ICC EVALUATION SERVICE

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February 22, 2011

TO: **PARTIES INTERESTED IN COLD-FORMED STEEL FRAMING MEMBERS**

SUBJECT: Revisions to the Acceptance Criteria for Cold-formed Steel Framing Members, Subject AC46-0211 (WM/DM)

Dear Colleague:

We are enclosing the revised ICC-ES Acceptance Criteria for Cold-formed Steel Framing Members (AC46), which was approved by the Evaluation Committee in February. The committee gave the revised criteria an effective date of March 1, 2011, and made the following revisions to the document that was initially presented:

1. Withdrew proposed changes to Section 1.4.

2. Withdrew proposed Section 3.2.4 and Figure 1.

3. Revised Sections 6.6.3 and 6.6.4 to:
   6.6.3 Ductility—ASTM A 370.
   6.6.4 Elongation—ASTM A 370.

If you have an evaluation report that falls under this criteria, the report will need to comply with the enclosed edition when you apply to revise the report. At the appropriate time, then, you should be prepared to show such compliance through submittal of appropriate data.

Thank you for your interest. If you have any questions, please contact Woods McRoy, P.E., Senior Staff Engineer at (800) 423-6587, extension 5686, or by e-mail at wmcroy@icc-es.org.

Yours very truly,

Gary G. Nichols

Gary G. Nichols, P.E., SECB
Vice President

GGN/raf

Enclosure

cc: Evaluation Committee

ICC EVALUATION SERVICE

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ACCEPTANCE CRITERIA FOR COLD-FORMED STEEL FRAMING MEMBERS

AC46

Approved February 2011

Effective March 1, 2011

Previously approved February 2010, February 2007, June 2006, October 2004, January 2001 March 2000, April 1998, January 1994

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 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 by ICC-ES for purposes of issuing ICC-ES evaluation reports.

ACCEPTANCE CRITERIA FOR COLD-FORMED STEEL FRAMING MEMBERS (AC46)

1.0 INTRODUCTION

1.1 Purpose: The purpose of this criteria is to establish requirements for cold-formed steel framing members 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 basis of recognition under the IBC is the United States of America provisions of AISI S100 and AISI S200 as referenced in IBC Sections 1604.3.3 and 2210. Bases of recognition under the IRC are IRC Sections R301.1.3, R505, R603, and R804. See Appendix B of this criteria for requirements for cold-formed steel framing members to be recognized in an evaluation report under the 2006 *International Building Code*® and the 2006 *International Residential Code*®.

1.2 Scope: This acceptance criteria applies to cold-formed steel framing members used in light-frame construction

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 AISI S100-07, North American Specification for Design of Cold-formed Steel Structural Members, 2007 edition, published by the American Iron and Steel Institute (AISI). The United States provisions of AISI S100 are applicable under this criteria.

1.3.4 AISI S200-07, North American Standard for Cold-Formed Steel Framing—General Provisions, American Iron and Steel Institute (AISI).

1.3.5 AISI S211-07, North American Standard for Cold-Formed Steel Framing—Wall Stud Design, American Iron and Steel Institute (AISI).

1.3.6 ASTM A 370-09ae1, Test Methods and Definitions for Mechanical Testing of Steel Products, ASTM International.

1.3.7 ASTM E 1966-01, Test Method for Fire-resistant Joint Systems, ASTM International.

1.3.8 ASTM A 924-07, Specification for General Requirements for Steel Sheet, Metallic Coated by the Hot-Dip Process, ASTM International.

1.3.9 S909-08, Standard Test Method for Determining the Web Crippling Strength of Cold-Formed Steel Beams, American Iron and Steel Institute (AISI).

1.3.10 UL 2079-04, Tests for Fire Resistance of Building Joint Systems – with Revisions through March 2006, Underwriters Laboratories Inc.

1.4 Definitions: Definitions are located in the referenced codes and standards.

2.0 GENERAL

The following information shall be submitted:

2.1 Data concerning material specifications; section properties; maximum allowable heights; maximum allowable spans and/or maximum allowable loads; and lateral, mechanical or material bracing requirements.

2.2 Method of field identification.

2.3 Quality control program.

2.4 Data in support of an application for recognition only under the IRC shall verify compliance with Sections R505, R603 and R804 of the IRC and the requirements noted in this criteria except for Section 4.0.

