



**INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS
UNIFORM EVALUATION SERVICES**

**EVALUATION CRITERIA
FOR
COMPOSITE STEEL SHEET AND NONCOMBUSTIBLE SHEATHING PANELS**

EC 012-2022

Revised January 2022 (Adopted May 2013, Revised January 2016, January 2020)

1.0 INTRODUCTION

1.1 Purpose:

This Evaluation Criteria establishes requirements for the use of combustible or noncombustible sheathing adhered to steel sheets as composite panels in floors and roofs. Products so evaluated shall be recognized in an evaluation report independently reviewed by an evaluation service agency under the 2021, 2018, and 2015 *International Building Code*® (IBC), 2021, 2018, and 2015 *International Residential Code*® (IRC), and the 2019 *California Building Code*® (CBC). Bases of recognition are IBC Section 104.11, IRC Section R104.11, and CBC Section 104.11.

1.2 Scope:

This Evaluation Criteria is applicable to composite floor and roof panels that support minimum code specified vertical and horizontal design loads for building and other structures, including diaphragms transferring in-plane forces to the lateral force-resisting system, providing fire-resistance, control sound transmission, and thermal transmittance. Composite panels consisting of sheathing adhered to sheet steel are fastened to cold-formed steel construction with steel self-drilling tapping screws or power-actuated fasteners.

Components of the structural assembly include the composite panels, and either steel self-drilling tapping screws or power-actuated fasteners. When proprietary components are used in the structural assembly, each of the proprietary components shall be listed in a separate product evaluation report from an ISO/IEC 17065 certification body accredited by an accreditation body conforming to ISO/IEC 17011 or other nationally recognized certification programs, which is accepted by the evaluation service agency for the intended use. Screws and fasteners shall be approved for use in connecting the composite panels to cold-formed steel construction.

1.3 Definitions:

The following terms shall have the meaning as indicated. Terms not defined in this Evaluation Criteria shall have the ordinarily accepted meaning for the context intended.

Composite panel is a proprietary building component consisting of combustible or noncombustible sheathing adhered to steel sheets.

Combustible or Non-combustible sheathing is a proprietary sheet product formed from a composition of one or more of the following ingredients: magnesium oxide, magnesium chloride, cement, sand, lime, nylon, fiberglass and other types of mesh material, a binding agent, specialized additives, wood shavings, recycled board scraps, gypsum, adhesive or water. Panels are normally produced in 4-foot (1.2 m) widths and 4, 8, 9, 10, and 12 foot (1.2, 2.4, 2.7, 3.0, and 3.6 m) lengths in thicknesses from 1/8 to 1 inch (3.2 mm to 25.4 mm).



Power-actuated fastener is a forced-entry, nail-like fastener designed to attach one material to another, characterized by a round (smooth or knurled) steel-wire shank with an upset head at one end and a point at the other end of the shank. Fasteners are typically hardened for penetrating steel and installed with a power tool reliant on compressed air or other gas.

Self-drilling tapping screw is an externally threaded fastener with the ability to drill its own hole and form or cut its own internal mating threads into metal without deforming its own threads or breaking during assembly.

2.0 REFERENCED STANDARDS:

Standards referenced in this criteria shall be applied consistent with the specific edition of the code(s) for which the Evaluation Report is prepared unless otherwise approved by the evaluation service agency.

2.1 American Iron and Steel Institute

- AISI S100, North American Specification for the Design of Cold-Formed Steel Structural Members
- AISI S905, Test Methods for Mechanically Fastened Cold-Formed Steel Connections
- AISI S907, Test Standard for Cantilever Test Method for Cold-Formed Steel Diaphragms

2.2 American Society of Mechanical Engineers

- ANSI/ASME B18.6.4-98, Standard Specification for Thread Forming and Thread-Cutting Screws
- ANSI/ASME B18.18-11 Quality Assurance for Fasteners

