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October 1, 2009

**TO: PARTIES INTERESTED IN THE ACCEPTANCE CRITERIA FOR WOOD SCREWS USED IN HORIZONTAL DIAPHRAGMS AND VERTICAL SHEAR WALLS**

**SUBJECT: Proposed Revisions to the Acceptance Criteria for Wood Screws used in Horizontal Diaphragms and Vertical Shear Walls, Subject AC120-1009-R1 (PB/YM)**

Dear Madam or Sir:

The revisions proposed to the subject acceptance criteria, as presented in the enclosed criteria draft, are being posted on the ICC-ES web site to allow for public comment. The revisions include:

1. Revising the title from “Acceptance Criteria for Wood Screws used in Horizontal Diaphragms and Vertical Shear Walls” to “Acceptance Criteria for Wood Screws Used in Horizontal Diaphragms, Vertical Shear Walls, and Braced Walls.” The reason for revising the title of AC120 is so that it accurately reflects its scope, which includes braced walls with wood structural panels as prescribed in the *International Residential Code*<sup>®</sup> (IRC).
2. Updating AC120 to include both the 2009 and the 2006 I-Codes, and delete to references to the 2003 IBC and the 1997 UBC.
3. Updating Section 1.3 (Codes and Referenced Standards) to reference the current editions of standards and to include reference standards that are cited in AC120.
4. Revising Section 3.2 to permit the use of self-drilling wood screws (installed without code-prescribed pilot holes) provided the screws comply with the ICC-ES Acceptance Criteria for Alternate Dowel-type Threaded Fasteners (AC233).
5. Revising the format of Section 4.0 (General Requirements and Test Methods) to have numbered paragraphs in each subsection.
6. Replacing reference to all code tables for diaphragms and shear walls in Section 4.0 with a reference to Section 1.2 (Scope) of AC120, which now lists all applicable code sections for diaphragms, shear walls and braced walls.
7. Revising the requirement for full-scale testing as now shown in Section 4.1.3 of the enclosed proposed draft of AC120. Previously, AC120 required full-scale

testing only when the evaluation report applicant requested greater allowable load capacities than the values assigned in the code for wood diaphragms and shear walls. A new requirement has been included, to cover cases where the applicant requests recognition of different fastener spacing for the assemblies constructed with wood screws, than the code-prescribed requirements for assemblies constructed with nails. Also, Section 4.1.3 now refers to specific test standards for conducting full-scale testing of horizontal diaphragms (ASTM E 455) and shear walls (ASTM E 564).

8. Including a restriction on the use of heat-treated screws because of their limited ductility. A new Section 4.1.4 states that shear walls and braced panels constructed with heat-treated screws are permitted for use in buildings assigned a Seismic Design Category A, B, or C. Additionally, the building's seismic force resisting system with shear walls with heat-treated screws is assigned seismic parameters typical for nonductile systems.
9. Revising Section 4.3.1 (Bending Yield Strength) by incorporating the requirements found in Section 4.4 (Bending Yield Strength) of the ICC-ES Acceptance Criteria for Alternate Dowel-type Threaded Fasteners (AC233).

The remaining revisions are considered editorial and do not merit individual reason statements in this letter.

You are cordially invited to submit written comments, within 30 days of the date of this letter. Please use the comment form on the web site attaching any letters to the form. An explanation of the alternate criteria process can be found on our web site at [http://www.icc-es.org/Criteria\\_Development/alternative\\_criteria\\_process.shtml](http://www.icc-es.org/Criteria_Development/alternative_criteria_process.shtml).

All comments received in the 30-day comment period will be considered. During this same 30-day period, however, the draft criteria will be balloted to the Evaluation Committee. If the public comments raise major issues, generate controversy, or require the criteria to be substantially rewritten, then ICC-ES staff may decide to rebalot the criteria; or place a revised draft on the web site for further public comment; or put the criteria on the agenda for a future Evaluation Committee meeting.

Correspondence received and a memo outlining staff's resolution of the comments in the correspondence will be posted on the web site shortly after the close of the comment period.

Your cooperation is requested in forwarding to the Los Angeles business/regional office all material directed to the Evaluation Committee. Parties interested in the deliberations of the committee should refrain from communicating, whether in writing or verbally, with committee members. The committee reserves the right to refuse communications that do not comply with this request.

Newly approved acceptance criteria may involve test methods or test protocols that are not currently included in the scope of testing services offered by accredited testing laboratories. As noted in the ICC-ES Rules of Procedure for Evaluation Reports, the scope of the laboratory's accreditation must include the type of testing that is to be reported to ICC-ES. We encourage accredited laboratories to expand their scopes of accreditation to include testing under newly approved acceptance criteria. Please note that testing laboratories must be accredited by the International Accreditation Service (IAS) or by another accreditation body that is a signatory to the International Laboratory Accreditation Cooperation Mutual Recognition Arrangement. For further information, please contact IAS at (562) 699-0541, extension 3309, or send an e-mail to [pmccullen@iasonline.org](mailto:pmccullen@iasonline.org).