2.5 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 Procedures for Evaluation Reports.

2.6 Test Reports: Test reports shall comply with AC85. Details describing the test configuration, test methods and test procedures, including load application rate, shall be identified in the test report.

3.0 TEST AND PERFORMANCE REQUIREMENTS

3.1 Material Specifications:

3.1.1 Steel: Steel specifications shall comply with Section A2 of the AISI S100 or Section A3 of the AISI S200, for the IBC and IRC. Nonstructural grades of steel shall be limited to interior nonload-bearing walls with lateral loads of 10 psf (480 Pa) or less.

3.1.2 Thickness: Minimum steel thicknesses shall comply with Section A2.4 of AISI S100, and Section A5.1 of AISI S200. Other thicknesses may be considered, provided substantiating data showing compliance with the applicable code and this criteria are submitted.

3.1.3 Protective Coating: For use with the IBC and IRC, a minimum of G60 (or equivalent) is required for all applications with the exception of minimum G40 (or equivalent) for interior nonload-bearing walls with lateral loads of 10 psf (480 Pa) or less.

3.2 Cold-formed Steel Framing Members: Evaluation reports on cold-formed steel framing members shall address the section properties and design approach as applicable:

3.2.1 Section Properties: Section properties shall be determined in accordance with AISI S100 for recognition under the IBC. Structural properties data for steel members shall include the minimum information noted in Appendix A of this criteria. Information on additional properties is optional and can be furnished.

3.2.2 Structural Performance: Capacity of members shall be determined in accordance with Chapters C and D of AISI S100. For members that exceed limitations specified in AISI S100 or do not conform to the requirements of AISI S100, tests are necessary to determine applicable strength and stiffness. See Section 4.2 (4.3 for web crippling) of this criteria.

3.2.3 Calculations: When section properties and/or design parameters are determined by calculations, calculations shall be submitted for a representative set of values to be be recognized in the evaluatIon report. All calculations shall be signed and sealed by the engineer responsible for the calculations. When calculations are generated using a computer program, the computer

program and version or edition shall be identified. The computer calculations shall include a sample input for each distinct section type to be recognized in the evaluation report. When calculations are computer-generated, a set of detailed, annotated confirmatory calculations shall be submitted. The detailed, annotated calculations shall be for one of each type of member to be recognized in the report. Thus, one detailed calculation would cover each cross section to be recognized. If multiple configurations of cross sections were to be covered under the report, then a different detail calculation may be required for each. (Example: Complex stiffeners, additional bends, or additional ribs could constitute a different member type, thus requiring additional detail calculations.)

3.3 Deflection Track:

For deflection track not conforming to Section B2.3 of AISI S211, the evaluation report shall specify the following: attachment details of the deflection track to the structure; nominal strength (R_n) of the track; resistance factor (Φ) and safety factor (Ω); deflection due to transverse load; fastener requirements between the deflection track and the stud; and the maximum gap permitted between the web of the deflection track and the end of the stud in place of section properties. Nominal strength (R_n), resistance factor (Φ) and safety factor (Ω), and deflection due to the transverse load on the wall shall be determined by testing in accordance with Section 4.4 of this criteria.

When the deflection track is intended for use as a component of a fire-resistant joint system, the system shall be tested in accordance with ASTM E 1966 or UL 2079.

4.0 DESIGN AND TESTING METHODS

4.1 Design Methods: This section is for cold-formed steel members that can be designed in accordance with Chapters C and D of AISI S100.

Data concerning section properties, maximum allowable heights, spans and/or loads shall be submitted showing compliance with AISI S100.

4.2 Testing Methods: For members whose strength and stiffness cannot be calculated in accordance with Chapters C and D of AISI S100, testing shall be conducted in accordance with Section F1 of the AISI S100, except for web crippling. Web crippling shall be tested in accordance with Section 4.3 below. Alternatively, under the IBC and IRC, design strength [allowable design strength] and stiffness may be determined by rational analysis based on appropriate theory and engineering judgment when supported by applicable test data. Specifically, design strength [allowable design strength] shall be determined from calculated nominal strength [resistance] by applying the resistance factors [factors of safety] of Section A1.2(b) of the AISI S100. Test data shall demonstrate that strength and stiffness are not less than the nominal strength and stiffness predicted by the analysis.

