February 3, 2020

TO: PARTIES INTERESTED IN STAPLES

SUBJECT: Proposed Revisions to the Acceptance Criteria for Staples, Subject AC201-0220-R1 (EL/MG)

Dear Colleague:

We are seeking your comments on proposed revisions to the subject acceptance criteria, as presented in the enclosed draft. The proposed revisions, which are being posted on the ICC-ES web site for 30 days of public comment, are summarized as follows:

1. The report holder for ESR-1539, the International Staple, Nail & Tool Association (ISANTA), has proposed replacing reference to ASTM F1575 and associated modifications with reference to a new ASTM standard, F3359, Standard Test Method for Determining Bending Yield Moment of Staples. The testing requirements in the new standard are consistent with the requirements currently in AC201, so we are in support of the proposed revision and it is not expected to impact current report holders under the criteria.

2. We intend to reference the same edition of ASTM F1667 in both the ICC-ES Acceptance Criteria for Nails (AC116) and AC201. AC116 references ASTM F1667-17, and we are proposing to reference this edition in AC201. There are no technical differences between the current and proposed editions of ASTM F1667 related to staples.

3. We have been asked to evaluate staples with a crown width between those that are listed in Table 56 of ASTM F1667-17. Since the IBC and IRC do not reference any particular “Dash” number in this table, we do not see a reason to limit recognition to these crown width/leg length geometries only. We are proposing revisions to Sections 3.1 and 3.2 of AC201 to require the flattened wire width and thickness dimensions and associated tolerances for staples to comply with Table 56 of ASTM F1667-17. We are also proposing to add a statement to Section 3.1 allowing crown width and leg length dimensions to differ from what is in Table 56 of ASTM F1667-17. We view this as a clarification of our current practice. We have not previously required compliance with particular “Dash” number dimensions. Instead, Section 6.0 Item 2 of AC201 requires the minimum crown width and leg length
requirements for the application to be described in the evaluation report based on code provisions.

While the Evaluation Committee will be voting on the revised criteria during the 30-day comment period, we will seriously consider all comments from the public and will pull the criteria back for reconsideration if public comments raise major issues. In that case, we would seek a new committee vote; further revise the draft and post it for a new round of public comments; or put the revised criteria on the agenda for a future Evaluation Committee hearing.

If they are of interest, please review the proposed revisions and send us your comments at the earliest opportunity.

To submit your comments, please use the form on the web site and attach any letters or other materials. If you would like an explanation of the “alternate criteria process,” under which we are soliciting comments, this too is available on the ICC-ES web site.

Please do not try to communicate directly with any Evaluation Committee member about a criteria under consideration, as committee members cannot accept such communications.

Thank you for your interest and your contributions. If you have any questions, please contact me at (800) 423-6587, extension 4315, or Mohamed S. Gallow, PhD, P.E., Staff Engineer, at extension 5333. You may also reach us by e-mail at es@icc-es.org.

Yours very truly,

Elyse G. Levy
Senior Staff Engineer

EL/raf

Encl.

cc: Evaluation Committee
PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR STAPLES

AC201

Proposed February 2020


(Previously editorially revised December 2017, February 2015, April 2011)

PREFACE

Evaluation reports issued by ICC Evaluation Service, LLC (ICC-ES), are based upon performance features of the International family of codes. (Some reports may also reference older code families such as the BOCA National Codes, the Standard Codes, and the Uniform 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.

ICC-ES may consider alternate criteria for report approval, provided the report applicant submits 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. ICC-ES retains the right to refuse to issue or renew any evaluation report, if the applicable product, material, 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 injury or unreasonable damage.

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1.0 INTRODUCTION


Since the code-referenced standard for staples includes various styles and sizes of staples, this criteria is needed to define more specific requirements for staples used in applications addressed by the codes, to establish minimum specifications for staples prescribed in the code and to establish the means of justifying load capacities of the staples for use in engineered connections.

1.2 Scope: This acceptance criteria applies to steel wire staples used to connect construction materials (including wood or metal elements) to wood and wood-based materials.