2.3 ASTM International

- ASTM A370-19e1 Standard Test Method for Steel Sheets
- ASTM A924/A924M, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process ASTM C954, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness
- ASTM C1002, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
- ASTM C1513, Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections
- ASTM E72-10 Standard Test Methods of Conducting Strength Tests of Panels for Building Construction
- ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
- ASTM E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
- ASTM E119, Standard Test Methods for Fire Tests of Building Construction and Materials
- ASTM E136, Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C.
- ASTM E413-10, Classification for Rating Sound Insulation
- ASTM E455-11, Standard Method for Static Load Testing of Framed Floor or Roof Diaphragm Constructions for Buildings
- ASTM E492, Standard Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine
- ASTM E989-06 Standard Classification for Determination of Impact Insulation Class (IIC)
- ASTM E2322-03 (2009) Standard Test Method for Conducting Traverse and Concentrated Load Tests on Panels used in Floor and Roof Construction

2.4 International Code Council

- 2021, 2018, and 2015 *International Building Code*® (IBC), International Code Council (ICC)
- 2021, 2018, and 2015 *International Residential Code*® (IRC), International Code Council (ICC)
- 2019 California Building Code® (CBC)

2.5 International Organization for Standardization

- ISO/IEC 17011:2017 Conformity assessment - General requirements for accreditation bodies accrediting conformity assessment bodies

- ISO/IEC 17020:2012 Conformity Assessment - Requirements for the Operation of Various Types of Bodies Performing Inspection
- ISO/IEC 17025:2017 General Requirements for the Competence of Testing and Calibration Laboratories
- ISO/IEC 17065:2012 Conformity assessment - Requirements for bodies certifying products, processes and services

2.6 Underwriters Laboratories, Inc.

- UL 263, Standard for Fire Tests of Building Construction and Materials
- UL 723, Standard for Surface Burning Characteristics of Burning Materials.

3.0 BASIC INFORMATION:

3.1 Roof and Floor Assembly Description:

Descriptions of assemblies shall include all components and provide the following information for each component as shown below where applicable:

3.1.1 Self-Drilling Tapping Screw:

- a. Product evaluation report from an ISO/IEC 17065 certification body (evaluation service agency) accredited by an accreditation body conforming to ISO/IEC 17011 or other nationally recognized certification programs, which is accepted by the evaluation service agency for the intended use.
- b. Identification of specific fastener to be used.
- c. Installation instructions that show required fastener spacing, depth of penetration, and edge distances.
- d. Packaging and product identification information.

3.1.2 Power-Actuated Fastener:

- a. Product evaluation report from an ISO/IEC 17065 certification body accredited by an accreditation body conforming to ISO/IEC 17011 or other nationally recognized certification programs, which is accepted by the evaluation service agency for the intended use.
- b. Identification of specific fastener to be used such as manufacturer's name, trade name, brand name, and the power-driven pin catalog number.
- c. Installation instructions, including minimum fastener spacing, depth of penetration, and end distances.
- d. Packaging and product identification information.

3.1.3 Combustible or Non-Combustible Sheathing:

- a. Product evaluation report from an ISO/IEC 17065 or certification body accredited by an accreditation body conforming to ISO/IEC 17011 or other nationally recognized certification programs, which is accepted by the evaluation service agency for the intended use.
- b. Identification of specific sheathing to be used such as manufacturer and product name, thickness, width and length of sheets with dimensional tolerances, and if applicable, product standard.
- c. Installation instructions that show required fastener spacing, depth of penetration, and edge distances.
- d. Packaging and product identification information.

3.1.4 Panel Steel Sheet to Sheathing Adhesive:

- a. Chemical and physical properties of adhesive used to bond sheet steel to non-combustible sheathing as defined within the submitted quality documentation.
- b. Description of means and methods for installation of adhesive to sheathing including thickness, application rate, cure time, temperature and humidity ranges, and installation pressures.
- c. Shelf and open container life expectancy.

3.1.5 Flat Steel Sheet (Adhered to Non-Combustible Sheathing):

- a. Standard specification number and grade (designated minimum yield strength) of steel in conformance with the applicable edition of AISI S100 based on the desired edition of the IBC, IRC, or CBC.

- b. Chemical, mechanical, and coating properties.
- c. The ratio of specified to actual tensile and yield strengths.
- d. Base sheet steel thickness exclusive of coatings.

3.1.6 Cold-Formed Steel Construction of Supporting Members:

- a. Standard specification number and grade (designated minimum yield strength) of steel used in conformance with the applicable edition of AISI S100 based on the desired edition of the IBC, IRC, or CBC.
- b. Chemical, mechanical, and coating properties.
- c. The ratio of specified to actual tensile and yield strengths.
- d. Base steel thickness exclusive of coatings.
- e. Four-part product designator for joists and rafters that identifies web depth, flange width, style, and thickness.

