ACCEPTANCE CRITERIA FOR POWER-DRIVEN PINS FOR SHEAR WALL ASSEMBLIES WITH COLD-FORMED STEEL FRAMING AND WOOD STRUCTURAL PANELS

AC230

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PREFACE

Evaluation reports issued by ICC Evaluation Service, LLC (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 propo sed 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 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 by ICC-ES for purposes of issuing ICC-ES evaluation reports.

ACCEPTANCE CRITERIA FOR POWER-DRIVEN PINS FOR SHEAR WALL ASSEMBLIES WITH COLD-FORMED STEEL FRAMING AND WOOD STRUCTURAL PANELS (AC230)

1.0 INTRODUCTION

1.1 Purpose: The purpose of this acceptance criteria is to establish requirements for power-driven pins, used to construct shear wall assemblies with cold-formed steel (CFS) framing and wood structural panels, resisting wind or seismic loads, to be recognized in an ICC Evaluation Service, LLC (ICC-ES), evaluation report under the 2009 *International Building Code*® (IBC) and the 2009 *International Residential Code*® (IRC). The bases of recognition are IBC Section 104.11 and IRC Section R104.11.

The reason for this criteria is the absence of referenced standards in the IBC that can be used to establish code compliance for shear walls consisting of wood structural panels attached to CFS framing with power-driven pins.

1.2 Scope: This criteria applies to power-driven pins used to attach wood structural panels to CFS framing to create shear walls or for general use. This criteria establishes requirements for determining single fastener connection strengths and shear wall unit shear strength and deflection.

The shear walls shall be limited to Type I shear walls (defined in Section A2 of AISI S200) which are protected by a weather-resistant exterior wall envelope. The shear wall assemblies are alternates to systems described in Section C2.2.2 of AISI S213 (referenced in IBC Section 2210. 6) and IRC Section R603. 9.

Recognition of shear wall assemblies shall be limited to height limits and seismic design categories indicated for the equivalent *R* system listed in Table 12.2-1 of ASCE 7 (Item A13 for shear walls which comply with Appendix A of this criteria; Item H for shear walls which do not comply with Appendix A of this criteria.).

Shear wall assemblies exhibiting failure modes that compromise the gravity load–carrying capacity of the studs or top track, such as buckling of vertical load–carrying members, during the in-plane cyclic-lateral load tests required in Section 3.5 of this criteria, are specifically excluded from the scope of this acceptance criteria.

1.3 Codes and Referenced Standards:

1.3.1 2009 *International Building Code*® (IBC), International Code Council.

1.3.2 2009 *International Residential Code*® (IRC), International Code Council.

1.3.3 ASCE/SEI 7-05, Minimum Design Loads for Buildings and Other Structures, including Supplements No. 1 and 2 and Excluding Chapter 14 and Appendix 11A; American Society of Civil Engineers.

1.3.4 ASTM A 370-07a, Standard Test Methods and Definitions for Mechanical Testing of Steel Products, ASTM International.

1.3.5 ASTM A 653-07, Specification for Steel Sheet, Zinc-Coated Galvanized or Zinc-Iron Alloy-Coated Galvannealed by the Hot-Dip Process, ASTM International.

1.3.6 ASTM A 1003-05, Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members, ASTM International.

1.3.7 ASTM D 1037-06a Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials, ASTM International.

1.3.8 ASTM D 1761-06 Standard Test Methods for Mechanical Fasteners in Wood, ASTM International.

1.3.9 ASTM D 2915-03, Standard Practice for Evaluating Allowable Properties for Grades of Structural Lumber, ASTM International.

1.3.10 ASTM E 2126-07a Standard Test Methods for Cyclic (Reversed) Load Test for Shear Resistance of Vertical Elements of the Lateral Force Resisting Systems for Buildings, ASTM International.

1.3.11 AISI S100-07, North American Specification for the Design of Cold-formed Steel Structural Members, American Iron and Steel Institute.