Intended uses of staples addressed in this criteria include the following: use in engineered connections; use as a direct substitute for code-prescribed nails in specific connections prescribed in the code; use in connections where staples are prescribed in the code; and use in stapled lateral force-resisting systems prescribed in the code.

1.3 Codes and Referenced Standards:


1.3.3 ASTM A641/A641M-09a, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire, ASTM International.


1.4 Definitions

1.4.1 Engineered Connection: A connection where the size and number of staples used are selected on the basis of the load being transferred at the connection and the recognized capacity of the staples.

1.4.2 Prescriptive Connection: A connection where the size and number of staples used are prescribed in the code.

1.4.3 Stapled Lateral Force-Resisting Systems: Shear walls, braced walls and diaphragms where staples are used to attach wood structural panel sheathing to wood framing.

2.0 BASIC INFORMATION

2.1 General:

The following information shall be submitted to ICC-ES:

2.1.1 Description: Staple specifications, including wire diameter and gage, wire material specifications, including coatings; and staple crown width and leg length. All dimensional specifications shall include tolerances.

2.1.2 Intended Use: The intended use of the staples shall be described. When the staples are to be used in connections prescribed in the code, the applicable code sections and/or tables shall be identified. The description of intended use shall indicate if the staples are intended for use in engineered connections.

2.2 Packaging and Identification: The method of packaging and identifying the staples shall be reported and shall comply with Section 12 of ASTM F1667. The identification shall include the gage, crown width and leg length. The evaluation report number shall appear on the packaging.

2.3 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.

2.4 Test Reports: Reports shall comply with AC85. These reports shall include sample selection procedure, test specimen preparation, test procedures, and results of all tests. Where indicated, photographs shall be included in the reports.

2.5 Product Sampling: Sampling of the staples for tests under this criteria shall comply with Section 3.2 of AC85.

2.6 Qualification Test Plan: A qualification test plan shall be submitted to and approved by ICC-ES staff prior to any testing being conducted.

3.0 SPECIFICATIONS AND PERFORMANCE REQUIREMENTS

3.1 General: Staples shall be flat top crown staples with flattened wire width and thickness dimensions complying with Table 60.56 of ASTM F1667. Crown width and leg length combinations may differ from those included in Table 56.

3.2 Staple Dimensions: Staples shall be formed from 14, 15 or 16 gage wire, and dimensional tolerances shall comply with Section 8.4 of ASTM F1667, except that flattened wire width and thickness tolerances shall comply with Table 56 of ASTM F1667.

3.3 Zinc-coated Steel Wire: For staples recognized as complying with ASTM A641, Class 1 coating weight, zinc-coated carbon-steel wire shall be tested and found to comply with ASTM A641, Class 1 coating weight in accordance with Table S1.1 of ASTM A641. A test sample shall consist of a minimum of seven specimens, unless otherwise specified in the standard.

3.4 Bending Yield Moment: Bending moment of staples shall be evaluated in accordance with ASTM F1575 F3359 as modified below on at least 15 specimens per wire diameter. Results shall be recorded as moments and all values and shall comply with Table 1 of this
PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR STAPLES (AC201)

criteria. The following changes shall be made to the procedures of ASTM F1575:

3.4.1 The distance between staple supports shall be 1 inch (25.4 mm). (Modification of ASTM F1575, Section 9.1.1.)

3.4.2 The staple leg shall be placed on supports such that it is resting on the “width” of the staple leg, the leg cross section dimension perpendicular to the length of the staple crown.

3.4.3 The diameter of the staple leg measured and used in calculations shall be the “width” of the staple leg. (Modification of ASTM F1575, Section 8.2.)

3.4.4 Staple bending moment [lbs.-in. (N-m)] shall be measured and recorded, rather than computing a fastener bending yield strength. (Modification of ASTM F1575, Section A1.1.)

4.0 ANALYSIS

4.1 Use in Engineered Connections: Design values for staples used in engineered wood-to-wood or metal-to-wood connections shall be determined in accordance with Sections 4.1.1 through 4.1.4, as applicable. Alternatively, the equations for determining the design values, defined in Sections 4.1.1 through 4.1.4, may be included in the evaluation report. The equations in Sections 4.1.1 through 4.1.4 take into account the fact that two staple legs are used in the connection. Both legs of the staple must have equal embedment lengths into the main and side members.

