



Designation: G198 – 17

Standard Test Method for Determining the Relative Corrosion Performance of Driven Fasteners in Contact with Treated Wood¹

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.*

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. 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

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 $32 \pm 2^\circ\text{C}$ ($90 \pm 3^\circ\text{F}$).

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 ($\frac{3}{8}$ 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.