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April 1, 2024

TO: **PARTIES INTERESTED IN PROPRIETARY DESIGNS AND ALTERNATE CONFIGURATIONS OF SHEET METAL TIES FOR ANCHORED MASONRY VENEER CONSTRUCTION**

SUBJECT: Proposed Revisions to the Acceptance Criteria for Joist Hangers and Similar Devices (AC13) Subject AC13-0424-R1 (DW/MC)

Dear Colleague:

We are seeking your comments on proposed revisions to the subject acceptance criteria, AC13, as presented in the enclosed draft. The revisions, which are being posted on the ICC-ES web site for 30 days of public comment, may be summarized as follows:

1. Remove all references and requirements for the evaluation of proprietary and alternate configurations of sheet metal ties for anchored masonry veneer as alternatives to corrugated sheet metal ties and Annex 2. All references and requirements are to be presented under a proposed new acceptance criteria.

Should the Evaluation Committee approve the proposed revisions to the criteria, no mandatory compliance date will be required.

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

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

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

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

Thank you for your interest and your contributions. If you have any questions, please contact me at (800) 423-6587, extension 3272, or Manuel Chan, P.E., S.E. Principal Structural Engineer, at extension 3288. You may also reach us by e-mail at es@icc-es.org.

Yours very truly,

Danny Wong, P.E., P.Eng.
Senior Staff Engineer

dw/mc/ls

Encl.

cc: Evaluation Committee

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PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR JOIST HANGERS AND SIMILAR DEVICES

AC13

Proposed April 2024

Previously approved October 2018, March 2018, February 2017, October 2016, June 2015, October 2010,
October 2006, October 2003, January 2003, January 2001

(Previously editorially revised February 2024, December 2020 and December 2011)

PREFACE

Evaluation reports issued by ICC Evaluation Service, LLC (ICC-ES), are based upon performance features of the International family of codes, and may include other codes, as applicable. For alternative materials design and methods of construction and equipment, see Section 104.2.3 of the 2024 International Building Code® (IBC), Section 104.11 of the 2021 IBC and earlier editions, and Section R104.11 of the 2021 IRC and earlier editions.

ICC-ES may consider alternate criteria for report approval, provided the report applicant submits data demonstrating that the alternate criteria are at least equivalent to the criteria set forth in this document, and otherwise demonstrate compliance with the performance features of the codes. ICC-ES retains the right to refuse to issue or renew any evaluation report, if the applicable product, material, or method of construction is such that either unusual care with its installation or use must be exercised for satisfactory performance, or if malfunctioning is apt to cause injury or unreasonable damage.

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

PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR JOIST HANGERS AND SIMILAR DEVICES (AC13)

1.0 INTRODUCTION

1.1 Purpose: The purpose of this criteria is to establish requirements for ICC Evaluation Service, LLC (ICC-ES), recognition of joist hangers, framing anchors, `hurricane ties' and similar devices under the 2024, 2021, 2018 and 2015 *International Building Code*® (IBC) Sections 2303.5, the 2024 and 2021 IBC Section 2304.10.4 and the 2018 and 2015 IBC Section 2304.10.3, the 2024 *International Residential Code*® (IRC) Section R104.2.2, and the 2021, 2018 and 2015 IRC Section R104.11.

~~This criteria also provides requirements for recognition of proprietary and alternate configurations of sheet metal ties for anchored masonry veneer, as alternatives to the corrugated sheet metal ties in Section 1404.7 of the 2021, 2018 and 2015 IBC and Section R703.8.4 of the 2021, 2018 and 2015 IRC. (There will be a proposal to remove this and Annex 2 out of this Acceptance Criteria and into a new one. Therefore, Section 1.3.8 and Annex 2 were not update to the 2024 IBC/IRC for this version of the AC.)~~

The reason for the development of this criteria is to provide a guideline for the evaluation of joist hangers and similar devices~~, and proprietary or alternate configurations of sheet metal anchors for masonry veneer~~, since the IBC and IRC and associated reference standards do not specify installation and quality requirements for these products.

1.2 Scope: The devices are used to support or attach wood members, such as joists, rafters, trusses, purlins, beams, girders, plates, posts, studs and headers, to wood, metal, concrete or masonry. Attachment may be by means of mechanical fastenings (nails, spikes, lag screws, wood screws, bolts, etc.). ~~Sheet metal ties for anchored masonry veneer in this criteria are used to attach anchored masonry veneer to wood framing members.~~

A "device," as the word is used in this criteria, may consist of one or more pieces or units so arranged as to transfer load vertically or laterally, within safe limits, from the end of a supported member (hereinafter referred to as a "joist") to a supporting member (hereinafter referred to as a "header"). ~~Sheet metal ties for anchored masonry veneer transfer out-of-plane lateral (horizontal) loads from masonry veneer construction to supporting wall framing.~~

1.3 Codes and Referenced Standards:

1.3.1 2024, 2021, 2018 and 2015 *International Building Code*® (IBC), International Code Council.

1.3.2 2024, 2021, 2018 and 2015 *International Residential Code*® (IRC), International Code Council.

1.3.3 NDS 2024 for the 2024 IBC and IRC; 2018 for the 2021 and 2018 IBC and IRC; and 2015 for the 2015 IBC and IRC. ANSI/AWC *National Design Specification for Wood Construction*® (NDS) and *Supplement*, American Wood Council.

1.3.4 AISI S100-16(2020) with S2-20 for the 2024 and 2021 IBC; -16 for the 2018 IBC and IRC; and -12 for the 2015 IBC and IRC. North American Specification for the Design of Cold-formed Steel Structural Members, American Iron and Steel Institute.

1.3.5 ASTM D1761-88(2000)$^{\varepsilon 1}$, Test Methods for Mechanical Fasteners in Wood, ASTM International. Tests conducted in accordance with ASTM D1761 on January 1, 2016 or later shall not be accepted in support of applications for recognition under the 2024, 2021, 2018, 2015 IBC under this criteria.

1.3.6 ASTM D7147-21 for the 2024 IBC and IRC; -11(2018) for the 2021 IBC and IRC;-11 for the 2018 IBC and IRC; and -05 for the 2015 IBC and IRC). Standard Specification for Testing and Establishing Allowable Loads of Joist Hangers, ASTM International.

1.3.7 ~~ASTM E754-80 (2022) Standard Test Method for Pullout Resistance of Ties and Anchors Embedded in Masonry Mortar Joints.~~

1.3.8 ISO 21930-2017 Sustainability in Buildings and Civil Engineering Works - Core Rules for Environmental Product Declarations of Construction Products and Services, International Organization for Standardization (ISO).

