moisture Test, after-exposure

cleaning methods, photographs, core fastener diameter measurements, and mass measurements.

12.2 Data for the treated wood specimens shall include treatment method and initial and final moisture content of the treated wood specimens as well as treatment retention level.

12.3 This report shall include the exposure period in each test and the position of the test sample including the fastener type in the test chamber.

12.4 *Corrosion Test Results Report:*

12.4.1 For metal coated or metallic fasteners the results of the exposure shall be expressed as corrosion rate (Practice G1) such as penetration per unit time, mass loss per unit time, loss in thickness over the exposure period, and comparison of corrosion rate with the control specimen group. Other results that shall be reported include percentage of various corrosion products on the surface of the fastener and the loss of cross-sectional area over the exposure period. Fasteners using metallic coatings shall report percentage of initial coating mass lost during the test.

12.4.2 Fasteners using nonmetallic coatings shall report any evidence of pitting, coating disbondment, or undercoating corrosion. Nonmetallic coated fastener reports shall not measure corrosion rate as corrosion for these materials is not uniform over the entire fastener surface. Comparison of the nonmetallic coated fastener corrosion to the standard galvanized coated fastener corrosion is not significant because of the nonuniform corrosion rate of nonmetallic-coated fasteners. If there is an intentional void placed in the nonmetallic coating during sample preparation, the size of the initial void, and the expansion of the void after testing shall be reported. Measurement of the initial fastener diameter and the change in fastener diameter after testing shall be reported for nonmetallic-coated fasteners.

12.5 Any disturbances that significantly alter the prescribed test conditions, such as wet periods that last twice as long as planned or extreme temporary temperature deviations in the steady state moisture tests, invalidate the test. Do not report results from such exposures.

13. Precision and Bias

13.1 *Precision*—The precision of this test method to determine the relative corrosion performance of metal, metal-coated, or nonmetallic-coated smooth or deformed shank driven fasteners in contact with treated wood is being determined.

13.2 *Bias*—The relative performance of metal, metal-coated, or nonmetallic-coated smooth or deformed shank driven fasteners has no bias because the performance is defined only in terms of this test method.

14. Keywords

14.1 cyclic fog testing; fastener corrosion; metal fasteners; metal-coated fasteners; nail; nonmetallic fasteners; pressure treated wood; steady state moisture testing; treated wood; wood preservatives

SUMMARY OF CHANGES

Committee G01 has identified the location of selected changes to this standard since the last issue (G198 – 11 (2016)) that may impact the use of this standard. (Approved May 15, 2017.)

(1) Revised 9.3.6 to remove the cuts between the fasteners as the moisture penetration is one dimensional and the cuts are not helping to bring moisture to the fasteners.