

# ACCEPTANCE CRITERIA FOR CORROSION-RESISTANT FASTENERS AND EVALUATION OF CORROSION EFFECTS OF WOOD TREATMENT CHEMICALS

**AC257**

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## PREFACE

Evaluation reports issued by ICC Evaluation Service, Inc. (ICC-ES), are based upon performance features of the International family of codes and other widely adopted code families, including the Uniform Codes, the BOCA National Codes, and the SBCCI Standard Codes. Section 104.11 of the *International Building Code*® reads as follows:

The provisions of this code are not intended to prevent the installation of any materials or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been approved. An alternative material, design or method of construction shall be approved where the building official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability and safety.

Similar provisions are contained in the Uniform Codes, the National Codes, and the Standard Codes.

This acceptance criteria has been issued to provide all interested parties with guidelines for demonstrating compliance with performance features of the applicable code(s) referenced in the acceptance criteria. The criteria was developed and adopted following public hearings conducted by the ICC-ES Evaluation Committee, and is effective on the date shown above. All reports issued or reissued on or after the effective date must comply with this criteria, while reports issued prior to this date may be in compliance with this criteria or with the previous edition. If the criteria is an updated version from the previous edition, a solid vertical line (|) in the margin within the criteria indicates a technical change, addition, or deletion from the previous edition. A deletion indicator (→) is provided in the margin where a paragraph has been deleted if the deletion involved a technical change. This criteria may be further revised as the need dictates.

ICC-ES may consider alternate criteria, provided the report applicant submits valid data demonstrating that the alternate criteria are at least equivalent to the criteria set forth in this document, and otherwise demonstrate compliance with the performance features of the codes. Notwithstanding that a product, material, or type or method of construction meets the requirements of the criteria set forth in this document, or that it can be demonstrated that valid alternate criteria are equivalent to the criteria in this document and otherwise demonstrate compliance with the performance features of the codes, ICC-ES retains the right to refuse to issue or renew an evaluation report, if the product, material, or type or method of construction is such that either unusual care with its installation or use must be exercised for satisfactory performance, or if malfunctioning is apt to cause unreasonable property damage or personal injury or sickness relative to the benefits to be achieved by the use of the product, material, or type or method of construction.

***Acceptance criteria are developed for use solely for purposes of issuing ICC-ES evaluation reports.***

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## 1.0 INTRODUCTION

**1.1 Purpose:** The purpose of this acceptance criteria is twofold: (1) to establish requirements for evaluating the corrosion resistance of fasteners that are exposed to a combination of wood treatment chemicals, weather, and salt corrosion in coastal areas; and (2) to establish requirements for evaluating the corrosion effects of wood treatment chemicals as they apply to metals in contact with proprietary wood treatment chemicals. This acceptance criteria is used to establish recognition in an ICC Evaluation Service, Inc. (ICC-ES), evaluation report under the 2009 and 2006 *International Building Code*<sup>®</sup> (IBC) and the 2009 and 2006 *International Residential Code*<sup>®</sup> (IRC). The bases of recognition are IBC Section 104.11 and IRC Section R104.11. Applicable code sections for salt corrosion are Section 302.1.3 of SSTD 10-99, Section 2308.2.1 of the 2006 IBC that references SSTD10, Section 304.3 of ICC 600-2008, and Section 2308.2.1 of the 2009 IBC that references ICC 600-2008. Applicable code sections for fasteners in preservative-treated wood (referred to in this criteria as chemically treated wood as defined in Section 1.4.3) are Section 2304.9.5 of the 2006 and 2009 IBC, Section R319.3 of the 2006 IRC, and Section R317.3 of the 2009 IRC.

The reason for the development of this criteria is to allow evaluation of corrosion resistance of fasteners that may be used as alternates to code-recognized fasteners, since the code does not provide test methods and performance requirements for alternate corrosion-resistant fasteners.

**1.2 Scope:** This criteria is applicable to corrosion-resistant fasteners and to the corrosion effect of wood treatment chemicals by the creation of an electrochemical environment in wood with treatment chemicals, water, elevated temperatures, and common construction metals. Test results have comparative value and are not correlated to exposure time in a natural environment. This criteria is not applicable to fire-retardant-treated wood (FRTW). Refer to Section 3.3 of AC66 for corrosion testing of FRTW.