Please submit all comments using the form on the web site. Attach any letters to the comment form. If you have any questions (not comments), please contact the undersigned at (800) 423-6587, extension 3306. You may also reach us by e-mail at [es@icc-es.org](mailto:es@icc-es.org).

Yours very truly,



Peter Bahlo, P.E.  
Senior Staff Engineer

PB/raf

Enclosure

cc: Evaluation Committee

# PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR WOOD SCREWS USED IN HORIZONTAL DIAPHRAGMS, AND VERTICAL SHEAR WALLS AND BRACED WALLS

## AC120

Proposed October 2009

Previously approved February 2006, September 1999, July 1997, July 1996

## 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.

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 proposed in this document, and otherwise meet the applicable performance requirements of the codes. Notwithstanding that a product, material, or type or method of construction meets the requirements of the criteria proposed in this document, or that it can be demonstrated that valid alternate criteria are equivalent to the criteria in this document and otherwise meet the applicable performance requirements 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 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.*

# PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR WOOD SCREWS USED IN HORIZONTAL DIAPHRAGMS, AND VERTICAL SHEAR WALLS AND BRACED WALLS

## 1.0 INTRODUCTION

**1.1 Purpose:** The purpose of this acceptance criteria is to establish requirements for recognition of wood screws in ICC Evaluation Service, Inc. (ICC-ES), evaluation reports under the ~~2003~~ 2009 and 2006 *International Building Code*<sup>®</sup> (IBC) and the ~~1997~~ *Uniform Building Code*<sup>™</sup> (UBC) 2009 and 2006 *International Residential Code*<sup>®</sup> (IRC). Bases of recognition are IBC Section 104.11 and ~~UBC Section 404.2-8~~ IRC Section R104.11.

The reason for this criteria is that the codes do not address the use of screws to attach structural wood sheathing to wood framing in the horizontal diaphragms, and shear walls and braced walls identified in Section 1.2 of this criteria.

**1.2 Scope:** This criteria is applicable to wood screws used as alternate fasteners to the nails for horizontal wood diaphragms, wood shear walls, and wood sheathed braced walls specified in the following codes:

**1.2.1 2009 IBC:** Sections 2305.2, 2305.3, 2306.2, 2306.3, 2306.5, 2308.9.3(3), 2308.9.3.1, and 2308.9.3.2.

**1.2.2 2006 IBC:** Tables 2306.3.1, 2306.3.2, 2306.4.1 and 2306.4.3 of the IBC and Tables 23-II-H, 23-II-I-1 and 23-II-2 of the UBC. Sections 2305.2, 2305.3, 2306.3, 2306.4.1, 2306.4.2, 2306.4.3, 2308.9.3(3), 2308.9.3.1, and 2308.9.3.2.

**1.2.3 2009 IRC:** Sections R602.3, R602.10.2 (Method WSP), and R602.10.4.

**1.2.4 2006 IRC:** Sections R602.3, R602.10.3(3), R602.10.5, and R602.10.6.

**1.3 Codes and Referenced Standards:** Where standards are referenced in this criteria, the standards shall be applied consistently with the code (IBC or IRC) upon which compliance of the fastener is based.

**1.3.1 ~~2003~~ 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 ~~1997~~ Uniform Building Code<sup>™</sup> (UBC), 2006 *International Residential Code*<sup>®</sup> (IRC), International Code Council.**

**1.3.5 ANSI/AF&PA National Design Specification (NDS) for Wood Construction with 2005 Supplement, ~~4994~~ 2005** edition, American Forest & Paper Association.

**1.3.6 ~~ANSI/AF&PA National Design Specification for Wood Construction (NDS), 2001 edition, American Forest & Paper Association.~~ ANSI/ASME Standard B18.6.1-1981 (reaffirmed 1997), Wood Screws (Inch Series), American Society of Mechanical Engineers.**

**1.3.7 ASTM D 1761- ~~88 (2000)~~ -06**, Test Methods for Mechanical Fasteners in Wood, ASTM International.

**1.3.8 ASTM D 2395-07a<sup>e1</sup>**, Standard Test Method for Specific Gravity of Wood and Wood-Based Materials,

ASTM International.

**1.3.9 ASTM D 4442-07**, Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials, ASTM International.

**1.3.10 ASTM D 4444-08**, Standard Test Method for Laboratory Standardization and Calibration of Hand-Held Moisture Meters , ASTM International.

**1.3.11 ASTM E 455-04**, Standard Method for Static Load Testing of Framed Floor or Roof Diaphragm Constructions for Buildings, ASTM International.