1.3.12 AISI S200-07, North American Standard for Cold-formed Steel Framing—General Provisions, American Iron and Steel Institute.

1.3.13 AISI S213-07, Standard for Cold-formed Steel Framing—Lateral Design, American Iron and Steel Institute.

1.3.14 AISI S905-08, Test Methods for Mechanically Fastened Cold-Formed Steel Connections, American Iron and Steel Institute.

1.3.15 US DOC PS-1-07, Structural Plywood, United States Department of Commerce, National Institute of Standards and Technology.

1.3.16 US DOC PS-2-04, Performance Standard for Wood-based Structural-use Panels, United States Department of Commerce, National Institute of Standards and Technology.

1.4 Definitions:

1.4.1 Allowable Stress Design (ASD): Method of proportioning structural components such that the allowable strength equals or exceed the required strength of the component under the action of the ASD load combinations.

1.4.2 Allowable Shear Strength: Nominal shear strength divided by the appropriate safety factor.

1.4.3 Available Shear Strength: Design shear strength (see Section 1.4.5) or allowable shear strength (see Section 1.4.2), as appropriate.

1.4.4 Base Steel Thickness: The base steel thickness is the thickness of the steel exclusive of all coatings.

1.4.5 Design Shear Strength: Resistance factor multiplied by the nominal shear strength, ΦR_n.

1.4.6 Drift: The difference in in-plane wall displacement between the top and bottom of the wall assembly.

1.4.7 Envelope: Plot of a series of points that bound a particular behavior.

1.4.8 Load Effect: Forces, stresses, and deformations produced in a structural component by the applied loads.

1.4.9 LRFD (Load and Resistance Factor Design): Method of proportioning structural components such that the design strength equals or exceeds the required strength of the component under the action of the LRFD load combinations.

1.4.10 Nominal Shear Strength: Shear strength of the wall assembly (without the resistance factor or safety factor applied) to resist lateral load effects.

1.4.11 Peak Strength: The maximum lateral resistance developed by the wall assembly.

1.4.12 Power-driven Pins: A forced-entry pin fastener characterized by an upset head and a point, typically hardened for penetrating steel and placed with a power tool.

1.4.13 Rational Engineering Analysis: Analysis based on theory that is appropriate for the situation, relevant test data if available, and sound engineering judgment.

1.4.14 Resistance Factor, Φ: Factor that accounts for unavoidable deviations of the nominal strength from the actual strength and for the manner and consequences of failure.

1.4.15 Shear Wall: Wall that provides resistance to lateral loads in the plane of the wall and provides stability for the structure.

1.4.16 Structural Analysis: Determination of load effects on members and connections based on principles of structural mechanics.

1.5 Notations:

1.5.1 h = Height of the test shear wall, in. (mm).

1.5.2 $t_{(specified)}$ = Specified base steel thickness, in. (mm).

1.5.3 $t_{(tested)}$ = Measured base steel thickness, in. (mm).

1.5.4 C_d = Deflection amplification factor.

1.5.5 F_s = Force corresponding to δ_{xe} on the envelope curve.

1.5.6 $F_{u(specified)}$ = Specified minimum tensile strength of the CFS studs used in the tested assemblies, ksi (MPa).

1.5.7 $F_{u(tested)}$ = Measured tensile strength of the CFS studs used in the tested assemblies, ksi (MPa).

1.5.8 I = Importance factor as defined by Section 11.5 of ASCE 7.

1.5.9 R_s = Adjustment factor for steel framing overstrength and thickness (see Section 3.34).

1.5.10 V_p = Peak shear strength from envelope curve, lbs. (N)

1.5.11 V_{ASD} = Allowable shear strength determined for the tested assembly, unadjusted by R_s, lbs (N).

1.5.12 V'_{ASD} = Allowable shear strength, adjusted by R_s, lbs (N).

1.5.13 V_{LRFD} = Design shear strength, lbs (N).

1.5.14 V'_{LRFD} = Design shear strength, adjusted by R_s, lbs (N).

1.5.15 δ_x = Inelastic deflection, in. (mm).