**1.2.1 Corrosion Resistance of Fasteners:** This criteria is used to evaluate corrosion resistance of fasteners (refer to Figure 1 for a flowchart) and applies to fasteners for use in wood-to-wood connections, metal-to-wood connections and wood to other engineered materials, nails and spikes [diameter of less than or equal to  $\frac{3}{8}$  inch (9.5 mm)], staples, and screws [diameter less than or equal to  $\frac{3}{8}$  inch (9.5 mm)] that are exposed directly to wood treatment chemicals and that, as a result of design application, may be exposed to one or more environmental corrosion accelerators, such as high humidity, elevated temperatures, direct weather or high moisture, or salt from coastal exposure. These fasteners are alternates to fasteners with code-recognized protection systems.

**1.2.2 Corrosion Effects of Wood Treatment Chemicals:** This criteria is used to evaluate corrosion effects of wood treatment chemicals (refer to Figure 1 for flowchart) that are different from benchmark treatment chemicals (represented in this criteria as CCA, Type C,

oxide formulation covered in AC190 and AWPA U1). The criteria is intended to identify wood treatment chemical compatibility with common construction metals.

**1.2.3 Structural Properties of Fasteners:** The structural performance of the fasteners evaluated under this criteria for corrosion shall be documented in an ICC-ES evaluation report in accordance with an ICC-ES acceptance criteria or a standard from an accredited standards organization.

## 1.3 Codes and Referenced Standards:

**1.3.1 2009 International Building Code**<sup>®</sup> (IBC), International Code Council.

**1.3.2 2006 International Building Code**<sup>®</sup> (IBC), International Code Council.

**1.3.3 2009 International Residential Code**<sup>®</sup> (IRC), International Code Council.

**1.3.4 2006 International Residential Code**<sup>®</sup> (IRC), International Code Council.

**1.3.5 SSTD 10-99, Standard for Hurricane Resistant Residential Construction**, International Code Council.

**1.3.6 ICC 600-2008, Standard for Residential Construction in High-Wind Regions**, International Code Council.

**1.3.7 ASTM A 90-01, Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings**, ASTM International.

**1.3.8 ASTM A 123-02, Standard Specification for Zinc (Hot-dip Galvanized) Coatings on Iron and Steel Products**, ASTM International.

**1.3.9 ASTM A 153-03, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware**, ASTM International.

**1.3.10 ASTM B 117-03, Standard Practice for Operating Salt Spray (Fog) Apparatus**, ASTM International.

**1.3.11 ASTM B 370-03, Standard Specification for Copper Sheet and Strip for Building Construction**, ASTM International.

**1.3.12 ASTM B 695-00, Standard Specification of Zinc Mechanically Deposited on iron and Steel**, ASTM International.

**1.3.13 ASTM D 9-05, Standard Terminology Relating to Wood and Wood-Based Products**, ASTM International.

**1.3.14 ASTM D 610-01, Standard Test method for Evaluating Degree of Rusting on painted Steel Surfaces**, ASTM International.

**1.3.15 ASTM G 85-02, Standard Practice for Modified Salt Spray (Fog) Testing**, ASTM International.

**1.3.16 ASTM G 1-03, Standard Practice for Preparing, Cleaning, and Evaluating Corrosion Test Specimens**, ASTM International.

**1.3.17 AWPA E12-94**<sup>®</sup>, Standard Method of Determining Corrosion of Metals in contact with Treated Wood, American Wood-Preservers' Association.

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**1.3.18** AWWPA U1-05<sup>®</sup>, Use Category System: Processing and Treatment Standard, American Wood-Preservers' Association.

**1.3.19** ICC-ES Acceptance Criteria for Nails and Spikes (AC116).

**1.3.20** ICC-ES Acceptance Criteria for Wood Screws Used in Horizontal Diaphragms and Vertical Shear Walls (AC120).

**1.3.21** ICC-ES Acceptance Criteria for Staples (AC201).

**1.3.22** ICC-ES Acceptance Criteria for Alternate Dowel-type Threaded Fasteners (AC233).

**1.3.23** ICC-ES Acceptance Criteria for Proprietary Wood Preservative Systems—Common Requirements for Treatment Process, Test Methods and Performance (AC326).

### 1.4 Definitions:

**1.4.1 Alternate Fastener:** The proprietary fastener tested for evaluation as an alternative to the benchmark fastener where corrosion resistance is imparted by coating and/or base-material formulation.

**1.4.2 Benchmark Fastener:** The standard as described in Section 3.1.3.

**1.4.3 Chemically Treated Wood:** Wood treated with the proprietary treatment chemicals are referred to using a proprietary trade name noted in an ICC-ES evaluation report on the treatment system. The wood is treated in accordance with an approved quality control procedure.