Testing programs under Section 4.2 of this criteria shall be submitted to the ES staff for review and acceptance prior to any testing being performed. The number of test specimens and test procedures and rate of loading shall be included in the test program submittal.

4.3 Web Crippling Tests:

4.3.1 Testing shall be conducted in accordance with AISI S909 on three similar specimens. Two series are required for each assembly: one series for interior reactions and a second series for end reactions. The load rate used under AISI S909 shall be reported. Both end reactions and interior reactions shall be evaluated in accordance with the conditions set forth in the applicable specification. The tested bearing width will be the minimum width recognized in the evaluation report. For member profiles available in multiple thicknesses, only the minimum thickness in each profile is required to be tested.

4.3.2 Conditions of Acceptance: The members shall be loaded to failure or dysfunctional distortions and the loads causing web crippling shall be recorded. The determination of nominal resistance, R_n, shall be based on Sections F1 of AISI S100. For ASD, the allowable design strength, R_a, is as follows:

$$R_a = R_n/\Omega.$$

where:

$$\Omega = \frac{1.6}{\varphi}$$

For LRFD, equation F1.1-1a of AISI S100 applies.

The results shall be compared to the design equations in Section C3.4 of AISI S100. The lowest result, from either testing or calculations, will determine the allowable value noted in the evaluation report. Where design capacities are derived from testing, the value will apply to greater thicknesses. If the calculated web crippling value is the lowest value, web crippling capacities for greater thicknesses are permitted to be calculated in accordance with the applicable specification.

4.4 Deflection Track:

The number of test specimens shall be determined in accordance with Section F1.1 of AISI S100.

Deflection track shall be tested in a simply supported beam configuration under center-point loading. Support points for the test setup shall be consistent with how the attachment of the deflection track is to be installed in the field. The deflection track shall be loaded to represent a single stud at the center point position between two fasteners attaching the deflection track to the structure. Sketches of the test assembly shall be provided with the test report.

The ultimate load shall be recorded, and the deflection during the test shall be recorded versus the load. Deflections shall be measured at the edge of the deflection track flange away from the web. Loading shall be applied at a rate of no greater than 0.1 inch (2.5 mm) per minute or 500 pounds (2 kN) per minute.

The resistance factor (Φ) and safety factor (Ω) shall be determined in accordance with Sections F1.1 and F1.2 of AISI S100 respectively.

5.0 FIELD IDENTIFICATION

Each cold-formed steel framing member shall have a legible label, stamp or embossment, at a maximum of 96 inches (2438 mm) on center, indicating the manufacturer's name, logo or initials; the evaluation report number (ESR-XXXX); the acronym "ICC-ES"; material minimum base-

metal thickness (uncoated) in decimal thickness or mils; minimum specified yield strength [if greater than 33 ksi (228 MPa)]; coating grade [if G60 or greater].

6.0 QUALITY CONTROL

6.1 Manufacturing:

6.1.1 Manufacturing Facility: The manufacturer of the cold-formed steel members shall maintain an in-house quality control program complying with the following:

6.1.1.1 Quality documentation complying with the ICC-ES Acceptance Criteria for Quality Documentation (AC10) shall be submitted.

6.1.1.2 The documentation shall specify the type of steel utilized and the level of quality assurance as outlined in Sections 6.2, 6.3, 6.4, 6.5, 6.6 and 6.7 to verify that each type of steel complies with that specified in the evaluation report.

6.1.1.3 The documentation shall include detail drawings for each member to be included in the evaluation report.

6.1.1.4 Third-party inspections are not required for factory-fabricated cold-formed steel members.

6.2 Tests shall verify the following: Steel thickness (uncoated), yield strength, tensile strength, total elongation, chemical composition and coating type and thickness. Where required by Section A2.3 of AISI S100, verification of ductility shall be included.

6.2.1 For steel specified as complying with one of the steel specifications noted in Section A2.1 of AISI S100, test data for each incoming steel coil from steel mills or steel service centers shall be in the form of mill certificates, independent laboratory tests or in-house testing with calibrated test equipment.

6.2.2 For steel permitted under Sections A2.2 and A2.3 of AISI S100, test data for each incoming steel coil shall be from independent laboratory tests or in-house testing with calibrated test equipment.

6.3 Records of all mill certificates, independent laboratory tests and in-house tests shall be retained by the manufacturer for a minimum of two years.