1.5.16 δ_{xe} = Strength design level response displacement, in. (mm).

1.5.17 Δ_a = Allowable story drift, in. (mm).

1.5.18 Δ_{VASD} = Deflection at V_{ASD}, in. (mm).

1.5.19 Δ_p = Deflection at the peak strength, in. (mm).

1.5.20 Φ = Resistance factor.

1.5.21 Ω_0 = Seismic Over-strength factor.

2.0 BASIC INFORMATION

2.1 General: The following information shall be submitted and shall be included in the submitted test reports:

2.1.1 Power-driven Pins:

2.1.1.1 Generic or trade name, and manufacturer's catalog number or catalog series.

2.1.1.2 Drawings and details of the pins noting the following: dimensions and manufacturing dimensional tolerances; head characteristics; shank deformations (if any); tip geometry; washer size and thickness, if used; head markings (if any); and material specifications, including specified tensile strength, case and core hardness range, and protective coatings.

2.1.1.3 Installation details and instructions, noting installation limitations and the sizes and locations of fasteners, and including a description of recommended tools and recommended tool operation.

2.1.1.4 A description of the method of packaging and field identification of the power-driven pins. The identifying information on each box or package of power-driven pins shall include the pin brand name and model number, nominal pin size and length, the evaluation report holder's name, the ASTM designation if applicable, and the ICC-ES evaluation report number.

2.1.2 CFS Framing: A description of CFS framing members used in the shear wall assemblies for which recognition is sought, including flange width, web depth, material specification, specified yield and tensile strengths, and specified base steel thickness.

2.1.3 Wood Structural Panels: A description of the wood structural panels used in the shear wall assemblies for which recognition is sought, including type, specification, thickness, and grade.

2.1.4 Shear Wall Assemblies: A description of the shear wall assemblies for which recognition is sought, including maximum height, aspect ratio, stud spacing, fastener spacing, orientation of wood structural panels, chord details and hold-down and anchorage details. A description of the applicable installations shall also be submitted addressing Seismic Design Categories, Occupancy Categories in accordance with IBC Table 1604.5, and seismic design factors (R, Ω_0, C_d).

2.2 Testing Laboratories: Testing laboratories shall comply with 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.

2.4 Product Sampling: Sampling of the power-driven pins for tests under this criteria shall comply with Section 3.2 of AC85.

3.0 TEST AND PERFORMANCE REQUIREMENTS

3.1 Requirements for Pins: Prior to shear wall testing, the core hardness of power-driven pins from the same lot as those that will be used in the shear wall testing shall be measured in accordance with ASTM A 370, and shall comply with the manufacturer's specifications. A minimum of five pins shall be tested.

3.2 Requirements for Wood Structural Panels: The wood structural panel component of the shear walls for which recognition is sought shall comply with a current ICC-ES evaluation report, a national product standard (PS-1 or PS-2), or otherwise be justified to the satisfaction of ICC-ES. The material shall be clearly identified to verify panel compliance. Minimum panel width shall be 12 inches (305 mm). Wood structural panels used in qualification testing in accordance with Sections 3.4 and 3.5 shall be representative of the shear wall assemblies for which recognition is sought.

3.3 Requirements for CFS Framing:

3.3.1 CFS framing used in shear wall assemblies recognized under this criteria shall comply with Sections 3.3.1.1 through 3.3.1.3.

3.3.1.1 CFS studs shall be C-shaped members with a minimum thickness designation of 33 mils, a minimum flange width of $1^5/_8$ inches (41 mm), a minimum web depth of $3^1/_2$ inches (89 mm) and a minimum edge stiffener length of $^3/_8$ inches (9.5 mm).