1.3.9 ~~TMS 402-16 for the 2021, and 2018 IBC and IRC; and -13 for the 2015 IBC. Building Code Requirements and Specifications for Masonry Structures, The Masonry Society.~~

2.0 BASIC INFORMATION AND TEST REPORTS

2.1 General: The following information shall be submitted:

2.2 Device Description: Complete information pertaining to components, material specifications, and manufacturing processes. Materials shall comply with an appropriate recognized national standard(s).

~~2.3~~ Fastener Description: Complete information pertaining to fastener type, size, diameter, dimensions, material specifications, and minimum specified bending yield strength of fasteners, as applicable. ~~Nails, spikes, wood screws, lag screws and bolts shall comply with appropriate national standards or be recognized in a current ICC-ES Evaluation Report. Alternate load transfer mechanisms must be identified and described.~~

2.4 Installation Instructions: Installation details and drawings, noting installation requirements and/or limitations.

2.5 Identification: Description of the method of identifying the product. Each device shall bear an imprint which clearly identifies the manufacturer. A registered trademark may serve as such identity. Labeling shall also be in accordance with the product identification provisions of the ICC-ES Rules of Procedure for Evaluation Reports.

2.6 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.

2.7 Test Reports: Test reports shall comply with AC85. All test reports shall be prepared by an independent testing laboratory in accordance with Section 4.2 of the ICC-ES Rules of Procedure for Evaluation Reports. Test reports shall include a complete description of devices tested; the dimensions of the specimens; the number, size, type, and method of installing fastenings; type of failure; and such other data as may be pertinent.

2.8 Sampling: Test specimens shall be sampled in accordance with Section 3.0 of AC85.

3.0 TEST AND PERFORMANCE REQUIREMENTS

3.1 General: A qualification test plan shall be submitted to and approved by ICC-ES staff prior to any testing being conducted. Every device shall be rated for direct load capacity under Allowable Stress Design (ASD) in accordance with Section 3.2 or 3.3 of this criteria. Joist hangers also shall be rated for torsional moment capacity in accordance with Section 3.4 of this criteria. The load capacity of `hurricane ties', as defined in Section 3.5, shall be evaluated in accordance with Section 3.5. Devices installed utilizing smooth shank stainless steel nails shall be tested with smooth shank stainless steel nails. ~~Sheet metal anchors for masonry veneer shall be evaluated in accordance with Annex 2.~~

3.2 Direct Load Capacity Tests: The testing procedure to establish direct load capacity shall be in accordance with ASTM D7147. For devices not readily adaptable to such assembly, an alternate assembly producing comparable results may be used.

3.3 Alternative Test Method for Direct Load Capacity Testing:

3.3.1 As an alternative to ASTM D7147, for devices sought for recognition under the 2012, 2009, and 2006 IBC and IRC, ASTM D1761 is permitted for use to conduct the direct load capacity testing and allowable load determination in accordance with Appendix A.

3.3.2 For existing report holders seeking recognition under the 2024, 2021, 2018 and 2015 IBC and 2021, 2018 and 2015 IRC of devices in existing reports previously evaluated using data from tests in accordance with ASTM D1761 under the 2012, 2009 or 2006 IBC and IRC, reanalysis and adjustment of allowable design values shall be provided in accordance with Annex 1. Reanalysis and adjustment in accordance with Annex 1 shall demonstrate equivalence to the allowable design values derived in accordance with the provisions outlined for direct load capacity in ASTM D7147.

3.4 Torsional Moment Capacity Test for Joist Hangers:

3.4.1 The testing procedure for determining torsional moment capacity for the joist hanger shall be in accordance with ASTM D7147 or ASTM D1761. At least three specimens of each size of device shall be tested. Specimens shall be prepared and tested in a manner that will show the torsional moment in inch-pounds required to deflect either the top or bottom of the joist 0.125 inch (3.2 mm) from its initial position, provided the moment is applied on the joist by rotating the joist at a distance of not less than 12 inches (305 mm) from the device.

EXCEPTION: Hangers supporting glued-laminated timber beams or hangers specifically designed to support only prefabricated wood I-joists.

3.4.2 The torsional moment capacity rating of the device shall be the average torsional load at which the lateral movement of either the top or bottom of the joist with respect to the original position of the joist is 0.125 inch (3.2 mm), such load to be the average for three or more tests.

3.4.3 Every device supporting a joist shall have a torsional moment capacity of not less than 75 pounds (334 N) times the depth of the joist.

3.5 Load Capacity of Hurricane-Ties:

3.5.1 `Hurricane ties' under this criteria are defined as connectors that attach roof framing members (rafters, roof joists, roof trusses) to wall top plates where these roof framing members bear directly on the top plate of the supporting walls. The hurricane ties are primarily used to transmit uplift loads from roof framing members to the supporting wall top plate. Hurricane ties may also optionally be rated to transmit horizontal (lateral) loads (perpendicular or parallel to the wall). The term `joist' in this section shall refer generally to the roof framing member (rafter, joist, or truss).

3.5.2 The uplift load capacity shall be determined using the test setup shown in Figure 1.

3.5.3 For horizontal load capacities (optional), test setups in Figures 2 and 3 shall be used to determine load capacities in the parallel-to-top-plate or perpendicular-to-top-plate directions, respectively.

3.5.4 Where a connector is of a design that is not adaptable to Figures 1, 2, or 3, as applicable, necessary test set-up departures shall be permitted provided they are approved by ICC-ES.

3.5.5 Connectors shall be tested in configurations consistent with end-use installation conditions with attention to, but not limited to, the following details:

3.5.5.1 The joist shall be a single member unless the connector is designed to be installed onto multiple-ply members. Test setups for multiple-ply members must replicate the number of members to be recognized in the evaluation report or adequately represent the range of number of members for recognition in the report.

3.5.5.2 Test assemblies utilizing 2 by 4 sawn lumber double-top plates shall be applicable to 2 by 4 and wider sawn lumber double-top plate installations. Test setups for single-top plate applications shall have a single top plate. Test assemblies utilizing sawn lumber wider than 2 by 4 plates shall only be applicable to installation on lumber of the same width or wider.

3.5.5.3 Reference specific gravities for the applicable joist and top plate shall be stated in the test report and shall be the basis of testing and corresponding test result adjustments.

3.5.5.4 Rotational restraint of the joist shall be consistent with end-use installation conditions in the evaluation report. Where rotational end restraint is end-use is provided by means other than the connector being evaluated, the joist used in the test setup is permitted to be restrained from rotation provided the restraint does not restrict vertical movement.

3.5.5.5 Test setups shall represent end-use installation conditions with respect to end-use of the connectors installed singly (individually), or in (opposing) pairs at each connection.

3.5.5.6 Connectors shall be tested for load rating in each horizontal (lateral) load direction recognized in the evaluation report (in/out/left/right), except where such conditions are clearly identical in geometry and load application.