**1.4.4 Corrosion-resistance Mechanism:** A coating or material formulation that prevents or restricts corrosion.

**1.4.5 Fastener Type:** Description of fastener attributes, including shank type, head style, length and material.

**1.4.6 Protective Coating Thickness:** Range of coating thicknesses representative of the product tested.

**1.4.7 Protective Coating Type:** The characterizing description of the fastener corrosion-protection coating.

**1.4.8 Sapwood:** Defined in ASTM D 9.

**1.4.9 Small-diameter Fastener:** A dowel-like mechanical fastener that has a smooth or threaded shank or legs and a shank or leg diameter of less than  $\frac{3}{8}$  inch (9.5 mm).

**1.4.10 Sample Lot:** A lot of at least 100 alternate or benchmark fasteners that are representative of the population of fasteners from which they are chosen.

**1.4.11 Test Member:** The object receiving fasteners to be tested, consisting of wood-based material that is preservative-treated or untreated depending on the exposure test to be conducted.

**1.4.12 Test Specimen:** The wood test members with embedded fasteners.

**1.4.13 Wood Treatment Chemicals:** A wood preservative system that is defined in another ICC-ES acceptance criteria and that covers specific requirements for the treatment products not covered in AC326.

## 2.0 BASIC INFORMATION

**2.1 General:** The following information shall be submitted:

**2.1.1 Product Description:** Complete descriptive information on the fasteners and treatment chemicals, including material specifications and:

For fasteners:

1. Generic or trade name.
2. Manufacturer's catalog number(s).
3. Size(s), nominal diameter(s) and length(s).
4. Coating type and thickness.
5. Base-material specification.
6. Features coated.

For wood treatment chemicals:

1. Generic or trade name.
2. Manufacturer's product number.
3. Intended AWWPA Use Categories, with treatment retention and penetration.
4. Wood species and products that can be treated with the chemical.

**2.1.2 Packaging and Identification:** Refer to the product-specific acceptance criteria.

**2.2 Testing Laboratories:** Testing laboratories shall comply with Section 2.0 of the ICC-ES Acceptance Criteria for Test Reports (AC85) and Section 4.2 of the ICC-ES Rules of Procedure for Evaluation Reports.

**2.3 Test Reports:** Test reports shall comply with AC85 and include the following information:

**2.3.1** The benchmark used in the testing and evaluation.

**2.3.2** The termination point of each test specimen as characterized by the exposure duration and the appropriate corrosion assessment.

**2.3.3** Photographs of the equipment and the terminated test specimens.

**2.4 Product Sampling:** Products shall be sampled in accordance with Section 3.2 of AC85. Additional requirements for sampling are specified in Sections 3.1.5 and 3.2.4 of this criteria.

## 3.0 TEST MATERIAL REQUIREMENTS

Corrosion resistance of fasteners shall be in accordance with Section 3.1. Corrosion effects of wood treatment chemicals shall be in accordance with Section 3.2.

### 3.1 Fastener Corrosion Resistance:

**3.1.1** The protective coating or corrosion protection feature of the alternate fasteners shall be identified by the proponent.

**3.1.2** The treatment chemical shall be identified by type and treatment level.

**3.1.3** The benchmark fastener shall be hot-dip galvanized and meet the specifications of ASTM A153, Class D. For fasteners that rely on base-material formulation for corrosion resistance, the benchmark fastener shall be identified in consultation with ICC-ES.

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**3.1.4** The benchmark and the alternate fastener shall be of the same nominal dimensions and shank design, and shall be representative of manufactured products. A minimum of one size and shank design shall be tested unless it is known that the corrosion resistance is related to shank design. If corrosion resistance is related to shank design or method of assembly, then at least two shank designs must be tested to verify performance over the product range.

**3.1.5** Products shall be sampled in accordance with AC85, Section 3.2. Five lots of the benchmark and alternate fasteners shall be available to sample.

**3.1.6** One lot of benchmark and alternate fasteners shall be selected from those available, and the necessary fasteners taken randomly from that lot.

**3.1.7** The benchmark and alternate fasteners shall be cleaned in accordance with ASTM G 1 before insertion into the wood test specimens.

**3.1.8** Zinc coating weight on the benchmark fasteners shall be determined in accordance with the ASTM A 90 on a minimum of ten fasteners sampled from the sample lot such that a minimum of 24 inches (610 mm) of shank length is evaluated.