3.3.1.2 CFS tracks shall have a minimum thickness designation of 33-mils with a minimum flange width of $1^1/_4$ inches (32 mm) and a minimum web depth equal to the web depth of the wall studs.

3.3.1.3 As a minimum, CFS studs and tracks shall be of ASTM A 1003, Grade 33, Type H steel or ASTM A 653 SS Grade 33 steel with a minimum G60 coating for members with a designation thickness of 33 and 43 mils; and ASTM A 1003, Grade 50, Type H steel or ASTM A 653 SS Grade 50, Class 1 steel with a minimum G60 coating for members with a designation thickness equal to or greater than 54 mils.

3.3.2 CFS framing used in shear wall test assemblies shall be representative of the shear wall framing for which recognition is sought.

3.3.3 The base steel thickness, yield strength, tensile strength and elongation of the steel of all tested CFS framing members shall be established from coupon tests of representative members. The yield strength and tensile strength of coupons cut from the representative CFS framing members shall be determined in accordance with ASTM A 370. These mechanical properties shall comply with the material specification that is to be recognized in the evaluation report.

3.3.4 If the measured tensile strength of the tested coupons exceeds the minimum value which is to be specified in the evaluation report, and/or the measured base steel thickness of the tested coupons exceeds the design base steel thickness which is to be specified in the evaluation report, the test results shall be adjusted as required by Sections 3.4.4, 3.7 and 3.8 using the following adjustment factor, R_s:

$$R_s = \left(\frac{F_{u(specified)}}{F_{u(tested)}}\right) \times \left(\frac{t_{(specified)}}{t_{(tested)}}\right) \leq 1.0$$

where:

$F_{u(specified)}/F_{u(tested)} \leq 1.10$

$t_{(specified)}/t_{(tested)} \leq 1.05$

When the tensile strength of the studs differs from the tensile strength of the tracks, R_s shall be based on the type of member (stud or track) where the predominant failure occurred, provided the tensile strengths of the studs and tracks are within 10 ksi of each other. When the failure of the shear wall is not predominantly due to one type of member (stud or track), R_s shall be based on the worse case of R_s for the studs and R_s for the tracks.

3.4 Single-Fastener Connection Tests:

3.4.1 Transverse Load (Optional): The allowable transverse load capacity of a connection comprised of a wood structural panel attached to CFS framing with a power-driven pin shall be the lesser of allowable strength due to the pull-through capacity of the wood structural panel and the allowable strength due to the pull-out capacity of the pin installed in CFS framing, determined as follows:

3.4.1.1 Pull-through Test: A test setup and procedure similar to the one described in ASTM D 1037 shall be used to determine the pull-through capacity of the power-driven pin installed in the wood structural panel. At a minimum, testing shall be performed on specimens with a panel edge distance that is representative of the minimum specified condition at the perimeter of the shear wall assembly for which recognition is sought. As an option, to address higher transverse load capacity of the fasteners in the field of the sheathing panel, additional data may be submitted.

The target number of test specimens shall be determined in accordance with ASTM D 2915, equation 1. Testing for representative material combinations shall be based on a minimum sample size of 15 specimens and a target of 5 percent precision with a 75 percent confidence for the mean capacity. The sample size need not exceed 30 specimens.

The average ultimate load shall be divided by a safety factor of 5 to determine the allowable load.

3.4.1.2 Pull-out Test: Pull-out testing of fasteners installed in CFS shall be conducted in accordance with

Section 8.3 of AISI S905, using the alternative tension test fixture. Sample size shall be determined in accordance with Section 7.0 of AISI S905. Allowable pull-out strength shall be determined in accordance with Section F1.1 of AISI S100. The available strengths shall be adjusted by R_s in accordance with Section 3.3.4.

3.4.2 Lateral Load (Optional): The provisions of this section are applicable if the shear wall design values are based on the provisions of Section 4.3. These provisions may also be used to determine available lateral strength values for inclusion in evaluation reports. See Section 6.0.