3.5.5.7 Test joists shall be the same thickness (breadth) of the joist member thickness to be recognized in the evaluation report, or the test joists shall be the minimum thickness of members to be recognized in the report. Test joists shall be tested in configurations with minimum

fastener edge and end distances that are to be recognized in the evaluation report. Reinforcement of the joist member in accordance with ASTM D7147, Section 9.5, shall be permitted.

3.5.6 Connectors shall be tested with the same fastener types with end-use installation conditions, and across the range of fastener lengths where different fastener lengths are to be reported.

3.5.7 When testing using the configuration shown in Figure 1, the following shall apply:

3.5.7.1 The top plate clear span between supports shall be a minimum of 14.5 inches (368 mm). The top plates shall be a minimum of 18 inches clear distance (457 mm) apart.

3.5.7.2 The joist shall be located beneath the top plates. The joist shall not be supported vertically at any time during the test by anything other than the hurricane tie.

3.5.7.3 Blocking is permitted to be installed between the top plates to prevent inward rotation of the plates.

3.5.8 When determining allowable capacities of a connector that may be used singly at the joist-top-plate connection, the following apply:

3.5.8.1 For testing a connector that is symmetric about the vertical load plane through the joist axis, a single connector shall be installed at each end of the test joist.

3.5.8.2 For testing the capacity of a connector that may be used singly at the end of the rafter, but that is not symmetric about the joist axis, a single connector shall be placed at each end and opposite faces of the joist (see Figures 2 and 3).

3.5.9 An initial load, or preload, shall not be applied for any tests of hurricane-tie connectors.

3.5.10 Displacement-measuring instrumentation shall be positioned to measure the relative movement of joist with respect to plate at the connector location in the direction of the applied load and shall be reported as the deflection for the particular load direction.

3.5.11 Connector allowable loads for each direction to be evaluated shall be determined in accordance with Sections 13, 14, and 15 of ASTM D7147.

3.5.12 Evaluation of hurricane tie connector devices that employ attachment to wall studs or framing members other than top plates are beyond the scope of this section. For such devices a test and evaluation plan shall be presented to and agreed upon by ICC-ES prior to testing.

4.0 ANALYSIS DETAILS

4.1 Compression Perpendicular to Grain: When the transfer of loads on the joist to the header is accomplished primarily by means of compression perpendicular to grain of the wood against the device, the allowable loads specified in the NDS shall not be exceeded.

4.2 Fastener Values: When the transfer of loads on the joist to the header is accomplished primarily by means of fasteners in wood, the allowable strength of fasteners specified in the NDS shall not be exceeded.

4.3 Multiple Devices: When more than one device is used at a joint, the devices shall be capable of operating in unison.

4.4 Provision for Shrinkage: Dimensions of devices, or methods of installation, shall make appropriate provisions for shrinkage of joist relative to header.

4.5 Alternate Load Transfer Mechanisms: For devices with load transfer mechanisms not recognized in the NDS, including but not limited to barbs and cleats, the applicant shall submit to ICC-ES for review and concurrence prior to testing, a test and evaluation plan, rational analysis, testing evidence, and evaluation criteria.

4.6 Smooth Shank Stainless Steel Nails: Reference nail withdrawal design values of smooth shank stainless steel nails shall be determined in accordance with Section 12.2.3.1(b) of the 2024 NDS, 2018 NDS, or an ICC-ES evaluation report for proprietary smooth shank stainless steel nails, as applicable.

5.0 MATERIALS AND WORKMANSHIP

Materials shall be of uniform quality and shall comply with the provisions of each applicable code when specified, otherwise material shall be limited to the following:

5.1 Minimum thickness of steel shall be as follows:

Sheet—No. 18 gage, U.S. Standard Gage.

Wire—No. 18 gage, U.S. Steel Wire Gage.

EXCEPTIONS:

1. Face-mounted joist hangers, supporting 2-by-4, 2-by-6, 2-by-8, and 2-by-10 wood joists or rafters, may be fabricated from minimum No. 20 gage sheet steel provided applicable sections of this criteria are complied with.

2. 'Hurricane ties' may be fabricated from minimum No. 22 gage sheet steel provided applicable sections of this criteria are complied with.

5.2 Steel shall be corrosion-resistant or shall be protected by galvanizing, electroplating, or with approved steel primer.

5.3 The device, after forming, shall evidence no fracturing in either the protective coating or the base metal.

5.4 The radius of a 90-degree bend intended to fit the corner of a joist or header shall be no greater than two times the thickness of the steel.

6.0 QUALITY CONTROL

6.1 General: For factory-welded joist hangers and similar devices, quality documentation and inspections shall be in accordance with Section A6.2. For all other joist hangers and similar devices, quality documentation and inspections shall be in accordance with Section A6.3.

6.2 Factory-welded Joist Hangers and Similar Devices:

6.2.1 Quality documentation complying with the ICC-ES Acceptance Criteria for Quality Documentation (AC10) shall be submitted for each facility manufacturing or labeling products that are recognized in the ICC-ES evaluation report.

6.2.2 A qualifying inspection shall be conducted at each manufacturing facility when required by the ICC-ES Acceptance Criteria for Inspections and Inspection Agencies (AC304).

6.2.3 Third party follow-up inspections are required under this acceptance criteria for factory-welded joist hangers and similar devices.

6.3 Joist Hangers and Similar Devices Without Welds:

6.3.1 Quality documentation complying with the ICC-ES Acceptance Criteria for Quality Documentation (AC10) shall be submitted for each facility manufacturing or labeling products that are recognized in the ICC-ES evaluation report.

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

6.3.3 An annual inspection shall be conducted at each manufacturing facility in accordance with AC304.

7.0 ENVIRONMENTAL PRODUCT DECLARATION (Optional):

Environmental impacts shall be assessed via an Environmental Product Declaration (EPD) based on a Life Cycle Assessment (LCA). The LCA and EPD shall be conducted in accordance with ISO 21930 and the appropriate Product Category Rule(s) for the product type.■

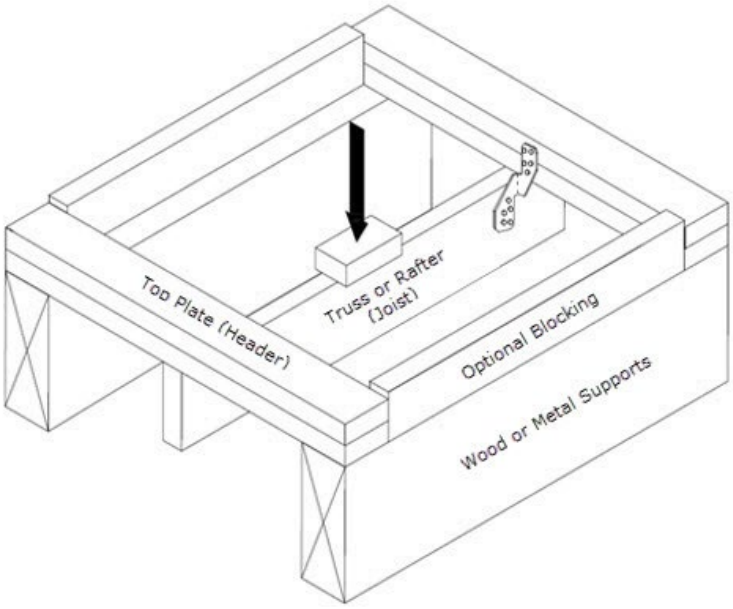


Figure 1—Hurricane Tie Test Setup, Vertical Load.