4.1.1 ASD Lateral Design Values: Reference lateral design values (Z) for stapled connections (two-member joints) for use in Allowable Strength Design (ASD) shall be the least value calculated for each of the yield mode equations shown in Figure 1.

4.1.2 LRFD Lateral Design Values: Reference lateral design values for stapled connections for use in Load and Resistance Factor Design (LRFD) shall be determined by multiplying values established in Section 4.1.1 by a conversion factor of 3.3.

4.1.3 ASD Withdrawal Design Values: Reference withdrawal design values (W) for carbon steel (bright and galvanized) staples installed in side grain of wood shall be calculated using the following equation:

\[ W = 2760 \ G^{0.52} \ D \]

where:

\( W \) = Staple reference withdrawal design value, in pounds per inch of penetration in the member holding both staple legs.

\( G \) = Assigned specific gravity of the wood from Table 12.3.3A of the NDS.

\( D \) = Nominal wire diameter, in inches, from Table 1.

For SI: \( W = 19.03 \ G^{0.52} \ D \)

where:

\( W \) = Staple reference withdrawal design value, in Newtons per mm of penetration in the member holding both staple legs.

\( G \) = The assigned specific gravity of the wood from Table 12.3.3A of the NDS.

\( D \) = Nominal wire diameter, in millimeters, from Table 1.

4.1.4 LRFD Withdrawal Design Values: Reference withdrawal design values (\( Z_w \)) for staples installed in side grain of wood shall be determined by multiplying values established in Section 4.1.3 by a conversion factor of 3.3.

4.2 Use as Direct Substitute for Code-prescribed Nails: Staples may substitute for code-prescribed nails in nonstructural connections prescribed in the code (such as for roofing attachment or for lathing and furring), under the following conditions:

- Lateral and withdrawal design values equal or exceed values described in the applicable code for the corresponding nail.
- Staple crown area \( [W(C-2T)] \) equals or exceeds net head area \( [\pi (H^2-D^2)/4] \) of corresponding nail,

where:

\( W \) = Width of the staple crown

\( C \) = Length of the staple crown

\( T \) = Thickness of the staple leg

\( H \) = Nail head diameter

4.3 Use as Prescribed: Staples which comply with the requirements of Section 3.0 may be recognized for use as prescribed in the IBC and IRC.

5.0 QUALITY CONTROL

5.1 The staples shall be manufactured under an approved quality control program with inspections by ICC-ES or by a properly accredited inspection agency that has a contractual relationship with ICC-ES.

5.2 Quality documentation complying with the ICC-ES Acceptance Criteria for Quality Documentation (AC10) shall be submitted. The quality control program shall verify continued compliance with fastener specifications provided in accordance with Section 2.1.

5.3 A qualifying inspection shall be conducted at each manufacturing facility in accordance with the requirements of the ICC-ES Acceptance Criteria for Inspections and Inspection Agencies (AC304).

5.4 See Annex A for alternate procedures for qualification and quality control of staples that are produced by manufacturers other than the report holder or a listee on the evaluation report.

6.0 EVALUATION REPORT RECOGNITION

The evaluation report shall include the following:

1. Basic information required by Sections 2.1 and 2.2, including product description, packaging and identification.
2. For staples used in prescriptive connections or lateral force–resisting systems, the applicable code sections, tables and connection types shall be identified, along with the following requirements for the staples: minimum crown width, leg length, size (gage) and spacing.
3. For staples used in engineered connections, reference design values or equations based on Section 4.1 of this criteria.
4. Placement methods, based on code requirements and the report holder’s installation instructions.

### TABLE 1—REQUIRED BENDING MOMENT

<table>
<thead>
<tr>
<th>STAPLE GAGE</th>
<th>NOMINAL WIRE DIAMETER (inch)</th>
<th>NOMINAL STAPLE WIDTH (inch)</th>
<th>MINIMUM BENDING MOMENT (lbs.-in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>0.080</td>
<td>0.0855</td>
<td>4.3</td>
</tr>
<tr>
<td>15</td>
<td>0.0720</td>
<td>0.073</td>
<td>4.0</td>
</tr>
<tr>
<td>16</td>
<td>0.0625</td>
<td>0.064</td>
<td>3.6</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm; 1 lbf-in = 0.113 N-m.