**3.1.9** For alternate fasteners utilizing a barrier or sacrificial coating as a corrosion resistance mechanism, the thickness of each coating layer shall be determined in accordance with the applicable ASTM standards for coated fasteners. For alternate fasteners that provide corrosion resistance via the base-material formulation, the content of the performing substance shall be determined in accordance with the applicable ASTM standards.

**3.1.10** Test members shall be through-treated sapwood of the southern pine species group and either chemically treated wood or untreated wood in accordance with Table 1. Some fastener applications may require the use of other species groups for the test member material. The test members shall be representative of new commercial materials in the end-use condition in terms of wood quality, preservative treatments and moisture content.

**3.1.11** For performance test methods and assessment methods, refer to Section 4.0.

### **3.2 Treatment Chemical Corrosion Effects:**

**3.2.1** The principal constituents of the treatment chemical shall be identified.

**3.2.2** The intended Use Categories following AWPA U1 shall be specified.

**3.2.3** Test members shall be treated at the level necessary to meet performance requirements of the planned Use Categories as defined by AWPA Standard U1.

**3.2.4** Products shall be sampled in accordance with AC85, Section 3.2. A minimum of five boards that are primarily sapwood shall be sampled and prepared following AWPA E 12. The boards shall be sized to accommodate fasteners to be tested.

**3.2.5** Treatment chemical retention and penetration shall be verified by using AWPA test methods and representative specimens of chemically treated wood cut from the same boards as the test members.

**3.2.6** Tests of the treatment chemical shall be performed with coupons of metals for which recognition is sought. The metals to be used are stainless steel (304), hot-dip galvanized steel (ASTM A 123, average 1 oz/ft<sup>2</sup> per side), carbon steel (uncoated) (SAE 1010), aluminum (2024-T3 or 5154-0 alloys), and copper (ASTM B 370). Coupons of 16 gauge [54 mils, 0.0538 inch (1.37 mm)] thickness are recommended. Coupons shall be a minimum thickness of 20 gauge [40 mils, 0.0396 inch (1.00 mm)] and a maximum thickness of 14 gauge [75 mils, 0.0747 inch (1.90 mm)].

**3.2.7** Test exposure shall include the benchmark combination of the treatment chemical CCA (ground contact) with hot-dip zinc galvanized coupons specified in Section 3.2.6.

**3.2.8** For performance test methods and assessment methods, refer to Section 4.0.

## **4.0 TEST METHODS AND PERFORMANCE REQUIREMENTS**

Corrosion resistance of fasteners shall be in accordance with Section 4.1 and applicable sections of 4.3, 4.4 and 4.5. Corrosion effects of wood treatment chemicals shall be in accordance with Section 4.2 and applicable sections of 4.3, 4.4 and 4.5.

### **4.1 Corrosion Resistance of Fasteners:**

**4.1.1** Table 1 shall be used to establish the exposure test requirements for fastener corrosion resistance testing based on planned report recognition.

**4.1.2** Each test procedure as described in Section 4.3 shall include a minimum of 10 benchmark and 10 alternate fasteners.

**4.1.3** Fasteners shall be installed perpendicular to the side grain of the test member so that the bottom surface of the head contacts the test member and the top of the head is not below the surface plane of the test member. A pilot hole shall be used only if required by manufacturer's field installation instructions.

**4.1.4** Each fastener shall be driven into the test member using the appropriate tool and practice.

**4.1.5** An equal number of benchmark and alternate fasteners shall be driven into each test member. Fasteners in each test specimen shall be alternately sequenced, spaced at least 12 times fastener diameter, and shall be positioned in a staggered pattern along the centerline of the test specimen where the center-to-center distance of the target lines is at least two shank diameters about the center line. Minimum end distance shall be 2 inches (51 mm) and minimum edge distance shall be  $\frac{1}{2}$  inch (13 mm). Maximum edge and end distance shall be less than 4 inches (101 mm). During installation, if a wood surface split greater than the nominal diameter of the installed fastener is observed, the installed fastener shall be rejected.

**4.1.6** After the fasteners are installed, the test specimen shall be kerf-cut between the fasteners. The kerf-cut shall be as deep as the fastener penetration. As an alternate, the test member may be sawn into separate blocks, each with an individual fastener.

**4.1.7** The moisture content of the wood test specimens shall be recorded when the test assemblies are

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placed in the chamber and when they are removed from the chamber. The beginning and final moisture contents of the test members shall be determined by using calibrated moisture meters in accordance with ASTM D 4444 or by oven-drying methods in accordance with ASTM D 4442. For chemical treatments carried in water, the initial moisture content of the test member shall not be less than 15 percent (oven-dry basis); and for treatments applied dry, the test member shall be conditioned to equilibrium moisture content at not less than 90°F (32°C) and 90 percent relative humidity.