3.1.7 Roof and Floor Assemblies:

- a. Details, drawings, and cross-sections illustrating tested assemblies.
- b. Fastener spacing, depth of penetration, and edge distances.
- c. Description of method of packaging and field identification as an approved product.
- d. Storage, material safety, and handling requirements.
- e. Allowable uniform and as applicable, concentrated gravity loads for roof and floor sheathing.
- f. Allowable shear resistance, aspect ratio limitations, and design deflections as a horizontal diaphragm.
- g. Orientation of composite panels to supports and adjacent panels, including whether joints coincide or are staggered.
- h. Span rating and the ability for use as combined sheathing and underlayment when applicable.
- i. Range of assemblies tested for variations in construction methods that affect tested outcomes for structural, fire, thermal, or sound control properties.
- j. Optional characteristics of fire-resistance rating, coefficient of thermal transmittance (U-factor), sound transmission class (STC), and impact insulation class (IIC) of any related assemblies.

3.2 Test Reports:

Test reports shall include all of the applicable information required in Section 3.1, the applicable test standard, UES Test Report Requirements Procedure No. ES-025, and the following:

- a. Detailed description and documentation of test setup and specimens.
- b. Test standard with the date of issue and an explanation of any deviation from the standard.
- c. Description of failure mode.
- d. Method and amount of product sampling from the manufacturing site.
- e. Identity of the personnel from the accredited laboratory who conducted or witnessed and verified construction of the assemblies.
- f. Certificate showing laboratory is accredited as complying with ISO/IEC Standard 17025 for the testing reported by an accreditation body conforming to ISO/IEC 17011 that is a signatory to the International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Arrangement (MRA).

3.3 Engineering Assessment:

Proposed structural performance properties shall be prepared and sealed by a registered design professional. Such properties include vertical load capacities, horizontal diaphragm in-plane shear load capacities, and load-deformation relationships. The assessment shall propose structural design values for use with Allowable Stress Design (ASD) and Load and Resistance Factor Design (LFRD) and may include equivalent values for Limit States Design (LSD). The assessment shall also establish equations to determine diaphragm deflection. Such equations shall reasonably fit the test data for the load-deformation relationship.

Proposed structural properties shall be based on appropriate factors of safety, scaling of results to similar materials, and adjustments for overstrength of tested materials. Structural properties shall also consider contributing terms appropriate for the specific products and influence of aspect ratio ranges, framing member spacing, steel thickness in flat sheet and framing members, composite panel orientation, type, slip, and location of fasteners, beam characteristics of the horizontal diaphragm and material strengths.

When the shear capacity of the diaphragm will be established for intermediate panel configurations between boundaries of tested panel configurations, the strength of fasteners in the composite panel shall be calculated in accordance with AISI S905 for each combination of sheathing thickness(es), maximum metal thickness, and fastener type and size tested, for which recognition is sought.

4.0 TESTING AND PERFORMANCE REQUIREMENTS:

4.1 General:

Test plans shall be submitted to the evaluation service agency for review and approval prior to testing.

4.2 Fasteners:

Self-drilling tapping screws and power-actuated fasteners shall comply with the requirements of this section.

4.2.1 Self-drilling tapping screws: Screws shall demonstrate compliance with or equivalence to one of the following test standards: ASTM C954, ASTM C1002, or ASTM C1513. Screws shall be listed in a product evaluation report from an ISO/IEC 17065 certification agency body accredited by an accreditation body conforming to ISO/IEC 17011 or other nationally recognized certification programs, which is accepted by the evaluation service agency.

4.2.2 Power-actuated fasteners: Power-actuated fasteners shall demonstrate compliance with the proprietary specifications as verified by qualification tests performed at the manufacturing location that is part of an ongoing quality control program and be listed in a product evaluation report from an ISO/IEC 17065 certification agency body accredited by an accreditation body conforming to ISO/IEC 17011 or other nationally recognized certification programs, which is accepted by the evaluation service agency.