Yield Mode I:

\[ Z = \frac{2F_{es}l_s}{K_D} \]

Yield Mode II:

\[ Z = \frac{2dF_{em}}{K_D} \left( \frac{l_m}{l_s} \right) \left[ \frac{F_{es}}{F_{em}} + 2 \left( \frac{F_{es}}{F_{em}} \right)^2 \left[ 1 + \frac{l_s}{l_m} + \left( \frac{l_s}{l_m} \right)^2 \right] + \left( \frac{F_{es}}{F_{em}} \right)^3 \left( \frac{l_s}{l_m} \right)^2 \right] - \frac{F_{es}}{F_{em}} \left( 1 + \frac{l_s}{l_m} \right) \]

Yield Mode III:

\[ Z = \frac{2}{K_D} \left[ \frac{-l_sF_{es}d}{2F_{es} + 1} + F_{es} \left( \frac{l_s^2}{2} \left( \frac{F_{es}}{F_{em}} + 1 \right)^2 + \frac{l_s^2}{2F_{es} + 1} + \frac{4M}{F_{es}d \left( 2 \frac{F_{es}}{F_{em}} + 1 \right)} \right) \right] \]

Yield Mode IV:

\[ Z = \frac{4F_{em}d}{K_D} \sqrt{\frac{M}{F_{em}d \left( 1 + \frac{F_{em}}{F_{es}} \right)}} \]

where:

- \( Z \) = Reference lateral design value for staple (2 legs), lbf.
- \( F_{em} \) = Dowel bearing strength of the main member, psi = 900 psi + \( F_e \) from Table 12.3.3 of the NDS for D<1/4”
- \( F_{es} \) = Dowel bearing strength of the side member, psi = 900 psi + \( F_e \) from Table 12.3.3 of the NDS for D<1/4”
- \( d \) = Nominal wire diameter, inch, from Table 1.
- \( M \) = Minimum staple bending moment, in-lbs, from Table 1.
- \( l_s \) = Length of staple in side member, inches.
- \( l_m \) = Length of staple in main member, inches, (minimum of 12D, where D is the nominal wire diameter from Table 1).
- \( K_D \) = Diameter coefficient for staple connections = 2.2
ANNEX A
Qualification and Quality Control Procedures for Purchased Staples

A1.0 General:

A1.1 Purpose: The purpose of this annex is to set forth alternate procedures for qualification of staples as complying with the provisions of AC201, and establishment of quality control for such staples, for staples that are produced by manufacturers other than the report holder.

A1.2 Scope: This annex applies to report holders who purchase staples from sources which have not submitted quality documentation to ICC-ES, and whose manufacturing facilities have not been audited by ICC-ES.

A1.3 Referenced Standards:


A1.4 Definitions:

A1.4.1 Report Holder: For the purposes of this annex, the term “report holder” shall refer to evaluation report holders or listees on evaluation reports who are recognized in the evaluation report to purchase staples.

A2.0 Qualification Process:

A2.1 General: The qualification process consists of four stages. At each stage, the quantity of staples ordered increases, until consistent conformance to the requirements of AC201, and comparable engineering drawings issued by the report holder, is assured. Characteristics subject to inspection and testing include staple bending moment, galvanized coating weight (where applicable), and physical dimensions for all staples as required by AC201. Sampling and evaluation shall be consistent with Table III, “Variables sampling plans,” verification level V of MIL-STD-1916. In this case, the sample size is 64 pieces.

At every step of the qualification process, or at any point in the auditing process, any product that is found to be nonconforming shall be scrapped, returned, or otherwise controlled so that it is not identified as covered by the evaluation report.