The shear strength of the single-fastener connection of the wood structural panel to the framing shall be determined by testing in general accordance with ASTM D 1761. Specimen geometry and fixtures shall be modified as necessary to obtain valid tests of the connection capacity. Test failures located away from the connection and clearly unrelated to the connection shall be censored from the data set and replaced.

Testing more than 30 specimens shall not be required. The target number of test specimens is determined in accordance with ASTM D 2915, equation 1. Testing for representative material combinations shall be based on a minimum sample size of 15 specimens and a target of 5 percent precision with a 75 percent confidence for the mean capacity.

The allowable strength and the design strength of a single fastener connection of the wood structural panel to the framing shall be determined in accordance with Section F1 of AISI S100, or other approved method with prior approval of ICC-ES. The available strengths shall be adjusted by R_s in accordance with Section 3.3.4.

3.5 Cyclic-load Shear Wall Tests:

3.5.1 Shear wall testing shall use materials, sheathing, connections of sheathing to framing, and framing spacing consistent with the details of construction to be recognized, including minimum fastener edge distances and framing section profiles, in the evaluation report, and shall be conducted in accordance with ASTM E 2126, Method A or Method C. The sheathing shall not bear on any portion of the test fixture.

3.5.2 The tested wall assemblies shall have aspect ratios (wall height-to-length ratios) and dimensions consistent with the intended use, and such aspect ratios shall be the maximum permitted for recognition in the evaluation report. Test wall assemblies shall have an aspect ratio of 1:1 to determine full available strength for applications with aspect ratios equal to or less than 2:1. If wall assemblies having an aspect ratio greater than 2:1 are recognized in the evaluation report, then an available strength reduction factor shall be determined by tests. The test-based reduction factor shall result in adjusted design shears that are no greater than those achieved using a reduction factor of $2w/h$, where w is the width of a test shear wall measured in the direction of application of force, and h is the height of the test shear wall. If the test-based reduction factor results in higher design shears, then the factor $2w/h$ shall be used to adjust the design shears. The maximum wall aspect ratio shall be no greater than 4:1.

3.5.3 A minimum of two replicate assemblies shall be tested for each shear wall assembly for which empirical data is sought. The shear wall unit shear values described in Section 4.2 may be based on the average of the two tests if the two test values are within 10 percent of each other; otherwise, the average of three test values shall be used.

3.6 Cyclic Shear Wall Data Analysis:

3.6.1 The documentation containing analysis shall be signed and sealed by a registered design professional.

3.6.2 The shear wall available unit shear values shall be determined as outlined in Section 3.7 for Allowable Stress Design or Section 3.8 for Load and Resistance Factor Design.

3.7 Allowable Stress Design (ASD):

The allowable shear strength, V_{ASD}, shall be taken as the lesser of the allowable strength based on drift and the allowable strength based on the peak test load of the shear wall, as described in Sections 3.7.1 through 3.7.3, as applicable. The drift corresponding to the allowable shear strength, Δ_{VASD}, shall be included in the analysis.

The adjusted allowable strength, V'_{ASD}, to be published in the evaluation report shall be equal to V_{ASD} multiplied by R_s, (defined in Section 3.3.4).

3.7.1 Allowable Strength Based on Drift (Seismic): The allowable shear strength shall be determined on the basis of the requirements of ASCE/SEI 7 Section 12.8.6 as follows:

(a) The maximum inelastic response displacement, δx, shall be taken as the lesser of the allowable story drift from Table 12.12-1 of ASCE 7, Δa, and the mean displacement at the peak strength of the tested wall assemblies, p, corresponding to the peak load, Vp, from the test.

(b) Using δ_x and the assigned C_d factor, the Strength Design level response displacement, δ_{xe}, shall be calculated as $\delta_{xe} = \delta_x I \div C_d$, where I is the importance factor determined in accordance with Section 11.5.1 of ASCE/SEI 7.