**4.1.8** For alternate fasteners that rely on base-material (or alloy) corrosion-resistance mechanisms, a matched set of new alternate fasteners shall be stripped and weighed. Weight and average diameter of the shank shall be reported.

**4.1.9** Proprietary wood treatment chemicals shall be identified and referenced using applicable ICC-ES evaluation reports. The type of wood and treatment chemical retention and penetrations shall be determined from grade stamps and observation and shall be specified in the test report. Retention and penetrations for the treated wood samples shall be documented in the test report by testing from an accredited test laboratory.

### **4.2 Corrosion Effects of Wood Treatment Chemicals:**

**4.2.1** The lumber (or treated wood product) shall be sampled from a minimum of five boards or representative pieces of treated product(s).

**4.2.2** Testing in accordance with Section 4.3 shall be performed for the most severe Use Category as defined by AWWA Standard U1 for which recognition is being sought. Tests for a defined AWWA Use Category treatment level are applicable to lower Use Category treatment levels.

**4.2.3** Table 1 shall be used to establish the exposure test requirements for corrosion effects of treatment chemicals based on the expected conditions of recognition.

**4.2.4** Testing shall include exposure of metal coupons to treated wood in accordance with the general size and assembly methods of AWWA E12. The initial moisture condition of the material shall be in accordance with Section 4.1.7.

**4.2.5** A minimum of 10 replicates per metal given in Section 3.2.6 shall be exposed with the treatment chemical.

**4.2.6** Each coupon shall be weighed to a precision of 0.5 percent, and the thickness measured at a precision of 1 percent.

**4.2.7** Moisture content shall be determined in accordance with Section 4.1.7 of this criteria.

### **4.3 Exposure Conditions:**

#### **4.3.1 Exposure Conditions for Corrosion Resistance of Fasteners:**

**4.3.1.1. Exposure Condition 1—(High Humidity):** The exposure condition shall be conducted at a steady state condition of not less than 90°F (32°C) and 90 percent relative humidity. Test specimens shall be examined at intervals of 336 hours and the percentage of

red rust on the heads of the benchmark fasteners and the percentage of red rust on the heads of the alternate fasteners (if ferrous) or other corrosion characteristics shall be recorded. The test shall continue until 1992 hours has elapsed.

**4.3.1.2. Exposure Condition 2—(Untreated Wood and Salt Water):** Test Procedures 1 and 2 shall be conducted with matched test specimens.

**4.3.1.2.1. Test Procedure 1:** Salt-spray testing shall be performed in accordance with ASTM B 117. Test specimens shall be untreated wood. Test specimens shall be visually examined at intervals of 336 hours and the percentage of red rust on the heads of the benchmark fasteners and the percentage of red rust on the heads of the alternate fasteners (if ferrous) or other corrosion characteristics of the alternate fasteners shall be recorded. The test shall continue until 1440 hours has elapsed.

**4.3.1.2.2. Test Procedure 2:** Salt spray testing shall be performed in accordance with ASTM G 85, Annex A5. Test members shall be untreated wood. Test specimens shall be visually examined at intervals of 336 hours and the percentage of red rust on the heads of the benchmark fasteners and percentage of red rust on the heads of the alternate fasteners (if ferrous) or other corrosion characteristics shall be recorded. The test shall continue until 1440 hours has elapsed.

**4.3.1.3. Exposure Condition 3—(Chemically Treated Wood and Moisture):** The test procedure shall be in accordance with Section 4.3.1.2 except that distilled water (Type IV) shall be used in place of salt water and the test member shall be treated wood.

**4.3.1.4. Exposure Condition 4—(Chemically Treated Wood and Salt Water):** The test procedure shall be in accordance with Section 4.3.1.2 except that the test member shall be treated wood.

### **4.3.2 Exposure Conditions for Corrosion Effects of Wood Treatment Chemicals:**

**4.3.2.1. Exposure Condition 5—(Dry Use):** The test specimens shall be exposed to a steady state environment of not less than 90°F (32°C) and 90-percent relative humidity. The test duration shall be a minimum of 720 hours.