A2.2 Stage 1: The first step of the process is to obtain carton size quantities of each staple diameter and material type to be qualified. Sixty-four staples shall be selected from the carton and all test samples are to come from this selection. Testing shall be conducted in accordance with the requirements of AC201. Tests may be performed by the report holder and do not have to be performed by an accredited laboratory. Depending on the number of tests to be performed (bending moment, coating, etc.) and the number of staples to be tested in each test (sample size of 7, 15, etc.), not all 64 staples may be used in a test. Each individual sample is to be tested as outlined in Section A2.1 for characteristics subject to inspection and testing. If compliance to all aspects is achieved, proceed to Section A2.3. If any nonconformances are found, the supplier shall be notified, and the process restarted, with new products submitted for testing. Upon the conclusion of testing, the staples in the sample shall be scrapped.

A2.3 Stage 2: The second stage of the process is to apply the quantity of staples to skid quantities of each type to be qualified. Testing shall be performed by an accredited laboratory. If staples pass all tests, the report holder shall provide a copy of the test report(s) to ICC-ES. The new samples shall be manufactured from a different heat of wire than was used in the sample under Stage 1. The samples shall be tested as described in Stage 1, with the exception that the 64 staples will be sampled from a number of cartons as specified by ASTM F1470. The number of cartons from which the 64 staples are selected for each fastener type is the “sample size” indicated in ASTM F1470, Table 3, for Sample Level A, for a “lot size” equal to the number of cartons in the skid that contain the type of staple being tested. Even though ASTM F1470 specifies Sampling Level B or C for some fastener characteristics in its Table 1, all fastener tests are performed on staples from the group of 64 selected from the number of boxes specified in ASTM F1470, Table 3, for Sample Level A. If the samples all exhibit conformance to the requirements of AC201, proceed to Section A2.4. If nonconformances related to ICC-ES requirements such as staple bending moment, etc., are found, the process must restart at Section A2.2, or be abandoned. Upon the conclusion of testing, the staples in the sample shall be scrapped.

A2.4 Stage 3: The third stage of the process is to move to container quantities. At the container level, the staples will generally be mixed by type within the container. The number of cartons from which the 64 staples are selected for each fastener type is the “sample size” indicated in ASTM F1470, Table 3, for Sample Level A, for a “lot size” equal to the number of cartons in the skid that contain the type of fastener being tested. Tests may be performed by the report holder and do not have to be performed by an accredited laboratory. Inspection and testing shall be as outlined in Section A2.2.2, above. If the staples demonstrate conformance, move to normal purchase practice, Section A2.5. In the case of major nonconformances related to ICC-ES requirements such as staple bending moment, etc., the process shall restart at Section A2.2, or be abandoned.
A2.5 Stage 4: The next six shipments of staples require testing, but at a reduced level. A “shipment” consists of product received from one order. For sampling purposes, each intermodal container or truckload is considered a separate shipment. If a shipment contains different fastener types, each fastener type shall be tested. For staple bending moment testing, a “type” consists of one diameter regardless of length. Test and inspect as described in Section A2.2, above, determining the number of cartons from which the 64 staples are to be selected using ASTM F1470 as described in Section A2.3, above. If nonconformances related to ICC-ES requirements such as staple bending moment, etc., are found, the process shall restart at Section A2.2, or be abandoned. If the staples are conforming, the supplier shall be considered to be qualified.

Supplier qualification shall continue with testing of each fastener type in each future shipment. However, after ten consecutive shipments have been tested with all staples conforming to all requirements, the Sample Level used in application of ASTM F1470 will change from Sample Level A to Sample Level B. This will always result in the 64 staples being selected from a smaller number of fastener cartons.

After five additional consecutive shipments have been tested with all staples conforming to all requirements, the Sample Level used in application of ASTM F1470 will change from Sample Level B to Sample Level C. This will usually result in the 64 staples being selected from a smaller number of fastener cartons.

After Sample Level has been switched from A to B or C, if any tested fastener types fail any test, the Sample Level will revert to A as at the beginning of Section A2.4.

A3.0 Quality System:

The report holder shall provide quality documentation complying with the ICC-ES Acceptance Criteria for Quality Documentation (AC10). The documentation shall address procedures complying with this annex. The report holder’s testing facility shall demonstrate that equipment, procedures and personnel are adequate to conduct the necessary testing. A qualifying inspection and annual inspections of the report holder’s testing and processing facility shall be conducted in accordance with AC304.