6.4 Periodic Measurements:

6.4.1 Periodic measurements of material base metal thickness (uncoated) are not required for steel coils that have mill certificates. Method of verification of the base metal thickness of the master coils that have mill certificates shall be detailed in the quality documentation.

6.4.2 Material without mill certification requires periodic measurement of material base metal thickness (uncoated). Measurements of material shall be performed with calibrated equipment, either in-house or by an independent laboratory.

6.4.2.1 Test specimens for periodic testing shall consist of one out of every 250 pieces for nonbearing studs and tracks and one out of every 100 pieces for bearing studs and joists.

6.4.2.2 Alternative specimen testing for the material thickness can be accomplished by measuring each final coil at a minimum of one measurement per 2,000 linear feet (610 m) for nonbearing studs and tracks and one measurement per 800 linear feet (245 m) for bearing studs and joists.

6.4.2.3 Another alternative is to measure each final coil at three locations: the beginning, the end, and at midpoint. Final coil is defined as the steel coil that has been slit into its final width prior to roll forming into a product without additional slitting.

6.4.3 Measurement may be of the total material thickness, including coating, provided complete details covering the methods of determining uncoated steel thickness are included in the quality documentation.

6.4.4 Description of test method shall be documented in the quality documentation. Measurements shall be of the uncoated base metal.

6.5 Additional quality control testing may be necessary as determined by ICC-ES when method No. 1, full section tensile tests, or No. 2, stub column tests, as defined in AISI S100 is used for strength increase from cold work of forming.

6.6 Quality control tests shall be conducted in accordance with the following:

6.6.1 Yield strength—ASTM A 370.

6.6.2 Tensile strength—ASTM A 370.

6.6.3 Ductility—ASTM A 370.

6.6.4 Elongation—ASTM A 370.

6.6.5 Coating—Zinc coating hot-dip process—ASTM A 924, Section 8.2.1.5. Other coatings are acceptable provided coatings comply with national standards.

6.7 Minimum conditions of acceptance for each test shall be specified in the in-house quality documentation for each specified steel. In addition to the tests listed in Section 6.2, the documentation shall include the following:

6.7.1 Minimum yield strength used in design, or minimum yield stress prior to yield strength increase due to cold work of forming, if applicable.

6.7.2 Minimum base steel thickness (uncoated) allowed for each thickness recognized in an evaluation report. Minimum bare steel thickness shall not be less than 95 percent of the design thickness. ■

APPENDIX A

Structural Properties

Member Size (inches) or Designation

Design Thickness (inches)

Weight (lbs/ft.)

Gross Section Properties:
- **Area (in^2)**
- **I_x (in^4)**
- **r_x (in)**
- **I_y (in^4)**
- **r_y (in)**

Effective Section Properties*:
- **I_x (in^4)**
- **S_x**
- **A (in^2)**

Moments:

Allowable Moment, M_a (in-lbs)

The allowable moment (M_a) is based on continuous bracing of the compression flange. For other conditions of compression flange bracing, the allowable moment must be determined in accordance with AISI S100.

Distortional Buckling Moment, M_{nd} (in-lbs)

The distortional buckling moment (M_{nd}) is base on continuous member restraint. For other conditions of member constraint, the distortional buckling moment must be determined in accordance with AISI S100.

Torsion Section Properties (Torsional section properties are optional for nonaxial load-bearing members):
- **X_o (in)**
- **J (in^4)**
- **C_w (in^6)**
- **R_o (in)**
- **β**

Notes:

The extreme fiber stress of the flexural members used in design shall be noted in the structural properties tables. This stress shall be the yield stress of the base metal.

In addition, if applicable, the following statement shall be noted in the table: “Effective properties and allowable moment incorporate stress increase as a result of cold work of forming, where applicable.”

Definitions:

*Effective section properties are the properties determined from the total effective width of each element of the member and used in the design of the member in accordance with AISI S100.

Effective area is the area based on using $f = F_y$ in equation B2.1-4. (Optional.)

APPENDIX B

Recognition under the 2006 *International Building Code*® and 2006 *International Residential Code*®

B1.0 INTRODUCTION

B1.1 Purpose: The purpose of this criteria is to establish requirements for cold-formed steel framing members to be recognized in an ICC Evaluation Service, LLC (ICC-ES), evaluation report under the 2006 *International Building Code*® (IBC) and the 2006 *International Residential Code*® (IRC). Basis of recognition under the IBC is the United States of America provisions of AISI-NAS and AISI General as referenced in IBC Sections 1604.3.3 and 2210. Bases of recognition under the IRC are IRC Sections R301.1.3, R505, R603, and R804.