**4.3.2.2. Exposure Condition 6—(Wet Use):** The test specimens shall be exposed following Section 4.3.1.2, Test Procedure 1 except that distilled water (Type IV) shall be used in place of salt water, the test members shall be treated wood and the exposure period shall be for a minimum of 720 hours Appendix A may be used as an alternative test procedure to ASTM B 117.

### **4.4 Fastener and Coupon Removal and Cleaning:**

**4.4.1** When the tests are terminated, the benchmark and alternate fasteners shall be removed from the wood test specimens by sawing or splitting the wood near the fasteners and carefully separating the fasteners from the wood test members. Removal of the metal coupons is by opening the wood test specimen, followed by careful separation of the metal coupon from the wood test member.

**4.4.2** If coating is lost by adhesion to the test members, the loss shall be noted in the report.

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**4.4.3** Fasteners and coupons shall be cleaned ultrasonically in deionized water at room temperature using a 7.5-minute  $\pm$ 2.5-minute submersion time. The ultrasonic cleaning shall be repeated as needed. Ultrasonic cleaning shall be followed with brushing using a nylon brush and rinsing with deionized water to remove loose corrosion products. The fasteners and coupons shall be dried with warm air. Alternate cleaning methods or cleaning procedures are permitted provided it can be demonstrated that they do not adversely affect the test results.

### 4.5 Assessment of Fastener and Coupon Corrosion:

#### 4.5.1 Coated Ferrous Fasteners:

**4.5.1.1.** Visual head and shank corrosion results shall be reported separately for each test.

**4.5.1.2.** The surface area and form of the corrosion shall be visually assessed using the procedures specified in Section 5 of ASTM D610. The surface area shall be estimated rounding to the nearest 5 percent from 0 to 50 percent. Areas greater than 50 percent shall be rounded to the nearest 10 percent. For coated ferrous products, the area to be estimated is the area of exposed base metal.

**4.5.1.3.** For each fastener, the form of corrosion shall be noted as general, pinpoint, or spots as described in ASTM D 610.

#### 4.5.2 Fasteners with Base-Material (or Alloy) Corrosion-resistance Mechanisms:

**4.5.2.1.** For corrosion-resistance mechanisms other than coatings, the corrosion performance assessment shall be determined by base-material weight loss and changes in average shank diameter. Following the exposure period, the weight and diameter are measured using cleaned and stripped fasteners from the exposure tests.

**4.5.2.2.** For each fastener, the form of corrosion shall be noted as general, pinpoint, or spots as described in ASTM D 610. Areas of compromise of top layer protection, such as blistering or other adhesion problems, shall be noted.

#### 4.5.3 Coupons:

**4.5.3.1.** Both contacting surfaces of the metal coupons shall be visually evaluated and the result averaged for each piece.

**4.5.3.2.** Visual assessment shall follow Sections 4.5.1.2 and 4.5.1.3.

**4.5.3.3.** Hot-dip galvanized coupons from the CCA treated wood shall serve as a test control and shall be evaluated in the same manner.

#### 4.5.4 Comparisons to Benchmarks:

**4.5.4.1.** Corrosion ratings for all fasteners or coupons shall be summarized by treatment using summary statistics, mean, standard deviation, and coefficient of variation.

**4.5.4.2.** Corrosion ratings of the benchmark materials and the alternate materials shall be compared

using a one-tail t-test to assess equality of corrosion performance. The significance level shall be 0.05 for comparisons and inferences.

**4.5.4.3.** For statistical tests where equality is rejected: If the mean corrosion rating of the alternate is better than that of the benchmark, the inference is that the corrosion resistance exceeds that of the benchmark; if the mean corrosion rating of the alternate is not as good as that of the benchmark, the inference is that the corrosion resistance is less than that of the benchmark.

**4.5.4.4.** The statistical results shall be combined with assessment of functional differences, that is, severe but not statistically equivalent corrosion conditions may be not functionally different and shall be subject to interpretation.

**4.5.4.5.** For treatment chemical tests, a corrosion rating relative to the CCA/hot-dip galvanized treatment shall be calculated and reported for each metal, and shall be a ratio of the mean corrosion rating of the treatment chemical to the mean corrosion rating of the CCA/hot-dip galvanized control.

**4.5.4.6.** Data and information from other documented assessment methods may be considered as supplemental documentation for comparison to visual assessment. Examples of other assessment methods are weight loss of samples, x-ray analysis, head-shank tension test results, etc.

## 5.0 QUALITY CONTROL

**5.1** Quality control requirements are given in product-specific acceptance criteria such as, AC116, AC201, AC233, AC120 and AC326. Corrosion resistance and/or corrosion effect must be addressed in the quality control documentation and procedure for the product.