(c) From the envelope curve defined in ASTM E 2126, the force F_s corresponding to δ_{xe} shall be determined.

(d) F_s shall be multiplied by a factor of 0.7 to determine the allowable shear strength.

3.7.2 Allowable Strength Based on Drift (Wind): The allowable shear strength shall be equal to the test load derived from the envelope curve at a deflection of $^{h}/_{180}$, where h is equal to the height of the tested shear wall assembly.

3.7.3 Allowable Strength Based on Peak Strength (Seismic and Wind):

From the envelope curve defined in ASTM E 2126, the allowable shear strength shall be taken as the average peak shear strength of the tested shear wall, $V_{p,}$, divided by a safety factor of 2.5 for seismic forces and 2.0 for wind forces.

3.8 LRFD (Load and Resistance Factor Design): For LRFD, the nominal shear strength shall be multiplied by a resistance factor $\Phi = 0.6$ (for seismic loads) or $\Phi = 0.65$ (for wind loads) to obtain the design shear strength,

V_{LRFD}. The adjusted design strength, V'_{LRFD}, to be published in the evaluation report shall be equal to V_{LRFD} multiplied by R_s (defined in Section 3.3.4).

The nominal shear strength shall be taken as the lesser of the nominal shear strength value based on drift and the nominal shear strength based on the peak test load of the shear wall as follows:

3.8.1 Nominal Strength Based on Drift: The nominal shear strength shall be determined as the lower of 2.5 times the allowable shear strength defined in Section 3.7.1 or 2.0 times the allowable shear strength defined in Section 3.7.2, whichever is less.

3.8.2 Nominal Strength Based on Peak Strength: The nominal shear strength shall be taken as the peak test load of the shear wall.

4.0 ENGINEERING ANALYSIS

4.1 General:

4.1.1 Available unit shear strength values of shear walls consisting of wood structural panels attached to CFS framing with power-driven pins shall be determined by using an empirical method according to Section 4.2 or an analytical method according to Section 4.3, and a shear wall deflection function shall be verified according to the provisions in Section 4.4. Seismic design compatibility of shear walls consisting of wood structural panels attached to CFS framing with power-driven pins shall be determined according to the provisions of Section 4.5.

4.1.2 Shear walls consisting of wood structural panels attached to CFS framing with power-driven pins shall conform to the limitations on sheathing, steel framing members, and fastener spacing for lateral resistant systems specified in AISI S213.

4.2 Shear Wall Unit Shear—Empirical:

For available unit shear values based on an empirical analysis, a cyclic shear wall test program shall be conducted as described in Section 3.5. The test program shall include maximum and minimum fastener spacing for each fastener/sheathing/stud thickness combination to be recognized. The shear wall test data analysis shall be as described in the applicable parts of Section 3.6. Linear interpolation is permitted to establish capacities at intermediate fastener spacings.

4.3 Shear Wall Unit Shear—Analytical:

4.3.1 An outline of an analytical method of deriving shear wall available shear strength values and an outline of a confirmation test plan shall be submitted to ICC-ES prior to conducting single-fastener connection tests in accordance with Section 3.4 and conducting shear wall confirmatory tests in accordance with Section 4.3.2. The proposed analytical method shall be based on rational engineering analysis and structural analysis using available power-driven pin connection shear strength values determined in accordance with Section 3.4. The results of confirmatory testing shall be used to demonstrate that the predicted shear wall available strength is less than actual available strength.