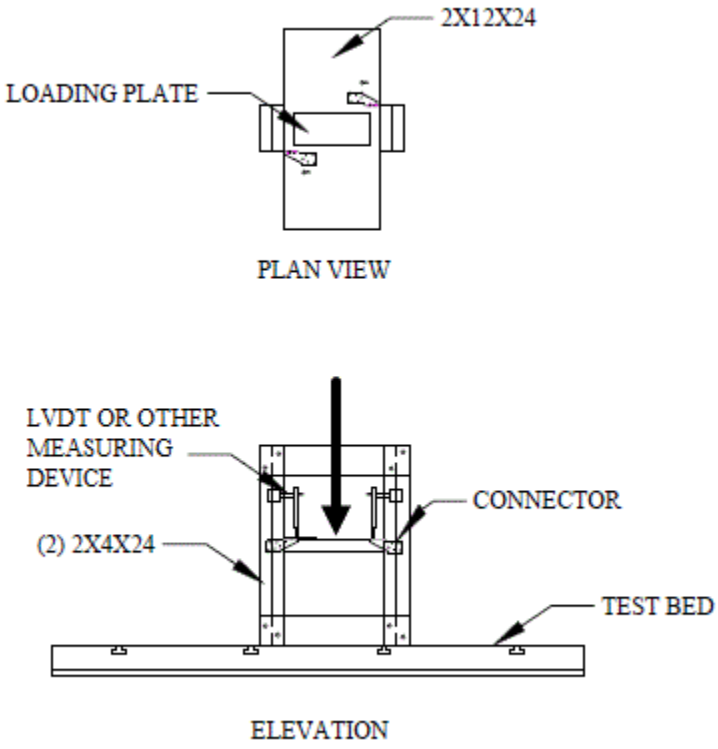


Figure 2—Hurricane Tie Test Setup, Load Parallel to Top Plate
(Option Shown: Joist Fasteners in Withdrawal)

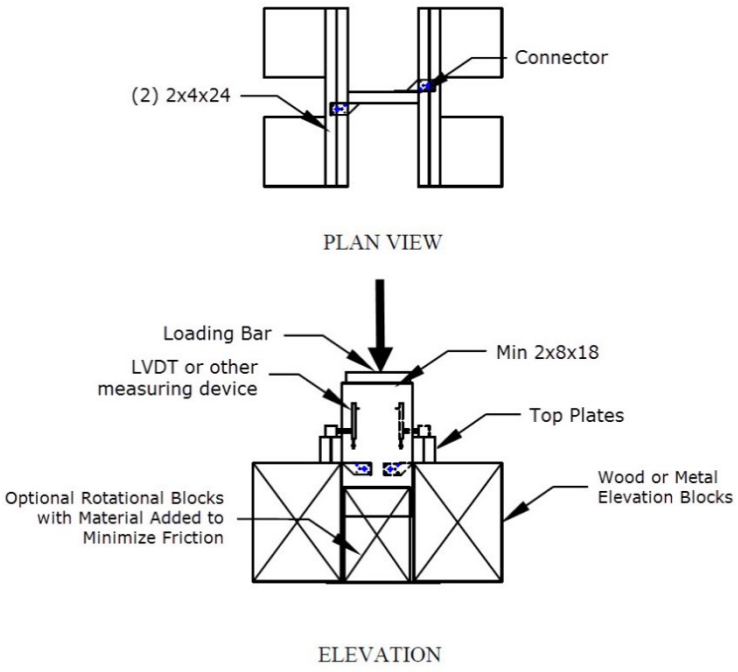


Figure 3—Hurricane Tie Test Setup, Load Perpendicular to Top Plate
(Options Shown: Top Plate Fasteners in Withdrawal)

ANNEX 1

EVALUATION OF DATA UNDER ASTM D1761 FOR USE WITH AC13 UNDER THE 2024, 2021, 2018 AND 2015 IBC

1.0 INTRODUCTION

The purpose of this annex is to provide existing report holders with a procedure for adjusting data obtained in accordance with ASTM D1761 for submittal to ICC-ES for evaluation reports in compliance with the 2024, 2021, 2018 and 2015 *International Building Code*® (IBC) with reference to ASTM D7147 as described in Section 3.2.2 of the criteria. The procedure outlines presumed values that shall be used in the absence of actual test information used for the adjustment of tested capacity values in Section 13 of ASTM D7147. Capacities determined by tests under ASTM D1761 shall be adjusted by this procedure and used in the assignment of allowable loads in accordance with Section 15 of ASTM D7147 also taking into consideration Section 14 of ASTM D7147.

2.0 TEST REPORT DATES

The procedure in this annex is applicable to testing conducted in accordance with ASTM D1761 and contained in the test reports dated prior to January 1, 2016. Tests conducted in accordance with ASTM D1761 on January 1, 2016 or later shall not be accepted in support of applications for recognition under the 2024, 2021, 2018, 2015 IBC under this criteria.

3.0 ADJUSTMENT PROCEDURE

3.1 Known Test Data: Where material strengths, properties, and dimensions of components used in the test assembly are known (provided in the test report under ASTM D1761), such data shall be used as required in ASTM D7147.

3.2 Unknown Test Data: Where the material strengths, properties, and dimensions of components in the test assembly are not known, the following values shall be used to determine the adjustment factors R_J, R_{HF}, R_{HT}, and R_S:

3.2.1 $F_{u\text{-}tested} = F_{u\text{-}spec} \times 1.27$

3.2.2 $t_{tested} = t_{spec}$

3.2.3 $G_{tested} = G_{nominal} \times 1.07$

3.2.4 $D_{tested} = D_{nominal} + 0.003$ inches

3.2.5 $F_{yb\text{-}tested} = F_{yb\text{-}nominal} \times 1.1$ (low- to medium-carbon steel nails)

$F_{yb\text{-}tested} = F_{yb\text{-}nominal} \times 1.4$ (hardened steel nails),

where D is the fastener diameter, in inches, and the other nomenclature above are as defined in ASTM D7147.