B1.2 Scope: This acceptance criteria applies to cold-formed steel framing members used in light-frame construction

B1.3 Codes and Referenced Standards:

B1.3.1 2006 *International Building Code*® (IBC), International Code Council.

B1.3.2 2006 *International Residential Code*® (IRC), International Code Council.

B1.3.3 AISI-NAS-01, North American Specification for Design of Cold-formed Steel Structural Members, 2001 edition, with 2004 supplement, published by the American Iron and Steel Institute (AISI). The United States provisions of AISI-NAS are applicable under this criteria.

B1.3.4 AISI General-04, AISI North American Standard for Cold-Formed Steel Framing—General Provisions, American Iron and Steel Institute (AISI).

B1.3.5 AISI WSD-04, AISI North American Standard for Cold-Formed Steel Framing—Wall Stud Design, American Iron and Steel Institute (AISI).

B1.3.6 AISI Header-04, AISI Standard for Cold-Formed Steel Framing—Header Design, American Iron and Steel Institute (AISI).

B1.3.7 AISI Lateral-04, AISI Standard for Cold-Formed Steel Framing—Lateral Design, American Iron and Steel Institute (AISI).

B1.3.8 AISI Truss-04, AISI Standard for Cold-Formed Steel Framing—Truss Design, American Iron and Steel Institute (AISI).

B1.3.9 ASTM A 370-97a, Test Methods and Definitions for Mechanical Testing of Steel Products, ASTM International.

B1.3.10 ASTM A 924-99, Specification for General Requirements for Steel Sheet, Metallic Coated by the Hot-Dip Process, ASTM International.

B1.3.11 TS 9-05, Standard Test Method for Determining the Web Crippling Strength of Cold-Formed Steel Beams, American Iron and Steel Institute (AISI).

B1.4 Definitions: Definitions are located in the referenced codes and standards.

B2.0 GENERAL

The following information shall be submitted:

B2.1 Data concerning material specifications; section properties; maximum allowable heights; maximum allowable spans and/or maximum allowable loads; and lateral, mechanical or material bracing requirements.

B2.2 Method of field identification.

B2.3 Quality control program.

B2.4 Data in support of an application for recognition only under the IRC shall verify compliance with Sections R505, R603 and R804 of the IRC and the requirements noted in this criteria except for Section B4.0.

B2.5 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 Procedures for Evaluation Reports.

B2.6 Test Reports: Test reports shall comply with AC85. Details describing the test configuration, test methods and test procedures, including load application rate, shall be identified in the test report.

B3.0 TEST AND PERFORMANCE REQUIREMENTS

B3.1 Material Specifications:

B3.1.1 Steel: Steel specifications shall comply with Section A2 of the AISI -NAS or Section A3 of the AISI General, for the IBC and IRC. Nonstructural grades of steel shall be limited to interior nonload-bearing walls with lateral loads of 5 psf (240 Pa) or less.

B3.1.2 Thickness: Minimum steel thicknesses shall comply with Section A2.4 of AISI-NAS, and Section A5.1 of AISI General. Other thicknesses may be considered, provided substantiating data showing compliance with the applicable code and this criteria are submitted.

B3.1.3 Protective Coating: For use with the IBC and IRC, a minimum of G60 (or equivalent) is required for all applications with the exception of minimum G40 (or equivalent) for interior nonload-bearing walls with lateral loads of 5 psf (240 Pa) or less.

B3.2 Cold-formed Steel Framing Members: Evaluation reports on cold-formed steel framing members shall address the section properties and design approach as applicable:

B3.2.1 Section Properties: Section properties shall be determined in accordance with AISI-NAS for recognition under the IBC. Structural properties data for steel members shall include the minimum information noted in Appendix C of this criteria. Information on additional properties is optional and can be furnished.

B3.2.2 Structural Performance: Capacity of members shall be determined in accordance with Chapters C and D of AISI-NAS. For members that exceed limitations specified in the applicable specifications or do not conform to the requirements of applicable specifications, full-scale tests are necessary to determine applicable strength and stiffness. See Section B4.2 (B4.3 for web crippling) of this criteria.