4.3.2 Cyclic-load shear wall testing in accordance with Section 3.5 shall be conducted and the results shall be analyzed in accordance with Section 3.6. Critical features of the power-driven pins, such as nominal shank diameter and head geometry, shall be incorporated in the validation test plan. Shear wall test assemblies shall have an aspect ratio as set forth in Section 3.5.2. No individual test shall be eliminated unless a rationale for its exclusion can be given. The minimum test program for each fastener diameter and head geometry (where appropriate) shall include:

4.3.2.1 The thinnest sheathing with the thinnest CFS studs (minimum base-metal thickness) at maximum and minimum fastener spacing; and

4.3.2.2 The thickest sheathing with the thickest CFS studs (maximum base-metal thickness) at minimum and maximum fastener spacing; and

4.3.2.3 For design tables with more than two CFS stud thicknesses and two sheathing thicknesses, an intermediate thickness sheathing with an intermediate thickness CFS stud (base-metal thickness) and minimum fastener spacing.

4.3.3 For the purpose of confirming the analytical model, an adjusted available shear strength value for each shear wall test assembly shall be derived in accordance with Section 3.7 or Section 3.8, as applicable, and these empirically derived adjusted available shear strength values shall meet or exceed, within 15 percent, the available shear strength values predicted by the analytical model.

4.3.4 For the purpose of confirming seismic equivalency according to Section 4.5, and deflection equations according to Section 4.4, each confirmatory test configuration shall be evaluated. The equivalency checks required by Section 4.5 shall be made using the analytically derived allowable load that will be published for the confirmation test assembly configuration.

4.4 Shear Wall Deflection:

4.4.1 Shear wall test data that were used to derive available shear strength values shall be used to verify deflection calculations that follow from AISI S213 deflection equations.

4.4.2 It shall be permitted to verify another displacement function that is supported by engineering derivation based on the principles of mechanics.

4.4.3 The shear wall deflection equation shall be considered acceptable when the deflections calculated at LRFD design strength levels using F_s [determined in accordance with Section 3.7.1(c)] are within ±20% or ±0.10 inch (whichever is less severe) of the deflections of the test specimens at δ_{xe} [determined in accordance with Section 3.7.1(b)].

4.5 Seismic Design Compatibility with a Code-defined Seismic-force Resisting System:

4.5.1 A seismic-force resisting system consisting of shear wall assemblies with CFS framing, wood structural panels, and power-driven pins may be used as an alternate to a seismic-force resisting system consisting of shear wall assemblies with CFS framing, wood structural panels, and flat-head tapping screws that are code prescribed in Sections B1 and C2.2.2(4) of AISI S213. The alternate shear wall assemblies with the power-driven pins may be assigned the following response modification coefficient, R, system overstrength factor, Ω_0, and deflection amplification factor, C_d, provided compliance with the evaluation parameters specified in Section A2 of Appendix A is established for the average results of a group of assembly tests from the same configuration:

Response Modification Coefficient:	$R = 6^1/_2$
System Overstrength Factor:	$\Omega_0 = 3$
Deflection Amplification Factor:	$C_d = 4$

4.5.2 Where the cyclic-load test data obtained from Section 3.5 for shear wall assemblies with CFS framing, wood structural panels, and power-driven pins establish noncompliance with any of the evaluation parameters specified in Appendix A, the values for the response modification coefficient, *R*, the system overstrength factor, Ω_0, and the deflection amplification factor, C_d, for seismic-force resisting systems consisting of these walls shall be no greater than 3. Additionally, use of seismic-force resisting systems consisting of these walls shall be limited to use in structures located in Seismic Design Categories A and B, where the height of the structures is unlimited.

5.0 QUALITY CONTROL

5.1 Quality documentation complying with the ICC-ES Acceptance Criteria for Quality Documentation (AC10) shall be submitted. The quality documentation shall ensure that the fastener properties listed in Section 2.1.1 are maintained.

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

6.0 EVALUATION REPORT RECOGNITION

The evaluation report shall include the following:

1. Basic power-driven pin information required by Section 2.1, including product description, installation procedures, and packaging and identification.

2. Shear wall assembly description, including size and material specifications for the CFS framing and the sheathing, and design requirements for hold-downs and foundation anchorage.