3.3 Ring Shank Nails: Where ring shank nails were used in the original test, the test values cannot be used within the context of this annex, unless the manufacturer's literature and evaluation report require the hanger to be installed with the same nails it was tested with.

3.4 Moisture Content: Where the test report contains the moisture content of wood members used in the test assembly, and where this moisture content is greater than the 11% threshold in Section 10.1 of ASTM D7147, such information may be used to determine the dowel bearing strength ($F_{em\text{-}tested}$) used in the determination of Z_{tested}, and compression perpendicular to grain ($F_{c\text{-}perp\text{-}tested}$), used to determine the adjustment factors R_J, R_{HF}, and R_{HT}, as follows:

3.4.1 $F_{em\text{-}tested}$ shall be the value determined by multiplying the dowel bearing capacity from Table 12.3.3 of the NDS based on G_{tested} as determined by Section 3.1 or 3.2, as required, multiplied by R_{FEM}, where R_{FEM} is calculated using the following equation:

$$R_{FEM} = \frac{49.95 - (1.186 \times MC_{tested})}{49.95 - (1.186 \times 11)}$$

where

MC_{tested} = recorded moisture content of respective test member in percent.

3.4.2 $F_{c\text{-}perp\text{-}tested}$ shall be the value determined using the equation 2250 x G_{tested} – 480 based on G_{tested} as determined by Section 3.1 or 3.2, as required, multiplied R_{FCP}, where R_{FCP} is calculated using the following equation:

$$R_{FCP} = \left(\frac{P_{12}}{P_g}\right)^{\left(\frac{11 - MC_{tested}}{M_p - 12}\right)}$$

where P_{12}, P_g and M_p are determined from the following table for the species or species combination of each wood member used in the test assembly:

Species or Species Combination	P_{12}	P_g	M_p
Douglas Fir-Larch	770	375	24
Southern Pine	790	390	21
Spruce-Pine-Fir	620	300	27
Hem-Fir	550	280	28

and where

P_{12} = Compression perpendicular to grain stress at the proportional limit at 12% moisture content (psi),

P_g = Compression perpendicular to grain stress at the proportional limit at green condition (psi), and

M_p = Intersection moisture content value (psi).

3.5 Structural Composite Lumber: Where structural composite lumber was used as the joist in the test setup in place of sawn lumber, the adjustment factor R_J may be taken to equal 1.00.

3.6 Application of Adjustments: The adjustment factors R_J, R_{HF}, R_{HT}, and R_{MC} shall be as calculated by Section 13 of ASTM D7147 taking into consideration the above assumptions. The overall adjustment factor applied to the test strength limit is as follows:

Overall adjustment factor = (lesser of R_J, R_{HF}, R_{HT}, and R_S) x R_{MC}.

ANNEX 2 (Applicable only for recognition under the 2021 IBC/IRC and earlier codes)

EVALUATION CRITERIA FOR PROPRIETARY DESIGNS AND ALTERNATE CONFIGURATIONS OF SHEET METAL TIES FOR ANCHORED MASONRY VENEER CONSTRUCTION

1.0 GENERAL

The IBC (through reference to TMS 402) and the IRC provide prescriptive physical characteristics and construction requirements for sheet metal ties for anchored masonry veneer construction. The airspace for such ties is limited to 1 inch. The purpose of this annex is to provide test requirements and evaluation criteria for sheet metal ties for anchored masonry veneer construction for the following non-prescriptive cases:

1.1 Sheet metal ties for anchored masonry veneer construction that comply with the code-specified physical characteristics of TMS 402-16 Section 12.2.2.5.1.1 or IRC 703.8.4.1 (0.03 in. thick) but are utilized with greater airspace than prescribed by the IBC and IRC.

1.2 Sheet metal ties for anchored masonry veneer construction that comply with the code-specified physical characteristics of TMS 402-16 Section 12.2.2.5.2.1 (0.06 in. thick).

1.3 Sheet metal ties for anchored masonry veneer construction that are of a proprietary physical design and intended for use with greater airspace than prescribed by the IBC and IRC.

2.0 TEST REQUIREMENTS

2.1 Corrugated Sheet Metal Ties for Airspace Greater than 1 inch: Corrugated sheet metal ties conforming to the requirements of TMS 402-16 Section 12.2.2.5.1.1 ($^{7}/_{8}$ in. x 0.03 in.) for installations with airspace greater than 1 inch (alternate configurations) shall be tested to determine capacities in the compressive and tensile direction as follows:

2.1.1 The compression and tension capacities of the tie shall be determined using the test setup similar to that shown in Figure 1 below.

2.1.2 Where a tie is of a design that is not adaptable to Figure 1, necessary test set-up departures shall be permitted provided the test setup departures are approved by ICC-ES.

2.1.3 Ties shall be tested in configurations consistent with end use installation conditions with attention to, but not limited to, the following details:

2.1.3.1 The sheet metal tie shall be fastened to the horizontal wood member, which simulates the wall stud, with the fastener specified by the manufacturer. The tie shall be connected to the vertical member of the test fixture, representing the masonry veneer, by any method suitable to ensure load transfer and hold the end of the tie in a vertical position. The connection shall be located a maximum of $1^{1}/_{2}$ inches from the end of the tie, representing the minimum required embedment into the masonry veneer.

2.1.3.2 Reference specific gravities for the horizontal wood test member shall be stated in the test report and shall be the basis of determining applicable species for wood framing member in the evaluation report.

2.1.3.3 The vertical test member shall be restrained from rotation. Other means of ensuring only vertical movement during testing shall be permitted provided they are approved by ICC-ES. The horizontal member shall be restrained to the test bed.

2.1.3.4 The tie shall be installed with the manufacturer-specified fastener and airspace value for which recognition is sought.

2.1.3.5 The airspace in the test shall be considered to be the vertical distance from the horizontal wood member and the bottom of the vertical member of the test fixture to which the tie is attached.

2.1.4 A minimum of three tests shall be performed for each combination of the tie and airspace configuration to be recognized.

2.1.5 The ultimate load and the load at 0.05 inches (1.2 mm) vertical movement of the vertical member shall be recorded for each test.

2.2 Sheet Metal Ties for Airspace Greater than 1 inch: Sheet metal ties for anchored masonry veneer conforming to TMS 402-16 Section 12.2.2.5.2.1 ($^{7}/_{8}$ in. x 0.06 in.) shall be tested in accordance with the following:

2.2.1 Compression and tension testing in accordance with Sections 2.1.1 through 2.1.5 above, and

2.2.2 Pull-out testing of ties from the mortar joint shall be tested in accordance with ASTM E754.

2.2.3 Push-through testing of ties into the mortar joint shall be tested in by means acceptable to and agreed upon by ICC-ES.