B4.0 DESIGN AND TESTING METHODS

B4.1 Design Methods: This section is for cold-formed steel members that can be designed in accordance with Chapters C and D of AISI-NAS.

Data concerning section properties, maximum allowable heights, spans and/or loads shall be submitted showing compliance with AISI-NAS.

B4.2 Testing Methods: For members whose strength and stiffness cannot be calculated in accordance with Chapters C and D of AISI-NAS, testing shall be conducted in accordance with Section F1 of the AISI-NAS, except for web crippling. Web crippling shall be tested in accordance with Section B4.3 below. Alternatively, under the IBC and IRC, design strength [allowable design strength] and stiffness may be determined by rational analysis based on appropriate theory and engineering judgment when supported by applicable test data. Specifically, design strength [allowable design strength] shall be determined from calculated nominal strength [resistance] by applying the resistance factors [factors of safety] of Section A1.1(b) of the AISI-NAS. Test data shall demonstrate that strength and stiffness are not less than the nominal strength and stiffness predicted by the analysis.

Testing programs under Section B4.2 of this criteria shall be submitted to the ES staff for review and acceptance prior to any testing being performed. The number of test specimens and test procedures and rate of loading shall be included in the test program submittal.

B4.3 Web Crippling Tests:

B4.3.1 Testing shall be conducted in accordance with AISI TS-9 on three similar specimens. Two series are required for each assembly: one series for interior reactions and a second series for end reactions. The load rate used under AISI TS-9 shall be reported. Both end reactions and interior reactions shall be evaluated in accordance with the conditions set forth in the applicable specification. The tested bearing width will be the minimum width recognized in the evaluation report. For member profiles available in multiple thicknesses, only the minimum thickness in each profile is required to be tested.

B4.3.2 Conditions of Acceptance: The members shall be loaded to failure or dysfunctional distortions and the loads causing web crippling shall be recorded. The determination of nominal resistance, R_n, shall be based on Sections F1 of AISI-NAS. For ASD, the allowable design strength, R_a, is as follows:

$$R_a = R_n/\Omega.$$

where:

$$\Omega = \frac{1.6}{\varphi}$$

For LRFD, equation F1.1-1 of AISI-NAS applies.

The results shall be compared to the design equations in Section C3.4 of AISI-NAS. The lowest result, from either testing or calculations, will determine the allowable value noted in the evaluation report. Where design capacities are derived from testing, the value will apply to greater thicknesses. If the calculated web crippling value is the lowest value, web crippling capacities for greater thicknesses are permitted to be calculated in accordance with the applicable specification.

B5.0 FIELD IDENTIFICATION

Each cold-formed steel framing member shall have a legible label, stamp or embossment, at a maximum of 48 inches (1219 mm) on center, indicating the manufacturer's name, logo or initials; the evaluation report number (ESR-XXXX); the acronym "ICC-ES"; material minimum base-metal thickness (uncoated) in decimal thickness or mils; minimum specified yield strength [if greater than 33 ksi (228 MPa)]; coating grade [if G60 or greater].

B6.0 QUALITY CONTROL

B6.1 Manufacturing:

B6.1.1 Manufacturing Facility: The manufacturer of the cold-formed steel members shall maintain an in-house quality control program complying with the following:

B6.1.1.1 Quality documentation complying with the ICC-ES Acceptance Criteria for Quality Documentation (AC10) shall be submitted.

B6.1.1.2 The documentation shall specify the type of steel utilized and the level of quality assurance as outlined in Sections B6.2, B6.3, B6.4, B6.5, B6.6 and B6.7 to verify that each type of steel complies with that specified in the evaluation report.

B6.1.1.3 Third-party inspections are not required for factory-fabricated cold-formed steel members.

B6.2 Tests shall verify the following: Steel thickness (uncoated), yield strength, tensile strength, total elongation, chemical composition and galvanized coating thickness. Where required by Section A2.3 of AISI-NAS, verification of ductility shall be included.

B6.2.1 For steel specified as complying with one of the steel specifications noted in Section A2.1 of AISI-NAS, test data for each incoming steel coil from steel mills or steel service centers shall be in the form of mill certificates, independent laboratory tests or in-house testing with calibrated test equipment.