3. Available shear strength values for each shear wall assembly, based on analysis of data in accordance with this criteria.

4. Available transverse strength of the single fastener connections, determined in accordance with Section 3.4, as applicable.

5. Lateral strength of single fastener connections, determined in accordance with Section 3.4, as applicable. When lateral connection strengths are included in the evaluation report, the report shall clearly state that these values are for general attachment of sheathing to CFS framing, and must not be used to determine shear wall or diaphragm capacities.

6. Design information addressing applicable Seismic Design Categories, seismic factors and coefficients in accordance with Section 4.5, and aspect ratios in accordance with Section 3.5.2,

7. A condition of use indicating that the wood structural panels used on weather-exposed surfaces defined in Section 202 of the IBC or Section R703 of the IRC shall be protected by a weather-resistant exterior wall envelope.

8. A statement that special inspections are required for the fastening and anchoring of the shear walls, in accordance with IBC Sections 1706.3 and 1707.4, unless exempted by IBC Sections 1706.1 and 1707.1, respectively. When special inspections are required, a statement of special inspections shall be submitted to the code official in accordance with IBC Section 1705.

9. A statement that allows for use under the IRC when an engineered design is submitted in accordance with the code.

10. The following conditions of use:

■ Calculations and details showing that the sheathing, the CFS framing and the foundation anchorage are adequate to resist the applied transverse loads and comply with applicable provisions in Sections C2 and C5 of AISI S213 must be submitted to the code official. The CFS framing must also be adequate to support the applied gravity loads. These calculations and details must be signed and sealed by a registered design professional, when required by the statues of the jurisdiction in which the project is to be constructed.

■ Calculations and details must be submitted to the code official showing how the lateral loads are transferred from the roof or floor diaphragm into the shear wall. These calculations and details must be signed and sealed by a registered design professional, when required by the statues of the jurisdiction in which the project is to be constructed.

■ When the shear wall assemblies are used in buildings that are more than one story tall, calculations and details must be submitted to the code official showing the load path for the transfer of lateral and overturning forces from the upper-story shear walls to the foundation. These calculations and details must be signed and sealed by a registered design professional, when required by the statues of the jurisdiction in which the project is to be constructed. ■

Appendix A

Equivalency Characteristics and Parameters for Power-driven Pins for Shear Wall Assemblies with Cold-formed Steel Framing and Wood Structural Panels

A1. Definitions:

V_{ASD} = allowable design capacity, not to exceed values as determined from Section 3.7 of this criteria.

Δ_{VASD} = displacement at V_{ASD}

V_P = peak strength capacity of the wall assembly

$\Delta_{0.8VP}$ = displacement at 80% post-peak strength capacity = $0.8V_P$

h_x = height of the wall assembly

A2. Characteristics and Parameters: The following requirements must be met to verify equivalency. V_{ASD} determined in accordance with Section 3.7 may be reduced to ensure compliance with the following requirements, provided the reduced V_{ASD} is used consistently throughout the determination of load values which are to be recognized.

(a) Ratio of peak load capacity, V_P, to ASD design capacity, V_{ASD}, shall be in accordance with the following:

$$2.5 \leq \frac{V_p}{V_{ASD}} \leq 5.0$$

The ratio of peak load capacity to ASD design capacity may exceed 5.0 provided the evaluation report includes a requirement that collectors and their connections, bearing and anchorage of the panel, and the lateral load path to the panel are designed in accordance with the special load combinations of Section 12.4.4 of ASCE 7, using E_m, where E_m is calculated using the test wall assembly overstrength.

(b) Ratio of post peak load displacement to ASD design capacity displacement shall be:

$$\frac{\Delta_{0.8VP}}{\Delta_{VASD}} \geq 11$$

(c) The minimum post-peak displacement shall be in accordance with the following:

$$\Delta_{0.8VP} \geq 0.028h_x$$