2.3 Proprietary Sheet Metal Ties for Airspace Greater than 1 inch: Proprietary sheet metal ties for anchored masonry veneer shall be tested in accordance with the following:

2.3.1 Compression testing in accordance with Sections 2.1.1 through 2.1.5 above.

2.3.2 Pull-out testing of ties from the mortar joint shall be tested in accordance with ASTM E754.

2.3.3 Push-through testing of ties into the mortar joint shall be tested in by means acceptable to and agreed upon by ICC-ES.

2.3.4 Tensile capacity of the tie shall be determined in accordance with AISI S100.

2.3.5 The tensile capacity of the tie and tie-to-wood member connection shall be tested in general accordance with Section 2.1 above and Figure 1, except that the vertical member shall be displaced in the upward (tension) direction.

3.0 ANALYSIS

3.1 Adjustment factor, R_{MT}: An adjustment factor, R_{MT}, for the allowable wall area supported by each tie or proposed configuration shall be determined from the testing required by Sections 2.1, 2.2.1, 2.3.1 and 2.3.5 of this Annex as follows:

3.1.1 The adjustment factor, R_{MT}, determined as the lesser of the two following ratios:

$$R_{MTUC} = U_C/125\ lb$$

$$R_{MT05C} = D_C/50\ lb$$

where:

U_C is the adjusted tested ultimate load (compression or tension) on the proprietary tie or alternate installation, in pounds

D_C is the average load at 0.05 inches displacement of the tie (relative displacement between the horizontal and vertical test members in Figure 1), in pounds

3.1.1.1 Where three specimens are tested, the ultimate load shall be the lowest of the three ultimate loads measured.

3.1.1.2 Where six specimens are tested, the average of the ultimate loads shall be used.

3.1.2 Where the tie is tested in both compression and tension, the lesser adjustment factor of the two test directions shall be used.

3.1.3 R_{MT} shall not exceed 1.0.

3.1.4 Spacing of ties around openings as required by IRC R703.8.4.1.1 and TMS 402 Section 12.2.2.5.6.4 shall be multiplied by the of the adjustment factor determined in Section 3.1.1, and shall be included in the evaluation report.

3.2 Tie and Mortar Joint Pull-out and Push-through Strength: The strength of tie pull-out or push-through of the mortar joint as required by Sections 2.2.2, 2.2.3, 2.3.2 and 2.3.3 shall be analyzed by either of the following:

3.2.1 The average adjusted ultimate pull-out or push-through strength shall not be less than 220 lb. with 5% accuracy and 75% confidence, or

3.2.2 The average adjusted pull-out or push-through strength shall not be less than the average ultimate strength of a comparative test using the same number of specimens of ties conforming to TMS 402-16 Section 12.2.2.5.1.1, in similar masonry construction, with 5% accuracy and 75% confidence.

3.3 Tie tensile capacity: The proprietary tie nominal tensile strength, required by Section 2.3.4, shall not be less than 220 lb.

3.4 Fastener to Wood: The fastener used for the wood connection shall be 8d common wire nail (0.131 in. diameter x 2 $^1/_2$ in. long) or other fastener with recognized withdrawal capacity equal to or exceeding that of the 8d common wire nail installed in the wood species (assigned specific gravity) for the evaluation report. For ties in which the nail hole size exceeds the fastener diameter by more than $^1/_{32}$ inch, nail-head pullover testing shall be conducted by means acceptable to and agreed upon by ICC-ES.

3.5 Adjustments to Test-based Values: Test based values shall be adjusted in accordance with ASTM D7147 Section 13.5, as applicable.

4.0 Other Requirements:

4.1 The airspace used in the test shall be used to establish the maximum airspace permitted for the tie. Where multiple airspaces are evaluated, interpolations shall not be permitted.

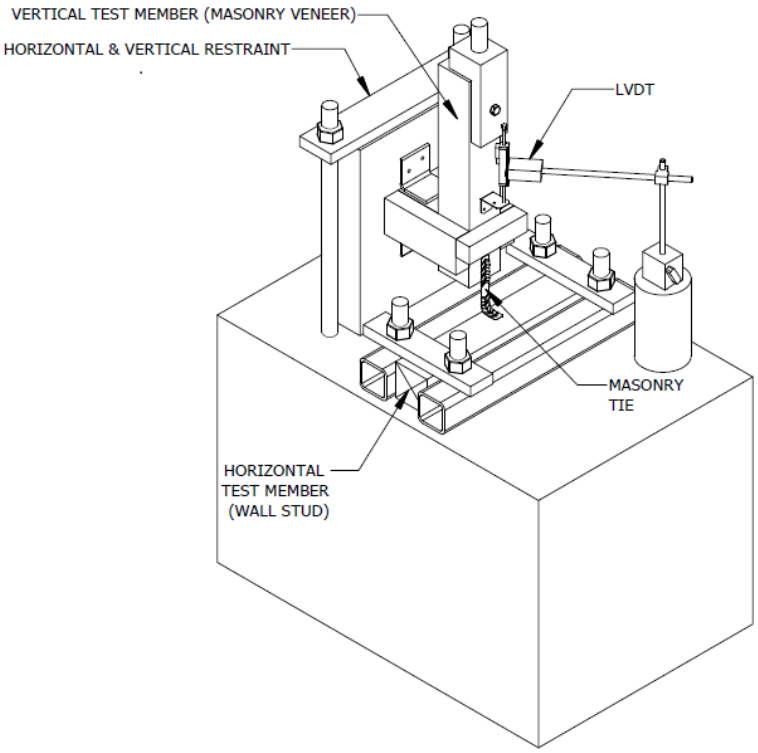
4.2 The evaluation report shall provide the maximum airspace and corresponding adjustment factor R_{MT} (or allowable supported area) for each tie or tie configuration.

4.3 The code-specified maximum horizontal and vertical tie spacing shall not be exceeded, and need not be adjusted.

4.4 The tie and wood fastener shall be corrosion resistant.

4.5 Vertical support of the anchored masonry veneer is not addressed by this criteria and must be in accordance with the applicable code.

4.6 Air space values evaluated under this criteria may not exceed 4 $^5/_8$ inches.



~~**Figure 1 - Test Setup for Testing of Anchored Masonry Veneer Ties**~~

APPENDIX A
EVALUATIONS UNDER THE 2012, 2009, AND 2006 IBC AND IRC

A1.0 INTRODUCTION

A1.1 Purpose: The purpose of this criteria is to establish requirements for ICC Evaluation Service, LLC (ICC-ES), recognition of joist hangers, framing anchors, `hurricane ties' and similar devices under Section 2303.5 of the 2012, 2009 and 2006 *International Building Code*® (IBC), and Section R104.11 of the 2012, 2009 and 2006 *International Residential Code*® (IRC).