**1.3.12 ASTM E 564-06**, Standard Practice for Static Load Test for Shear Resistance of Framed Walls for Buildings, ASTM International.

**1.3.13 ASTM F 1575-03**, Standard Test Method for Determining Bending Yield Moment of Nails, ASTM International.

## 2.0 BASIC INFORMATION

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

**2.1.1 Description:** Complete information concerning material specifications, diameters (head, shank, major and minor), length, thread type (cut or rolled), and profile, and manufacturing process:

**2.1.2 Installation Instructions:** Installation details and limitations.

**2.1.3 Packaging and Identification:** A description of the method of packaging and field identification of the screws. Where practical with respect to available space on the fastener head, each fastener shall be identified by the manufacturer's identifying mark or logo and the length designation. Each container of fasteners shall have a label noting the evaluation report holder's name and address, the evaluation report number, and the fastener size.

**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 Reports of Tests:** Test reports shall comply with AC85.

**2.4 Product Sampling:** Sampling of the fasteners for tests under this criteria shall comply with Section 3.2 of AC85.

## 3.0 FASTENER SPECIFICATIONS

**3.1 Materials** shall conform to a national industry standard.

**3.2 Wood screw design** shall conform to ANSI/ASME B18.6.1, except when the differences between the characteristics of the wood screw and the requirements of the standard are identified. Screws having different dimensions than those specified in ANSI/ASME B18.6.1, or screws that are self-drilling (installed without a lead hole), may be used when qualified in accordance with the ICC-ES Acceptance Criteria for Alternate Dowel-type Threaded Fasteners (AC233).

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**4.0 GENERAL REQUIREMENTS AND TEST METHODS**

**4.1 General:**

4.1.1 Wood screws are permitted as alternates to the nails used in the horizontal diaphragms, and vertical shear wall assemblies and wood sheathed braced walls specified in ~~Tables 2306.3.1, 2306.4.1 and 2306.4.3 of the IBC and Tables 23-II-1, 23-II-1-1 and 23-II-1-2 of the UBC~~ the applicable code sections shown in Section 1.2 (Scope), provided side-by-side comparative tests are performed using the code-specified nails and the alternate wood-screw fasteners. The comparison testing shall consist of the lateral strength and stiffness testing and the pull-through and pull-out withdrawal testing described in this section criteria.

4.1.2 Horizontal diaphragms and vertical shear walls constructed with the wood screws that ~~are recognized in the evaluation report~~ directly substitute for the code specified nails shall have the same allowable capacities and predicted deflections as those specified in ~~Tables 2306.3.1, 2306.4.1 and 2306.4.3 of the IBC and Tables 23-II-1, 23-II-1-1 and 23-II-1-2 of the UBC~~ the applicable code sections shown in Section 1.2 (Scope).

4.1.3 Full-scale horizontal diaphragm and vertical shear wall testing, conducted in accordance with ASTM E 455 and ASTM E 564, respectively, for each combination of type of lumber and wood structural panels, is required if the evaluation report applicant requests recognition of greater allowable load capacities or different fastener spacing for the assemblies constructed with the wood screws to be greater than those prescribed by the code for than code prescribed assemblies constructed with nails. A qualification test plan shall be submitted to ICC-ES prior to commencement of testing.

4.1.4 Shear walls and braced panels constructed with heat-treated screws are permitted for use in buildings assigned a Seismic Design Category A, B, or C. Additionally, the building's seismic force resisting system with shear walls with heat-treated screws shall be assigned a response modification coefficient,  $R$ , equal to 1.5, a system overstrength coefficient,  $\Omega_o$ , equal to 2.5, and a deflection amplification factor,  $C_d$ , equal to 1.5.

**4.2 Specimen Preparation:**

4.2.1 Tests shall be conducted using the same species of ~~sawn~~ lumber (~~Douglas fir-larch or southern pine~~ (compliant with Section 2303.1.1 of the IBC) and ~~sheathing material type (plywood or particle board)~~ wood structural panel type and thickness (compliant with Section 2303.1.4 of the IBC) for which recognition is desired, with the exception that recognition can be extended to both rated sheathing and Structural I panels if rated sheathing panels are used in the tests in lieu of Structural I grade panels. The lumber framing and ~~sheathing~~ wood structural panels shall be conditioned in accordance with Section 9 of ASTM D 1761 ~~until to reach equilibrium is reached with a moisture content of 10 to 14 percent.~~ The moisture content of the wood samples shall be determined in accordance with ASTM D 4442 or ASTM D 4444.

4.2.2 ~~Sheathing materials~~ All wood structural panels used for testing shall have the same specific gravity. The specific gravity measurements shall be performed on ~~determined for one sample from each piece of sheathing material~~ wood structural panel. The specific gravity and

~~wood species~~ of the wood framing materials shall be determined in accordance with ASTM D 2395.