**5.2** Third-party follow-up inspections shall be as required in the product-specific acceptance criteria.

## 6.0 EVALUATION REPORT RECOGNITION

**6.1 Fasteners:** The evaluation report shall include a description of the alternate fasteners, installation requirements, special inspection requirements, and product identification; and shall include a finding that the alternative fasteners have a corrosion resistance that meets or exceeds that of the benchmark fasteners for the exposure conditions tested. Conditions of use for the alternative fasteners shall be specified in the evaluation report. **Structural performance shall be documented in the ICC-ES evaluation report either by reference to a manufacturer's ICC-ES evaluation report for structural properties or by submittal of documentation on structural performance in accordance with Section 1.2.3.**

**6.2 Treatment Chemicals:** The evaluation report shall include a description of the wood treatment chemical, special inspection requirements, Use Categories in accordance with AWPA U1, and product identification. The evaluation report shall also include a finding of the chemical corrosion effect relative to the CCA/hot-dipped galvanized benchmark as calculated in Section 4.5.4.5. ■

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**TABLE 1—EXPOSURE CONDITIONS FOR FASTENERS AND TREATMENT CHEMICAL TESTS WITH INTENDED USE AND LIMITATIONS OF RECOGNITION**

<b>EXPOSURE CONDITION</b>	<b>TYPICAL APPLICATIONS</b>	<b>RECOGNITION LIMITATIONS</b>
<b>Corrosion Resistance of Fasteners</b>		
1	Treated wood in dry use applications (4.3.1.1)	Limited to use where equilibrium moisture content of the chemically treated wood meets the dry service conditions as described in the NDS.
2	Aboveground with coastal salt exposure (4.3.1.2)	Limited to clean untreated wood and materials without known corrosion effects greater than that of clean untreated wood.
3	General construction (4.3.1.3)	Limited to freshwater and chemically treated wood exposure, e.g., no saltwater exposure.
4	Coastal construction (4.3.1.4)	No limitations on use with respect to moisture and chemically treated wood except that chemical wood treatment must have the same or lesser corrosion effects as qualification conditions.
<b>Corrosion Effects of Wood Treatment Chemicals</b>		
5	Dry use (4.3.2.1)	Limited to dry use as defined by the NDS.
6	Wet use (4.3.2.2)	No environmental limitations to use based on moisture condition, except that running water exposures shall be used with caution.

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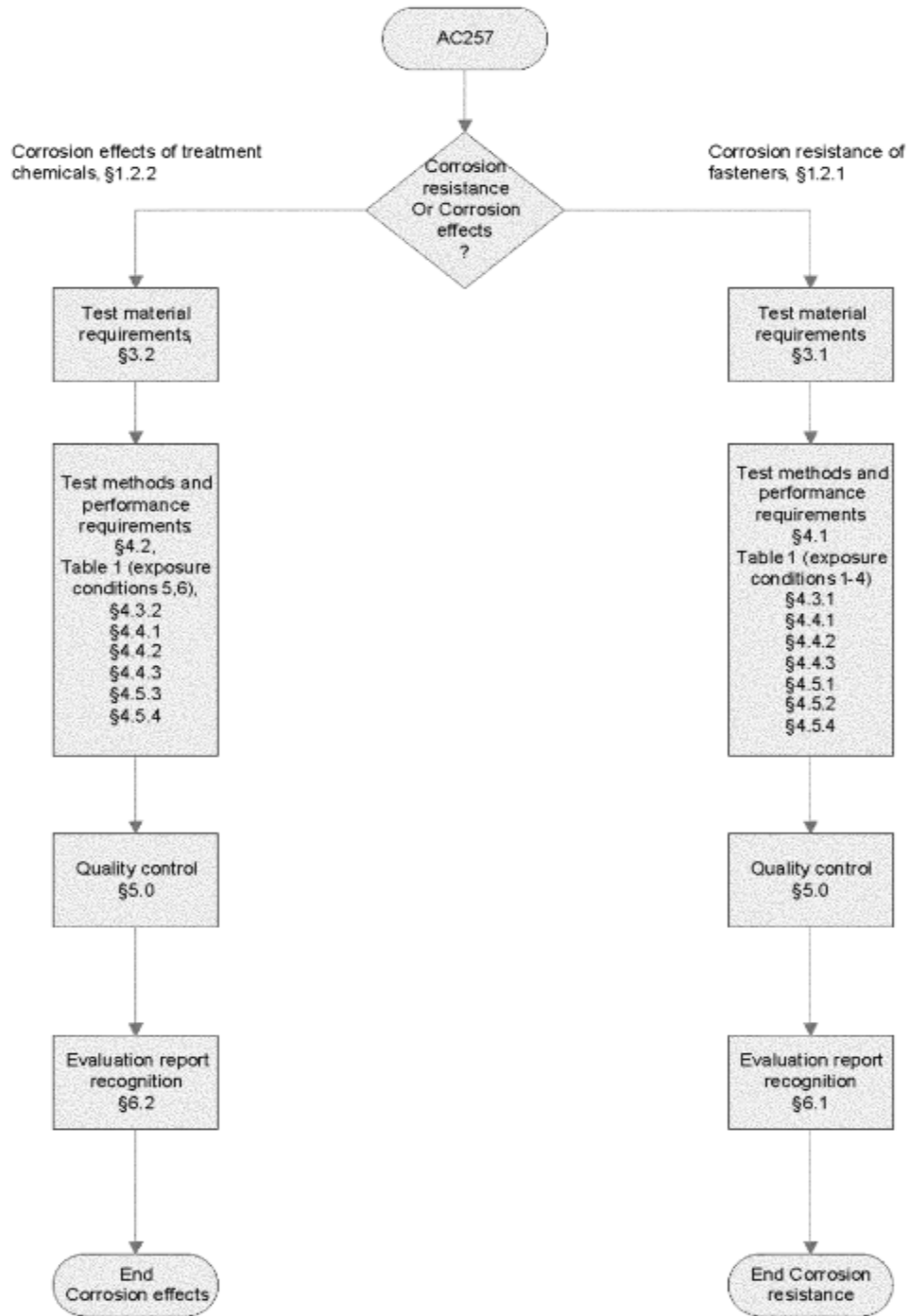