The reason for the development of this criteria is to provide a guideline for the evaluation of joist hangers and similar devices, since the IBC and IRC and associated reference standards do not specify installation and quality requirements for these products.

A1.2 Scope: The devices are used to support or attach wood members, such as joists, rafters, trusses, purlins, beams, girders, plates, posts, studs and headers, to wood, metal, concrete or masonry. Attachment may be by means of mechanical fastenings (nails, spikes, lag screws, wood screws, bolts, etc.)

A "device," as the word is used in this criteria, may consist of one or more pieces or units so arranged as to transfer load vertically or laterally, within safe limits, from the end of a supported member (hereinafter referred to as a "joist") to a supporting member (hereinafter referred to as a "header").

A1.3 Codes and Referenced Standards:

A1.3.1 2012, 2009 and 2006 *International Building Code*® (IBC), International Code Council.

A1.3.2 2012, 2009 and 2006 *International Residential Code*® (IRC), International Code Council.

A1.3.3 ANSI/AF&PA National Design Specification for Wood Construction (NDS) and Supplement, American Forest & Paper Association. (Refer to Table A1 of this acceptance criteria for edition date.)

A1.3.4 ASTM D1761-88(2000)$^{\varepsilon 1}$, Test Methods for Mechanical Fasteners in Wood, ASTM International.

A1.3.5 ASTM D7147-05, Standard Specification for Testing and Establishing Allowable Loads of Joist Hangers, ASTM International.

A2.0 BASIC INFORMATION AND TEST REPORTS

A2.1 General: The following information shall be submitted:

A2.2 Product Description: Complete information pertaining to components, material specifications, and manufacturing processes. Materials shall comply with an appropriate recognized national standard(s).

A2.2.1 Installation Instructions: Installation details and drawings, noting installation requirements and/or limitations.

A2.2.2 Identification: Description of the method of identifying the product. Each device shall bear an imprint which clearly identifies the manufacturer. A registered trademark may serve as such identity. Labeling shall also include the ICC-ES evaluation report number.

A2.2.3 Testing Laboratories: Testing laboratories shall comply with Section 2.0 of the ICC-ES Acceptance Criteria for Test Reports (AC85) and Section 4.2 of the ICC-ES Rules of Procedure for Evaluation Reports.

A2.2.4 Test Reports: Test reports shall comply with AC85. All test reports shall be prepared by an independent testing laboratory in accordance with Section 4.2 of the ICC-ES Rules of Procedure for Evaluation Reports. Test reports shall include a complete description of devices tested; the dimensions of the specimens; the number, size, type, and method of installing fastenings; type of failure; and such other data as may be pertinent.

A2.2.5 Sampling: Test specimens shall be sampled in accordance with Section 3.0 of AC85.

A3.0 TEST AND PERFORMANCE REQUIREMENTS

A3.1 General: A qualification test plan shall be submitted to and approved by ICC-ES staff prior to any testing being conducted. Every device shall be rated for direct (vertical) capacity under Allowable Stress Design (ASD) in accordance with Section A3.2 or A3.3 of this criteria. Joist hangers also shall be rated for torsional moment capacity in accordance with Section A3.4 of this criteria. Devices installed utilizing smooth shank stainless steel nails shall be tested with smooth shank stainless steel nails.

A3.2 Direct (Vertical) Load Capacity Tests: The testing procedure to establish direct load capacity shall be in accordance with ASTM D1761 and conform to the following provisions:

A3.2.1 A minimum of three test specimens for each size of device shall be tested. If the ultimate load for any one of the test specimens varies more than 20 percent from the average, three additional tests shall be conducted.

A3.2.2 A test specimen shall consist of an assembly of a joist and two headers of appropriate size fastened together by a device to be tested, as illustrated in Figure 7 of ASTM D 1761. The minimum length for joists and headers shall be 18 inches (457 mm). The joist length need not exceed 24 inches (610 mm). Headers shall have a length sufficient to provide the intended hanger-to-header contact for the hanger, that is, space for nailing and bearing as applicable.

For devices not readily adaptable to such assembly, an alternate assembly producing comparable results may be used.

For `hurricane ties', as defined in Section 3.5.1, the test setup shall consist of an assembly of a joist (rafter, roof joist, or roof truss) and two double top plates of 2×4 lumber, fastened together by a device to be tested, as illustrated in Figures 1, 2, and 3 of this criteria. The joist shall be a single member unless the hurricane tie is designed to be installed onto multiple-ply members. Blocking is permitted to be installed between the top plates to prevent inward rotation of the top plates. When determining allowable loads for a single hurricane tie, one such tie shall be installed at each end of the joist. When testing for uplift loads in accordance with Figure 1, the following shall apply: the top plates shall be a minimum of 18 inches (457 mm) apart; the joist shall be located beneath the top plates; and the joist shall not be supported vertically at any time during the test by anything other than the hurricane tie. Testing in accordance with

Figures 2 and 3 for the determination of lateral load capacity parallel and perpendicular to the top plates is optional. Test setups shall be in agreement with the end-use conditions of the evaluation report in general agreement with the requirements of Section 3.5 of this criteria.

A3.2.3 The species of lumber used shall have a specific gravity not greater than 0.55 as determined in accordance with the NDS.

A3.2.4 The moisture content at time of test shall be greater than 11 percent.

A3.2.5 A specimen, when inserted in the testing machine, shall have the top of the joist level, and the sides vertical. Except for the restraint provided by the device, the joist shall be unrestricted for vertical movement. For testing of hurricane ties, the tie is permitted to be restrained from rotation provided the restraint does not restrict vertical movement and the tie is not intended to prevent rotation when installed.

A3.2.6 A dial gauge reading to 0.001 inch (0.0254 mm) shall be used for the measurement of vertical movement of the joist with respect to the headers.

A3.2.7 For testing joist hangers and similar devices, an initial load, ranging from 5 to 20 percent of ultimate load, shall be applied to the joist to seat the test assembly. This load shall then be removed and the gauges shall be set to zero and so recorded, with the amount of the initial load. For testing of hurricane ties, an initial load, or preload, shall not be applied for any tests.

A3.2.8 Load shall be applied at either a uniform crosshead rate between 0.03 to 0.10 inch (0.8 to 2.5 mm) per minute, or at a rate of loading which will result from approximately this machine head speed. The rate of loading shall be reported with the test data.

A3.2.9 Both load and gauge readings shall be recorded at appropriate intervals of load.