4.2.3 A sample population, consisting of a minimum of 10 randomly picked nails and wood screws taken from the overall population that is representative of current production, shall be used for each test described in this section criteria. ~~The sheathing and lumber shall be conditioned to a moisture content of 12 to 14 percent prior to testing.~~ The fasteners shall be driven flush with the face of the sheathing material and shall be installed in accordance with ~~Part 11 of the NDS~~ the manufacturer's installation instructions for wood screws and Section 11.1.5 of the NDS for nails, under the IBC and ~~Parts XI and XII of the NDS for wood screws and nails under the UBC.~~

**4.3 Bending Yield Strength:**

4.3.1 The bending yield strength shall be determined for the nails and screws used in comparative testing, and the tests shall be in accordance with ASTM F 1575, and the following: (1) The 5 percent diameter bending yield strength shall be defined by the section at the minor thread diameter, and (2) The screws shall be placed on the cylindrical bearing points for testing so that the transition zone between shank and thread is as close as possible to the midpoint between the bearing points, with the load applied at the transition or in the threaded section, and (3) The screw's designation, overall length, length of thread, minor thread diameter, and bending yield strengths shall be recorded.

4.3.2 The screws shall have an average bending yield strength equal to or greater than the average bending yield strength of the nails. In addition, the bending yield strength of the nails shall be equal to or greater than the bending yield strength for the nail specified in the NDS. The average bending yield strength of the tested screw shall not exceed the specified bending yield strength by more than 10 percent.

**4.4 Lateral Testing:**

4.4.1 Tests for lateral resistance and fastener slip ~~must~~ shall be in accordance with ASTM D 1761. Test specimens shall contain joints with the load applied in the direction parallel to the face grain of the ~~wood~~ structural sheathing panel and parallel to the grain of the framing lumber.

4.4.2 The nail and wood screw lateral strength and slip test shall be used to determine the contribution of the fastener to the diaphragm or shear wall strength and deflection. Load-slip curves shall be derived from the load and lateral movement measurements taken during testing of the 10 sampled nails and wood screws.

4.4.3 Using average values, the contribution of the wood screw fastener to the diaphragm or shear wall deflection, determined from the generated load-slip curve, shall not be greater than that of the fastener listed in the code tables.

4.4.4 Using the average of the ~~ultimate peak~~ load values, the strength of the wood screw connection shall be greater than that of the nailed connection.

**4.5 Withdrawal Test:**

4.5.1 Fastener pullout capacity shall be tested in accordance with ASTM D 1761 on a minimum of 10 samples of each lumber species for which recognition is sought.

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4.5.2 The average capacity of the wood screw fasteners to resist pullout forces shall be equal to or greater than that of the nails.

**4.6 Pull-through Test:**

4.6.1 Fastener pull-through capacity shall be tested by means of a test setup in which the wood screw installed in the wood structural sheathing is pulled through the sheathing. A modification of the test procedure for fastener withdrawal described in ASTM D 1761 may be used. A minimum of 10 samples of each type of wood structural sheathing material for which recognition is sought is required.

4.6.2 The average ultimate peak load capacity of the wood screw test results shall be greater than that of the nails.

**4.7 Connection Tests:**

4.7.1 The wood screw connection test shall demonstrate that the wood screw can be installed with the same edge and end distance and spacing as noted in the code for nails. The wood screw connection test shall be conducted on a minimum of two specimens that consist of sheathing material of the type and thickness of wood structural panels and the specific gravity and size of framing lumber of the grade and size, for which recognition is sought. Each wood structural sheathing material and framing member combination shall be evaluated using a minimum of 10

fasteners per specimen. Wood screws shall be installed flush with the sheathing material face and into the wood framing member at the minimum spacing and edge distances specified in the code tables. The fastener wood screw shall be installed perpendicular to the grain of both the sheathing material and the wood framing member.

4.7.2 A visual inspection of the connection shall be made after the wood screws are driven into the material. The installation of the screws must not result in splitting of the sheathing material or framing.

**5.0 QUALITY CONTROL**

5.1 A quality control manual complying with Information as required by the ICC-ES Acceptance Criteria for Quality Control Manuals Documentation (AC10) shall be submitted. ~~The quality control manual and~~ shall include sufficient detail to provide verification that the manufactured fasteners comply with the evaluation report, and are consistent with the fasteners used in the qualifying tests.

5.2 Third-party follow-up inspections are not required under this acceptance criteria.

**6.0 EVALUATION REPORT RECOGNITION**

6.1 The evaluation report shall include the following statement: "This evaluation report does not address fastener corrosion when the fastener is installed in chemically treated wood." ■

**TABLE 1—REFERENCED STANDARDS**

STANDARD	DATE OF STANDARD	
	IBC	UBC
ASTM D 1761	1988 (2000)	1988 (1995)
NDS	2001	1991