FIGURE 1— FLOWCHART FOR TESTING, PROCESSES—CORROSION RESISTANCE OF FASTENERS AND CORROSION EFFECTS OF TREATMENT CHEMICALS

**ACCEPTANCE CRITERIA FOR CORROSION-RESISTANT FASTENERS AND EVALUATION  
OF CORROSION EFFECTS OF WOOD TREATMENT CHEMICALS (AC257)**

**APPENDIX A  
ALTERNATE WET EXPOSURE TEST PROCEDURE**

**A1.0 SCOPE AND SIGNIFICANCE**

This test procedure is an alternative to the ASTM B 117 water spray procedure (without salt). It has been demonstrated that keeping the treated wood wet and moist greatly accelerates corrosion at the wood-metal interface. The treated wood test specimen is best maintained at an elevated wood moisture content, by placing one end of the test specimen in a shallow depth of water while the test specimen is maintained in the constant temperature-constant-humidity environment. This allows capillary action of the test specimen to pull moisture from the base of the test specimen into the entire test specimen. Indications are that slanting the test specimen from vertical (10 to 20 degrees) aids in accelerating the coupon corrosion test. For this accelerated test to yield meaningful data, the metal-wood exposure time shall be a minimum of 30 days for metal coupons in contact with wood and treated wood, and a minimum of 60 days for contact between metal fasteners and wood/treated wood. It has been demonstrated in at least two field tests that this method may exaggerate the corrosion relative to real world corrosion on both mild steel (C1010) and hot dip galvanized steel.

**A2.0 METHOD AND APPARATUS**

After treatment of wood samples, follow chemical producer recommendations for method and duration to “fix” or “stabilize” the treatment chemical. After this stabilization period, completely saturate the treated wood sample by placing the treated wood sample weighted down with inert glass weight or stainless steel sheeting (Figure 1 of AWPA E 10), and follow rewetting procedure 1 or 2:

1. Saturate the wood sample by use of a vacuum desiccator as detailed in AWPA Standard E-10 (current edition), with either tap, deionized, or distilled water. Once the treated wood is completely wetted, quickly assemble the corrosion test specimen and place it into the exposure environment. Wood shall be rewetted by this same method every seven days until the test is terminated and the test unit disassembled for evaluation.
2. Saturate the treated wood sample by submerging it in a beaker or glass pan filled with water (tap, deionized, or distilled water) for approximately 24 hours, or until wood sample no longer gains mass. Once the treated wood is completely wetted, quickly assemble the corrosion test specimen and place it into the exposure environment. Wood shall be rewetted by this same method every seven days until the test is terminated and the test unit disassembled for evaluation.