A3.2.10 Test results may be presented in tabular form or by means of a graph.

A3.2.11 For compliance with the applicable code, each device shall be rated for direct load (vertical) capacity at the lowest value determined from the following:

A3.2.11.1 The allowable vertical load for a normal duration of loading of the joist hanger or similar device shall be the lowest value determined from tests using the criteria given in Sections A3.2.11.1.1 through A3.2.11.1.3.

A3.2.11.1.1 The lowest ultimate vertical load for a single device from any test divided by 3 (where three tests are conducted and each ultimate vertical load does not vary more than 20 percent from the average ultimate vertical load).

A3.2.11.1.2 The average ultimate vertical load for a single device from all tests divided by 3 (where six or more tests are conducted).

A3.2.11.1.3 The average from all the tests of the vertical load that produces a vertical movement of the joist with respect to the header of 0.125 inch (3.2 mm).

A3.2.11.2 The device shall have a direct load capacity rating no greater than calculated in accordance with the NDS for nails or other fasteners utilized to attach the joist hanger or similar device to the wood members and allowable bearing loads that contribute to the capacity of the hanger.

A3.2.11.3 The device shall have a direct load capacity rating no greater than the allowable design load determined in accordance with the NDS for the wood members forming the connection.

A3.3 Alternative Test Method for Direct (Vertical) Load Capacity Testing: As an alternative to ASTM D 1761, the provisions of ASTM D 7147 may be followed to establish direct load capacity, provided that analysis of test data and derivation of allowable loads are in accordance with Sections 13, 14 and 15 of ASTM D 7147.

A3.4 Torsional Moment Capacity Test for Joist Hangers:

A3.4.1 The torsional moment capacity for the joist hanger shall be determined in accordance with ASTM D 1761. At least three specimens of each size of device shall be tested. Specimens shall be prepared and tested in a manner that will show the torsional moment in inch-pounds required to deflect either the top or bottom of the joist 0.125 inch (3.2 mm) from its initial position, provided the moment is applied by rotating the joist at a distance of not less than 12 inches (305 mm) from the device.

EXCEPTION: Hangers supporting glued-laminated beams or hangers specifically designed to support only prefabricated wood I-joists.

A3.4.2 The torsional moment capacity rating of the device shall be the average torsional load at which the lateral movement of the top or bottom of the joist with respect to the original position of the joist is 0.125 inch (3.2 mm), such load to be the average for three or more tests.

A3.4.3 Every device supporting a joist shall have a torsional moment capacity of not less than 75 pounds (334 N) times the depth of the joist.

A4.0 ANALYSIS DETAILS

A4.1 Compression Perpendicular to Grain: When the transfer of loads on the joist to the header is accomplished primarily by means of compression perpendicular to grain of the wood against the device, the allowable loads specified in the NDS shall not be exceeded.

A4.2 Fastener Values: When the transfer of loads on the joist to the header is accomplished primarily by means of fasteners in wood, the allowable strength of fasteners specified in the NDS shall not be exceeded.

A4.3 Multiple Devices: When more than one device is used at a joint, the devices shall be capable of operating in unison.

A4.4 Provision for Shrinkage: Dimensions of devices, or methods of installation, shall make appropriate provisions for shrinkage of joist relative to header.

A4.5 Design Value Modifications for Joist Hangers or Similar Devices: Allowable design values for joist hangers or similar devices that are determined by calculation (Sections A3.2.11.2 and A3.2.11.3) shall be permitted to be modified by the appropriate duration of loading factors as specified in the NDS, except when limited by a test-based design value. Allowable design values determined by test results (Section A3.2.11.1) shall not be modified by duration of load factors.

A4.6 Smooth Shank Stainless Steel Nails: Reference nail withdrawal design values of smooth shank stainless steel nails shall be determined in accordance with Section 12.2.3.1(b) of the 2018 NDS or an ICC-ES evaluation report for proprietary smooth shank stainless steel nails, as applicable.

A5.0 MATERIALS AND WORKMANSHIP

Materials shall be of uniform quality and shall comply with the provisions of each applicable code when specified, otherwise material shall be limited to the following:

A5.1 Minimum thickness of steel shall be as follows:

Sheet—No. 18 gage, U.S. Standard Gage.

Wire—No. 18 gage, U.S. Steel Wire Gage.

EXCEPTIONS:

1. Face-mounted joist hangers, supporting 2-by-4, 2-by-6, 2-by-8, and 2-by-10 wood joists or rafters, may be fabricated from minimum No. 20 gage sheet steel provided applicable sections of this criteria are complied with.
2. `Hurricane ties' and similar devices may be fabricated from minimum No. 22 gage sheet steel provided applicable sections of this criteria are complied with.

A5.2 Steel shall be corrosion-resistant or shall be protected by galvanizing, electroplating, or with approved steel primer.

A5.3 The device, after forming, shall evidence no fracturing in either the protective coating or the base metal.

A5.4 The radius of a 90-degree bend intended to fit the corner of a joist or header shall be no greater than two times the thickness of the steel.

A6.0 QUALITY CONTROL

A6.1 General: For factory-welded joist hangers and similar devices, quality documentation and inspections shall be in accordance with Section A6.2. For all other joist hangers and similar devices, quality documentation and inspections shall be in accordance with Section A6.3.

A6.2 Factory-welded Joist Hangers and Similar Devices:

A6.2.1 Quality documentation complying with the ICC-ES Acceptance Criteria for Quality Documentation (AC10) shall be submitted for each facility manufacturing or labeling products that are recognized in the ICC-ES evaluation report.

A6.2.2 A qualifying inspection shall be conducted at each manufacturing facility when required by the ICC-ES Acceptance Criteria for Inspections and Inspection Agencies (AC304).

A6.2.3 Third party follow-up inspections are required under this acceptance criteria for factory-welded joist hangers and similar devices.

A6.3 Joist Hangers and Similar Devices Without Welds:

A6.3.1 Quality documentation complying with the ICC-ES Acceptance Criteria for Quality Documentation (AC10) shall be submitted for each facility manufacturing or labeling products that are recognized in the ICC-ES evaluation report.

A6.3.2 A qualifying inspection shall be conducted at each manufacturing facility in accordance with the requirements of the ICC-ES Acceptance Criteria for Inspections and Inspection Agencies (AC304).

A6.3.3 An annual inspection shall be conducted at each manufacturing facility in accordance with AC304.■

TABLE A1—REFERENCED STANDARDS

STANDARD	DATE OF STANDARD			
	2012 IBC	2009 and 2006 IBC	2012 IRC	2009and 2006 IRC
ANSI/AF&PA National Design Specification for Wood Construction (NDS) and Supplement	2012	2005	2012	2005