B6.2.2 For steel permitted under Sections A2.2 and A2.3 of AISI-NAS, test data for each incoming steel coil shall be from independent laboratory tests or in-house testing with calibrated test equipment. Calibration certificates shall indicate traceability to national standards of measurement. The manufacturer shall have an established program for the calibration and verification of its measuring and test equipment.

B6.3 Records of all mill certificates, independent laboratory tests and in-house tests shall be retained by the manufacturer for a minimum of one year.

B6.4 Periodic Measurements:

B6.4.1 Periodic measurements of material base metal thickness (uncoated) are not required for steel coils that have mill certificates. Method of verification of the base metal thickness of the master coils that have mill certificates shall be detailed in the quality documentation.

B6.4.2 Material without mill certification requires periodic measurement of material base metal thickness (uncoated). Measurements of material shall be performed with calibrated equipment, either in-house or by an independent laboratory.

B6.4.2.1 Test specimens for periodic testing shall consist of one out of every 250 pieces for nonbearing studs and tracks and one out of every 100 pieces for bearing studs and joists.

B6.4.2.2 Alternative specimen testing for the material thickness can be accomplished by measuring each final coil at a minimum of one measurement per 2,000 linear feet (610 m) for nonbearing studs and tracks and one measurement per 800 linear feet (245 m) for bearing studs and joists.

B6.4.2.3 Another alternative is to measure each final coil at three locations: the beginning, the end, and at midpoint. Final coil is defined as the steel coil that has been slit into its final width prior to roll forming into a product without additional slitting.

B6.4.3 Measurement may be of the total material thickness, including coating, provided complete details covering the methods of determining uncoated steel thickness are included in the quality documentation.

B6.4.4 Description of test method shall be documented in the quality documentation. Measurements shall be of the uncoated base metal.

B6.5 Additional quality control testing may be necessary as determined by ICC-ES when method No. 1, full section tensile tests, or No. 2, stub column tests, as defined in AISI-NAS is used for strength increase from cold work of forming.

B6.6 Quality control tests shall be conducted in accordance with the following:

B6.6.1 Yield strength—ASTM A 370.

B6.6.2 Tensile strength—ASTM A 370.

B6.6.3 Ductility—Section A2.3 of AISI-NAS.

B6.6.4 Elongation—Section A2.3 of AISI-NAS.

B6.6.5 Coating—Zinc coating hot-dip process—ASTM A 924, Section 7.2.1.5. Other coatings are acceptable provided coatings comply with national standards.

B6.7 Minimum conditions of acceptance for each test shall be specified in the in-house quality documentation for each specified steel. In addition to the tests listed in Section B6.1, the documentation shall include the following:

B6.7.1 Minimum yield strength used in design, or minimum yield stress prior to yield strength increase due to cold work of forming, if applicable.

B6.7.2 Minimum base steel thickness (uncoated) allowed for each thickness recognized in an evaluation report. Minimum bare steel thickness shall not be less than 95 percent of the design thickness.

APPENDIX C

Structural Properties

MEMBER SIZE (inches) OR DESIGNATION	DESIGN THICKNESS (inches)	WEIGHT (lbs./ft.)	GROSS SECTION PROPERTIES					EFFECTIVE SECTION PROPERTIES*			ALLOWABLE MOMENT M_a (in.-lbs.)*	TORSIONAL SECTION PROPERTIES**				
			Area (in^2)	I_x (In^4)	r_x (in)	I_y (In^4)	r_y (in)	I_x (In^4)	S_x (In^3)	A (in^2)		X_o (in)	J (In^4)	C_w (In^6)	R_o (in)	β

For **SI:** 1 inch = 25.4 mm, 1 lb./ft. = 1.488 kg/m, 1 in. - lb. = 11.30 N · m.

Notes:

The extreme fiber stress of the flexural members used in design shall be noted in the structural properties tables. This stress shall be the yield stress of the base metal.

In addition, if applicable, the following statement shall be noted in the table: “Effective properties and allowable moment incorporate stress increase as a result of cold work of forming, where applicable.”

Definitions:

*Effective section properties are the properties determined from the total effective width of each element of the member and used in the design of the member in accordance with NAS.

1. Effective area is the area based on using $f = F_y$ in equation B2.1-4. (Optional.)

**Torsional section properties are optional for nonaxial load-bearing members.