4.3 Combustible or Non-Combustible Sheathing:

The Combustible or Non-combustible sheathing manufacturer shall demonstrate compliance with the proprietary specifications as verified by qualification tests performed at the manufacturing location that is part of an ongoing quality control program. Surface burning characteristics in accordance with ASTM E84 or UL 723 shall be established and comply with interior finish requirements in IBC Section 803.1.1. Combustible or Non-combustible sheathing shall be listed in a product evaluation report from an ISO/IEC 17065 accredited certification body or other nationally recognized certification program accepted by the evaluation service agency.

4.4 Flat Sheet Steel:

Flat sheet steel shall demonstrate compliance with the specified standard and grade for which recognition is sought. Testing may be conducted by the mill or a testing laboratory complying with Section 3.2.f of this criteria. Where the number of steel coupon specimens is not noted in the specific standard, a minimum of three steel coupon specimens shall be tested to show compliance with the appropriate standard and to determine the minimum uncoated steel thickness and strength. Steel tension tests and elongation calculations shall be performed in accordance with ASTM A370.

4.5 Cold-Formed Steel Supporting Members:

Cold-formed steel support members shall demonstrate compliance with the specified standard and grade for which recognition is sought as verified by qualification tests performed at the manufacturing location that is part of an ongoing quality control program. Testing may be conducted by the mill or a testing laboratory complying with Section 3.2.f of this criteria. Tests shall verify steel thickness, yield, and tensile strengths, total elongation, chemical composition, and protective coating type and thickness. Cold-formed steel supporting members shall be listed in a product evaluation report from an ISO/IEC 17065 certification body accredited by an accreditation body conforming to ISO/IEC 17011 or other nationally recognized certification programs, which is accepted by the evaluation service agency.

4.6 Structural Performance:

Structural composite assemblies shall be tested for their intended end use and approval as horizontal diaphragms and underlayment, floor or roof assemblies as shown below shall be tested and evaluated for each variation in components that significantly affects test results as shown in the engineering assessment:

4.6.1 Diaphragm Shear Strength and Stiffness (Mandatory):

Diaphragm testing shall be performed in accordance with AISI S907 or ASTM E455. The scope of the testing shall bound the range of variable component values for composite panel thickness (sheet steel and/non-combustible sheathing); material strengths; spacing and base steel thickness of steel framing members; type, spacing, and edge distance of sheathing fasteners; and the orientation of panels for which recognition is sought in the evaluation report.

4.6.2 Fastener Strength (Optional):

When the shear capacity of the diaphragm will be established for intermediate panel configurations between boundaries of tested panel configurations, the strength of fasteners in the composite panel shall be tested in accordance with AISI S905. Each combination of sheathing thickness(es), maximum metal thickness(es), and fastener type and size, for which recognition is sought shall be tested. The loads applied to the connection and fastener slip shall be measured.

4.6.3 Floor or Roof Sheathing (Optional):

When the sheathing component is not already approved for supporting vertical floor and roof loading, in the IBC, IRC, CBC, or a product evaluation report accepted by the evaluation service agency, the composite panels shall be tested to determine the following load capacities:

4.6.3.1 Concentrated Live loads:

Composite Panels shall be tested in accordance with ASTM E2322 for optional concentrated live load capacity. The concentrated load shall be applied over an area measuring a minimum of 2½ feet (762 mm) square. The load shall be applied at the most critical location. Multiple tests may be necessary to determine the critical location.

4.6.3.2 Uniform Live loads:

Composite Panels shall be tested in accordance with ASTM E2322 for uniform load capacity.

4.7 Fire-Resistance Ratings (Optional):

Values for fire-resistance-rated roof and floor-ceiling assemblies shall be established by tests conducted in accordance with ASTM E119. or UL 263

4.8 Noncombustible Classification (Optional):

Classification for the structural composite assembly as noncombustible shall be established by tests conducted in accordance with ASTM E136 at an age of 28 days after manufacture. Tests shall be conducted on the sheathing component alone.

4.9 Sound Controlled Assemblies (Optional):

Values for sound-controlled assemblies shall be established by tests conducted in accordance with ASTM E90 and ASTM E413 for airborne sound insulation (STC) and ASTM E492 and ASTM E989 (for impact sound insulation (IIC)).

5.0 QUALITY CONTROL

5.1 Quality documentation complying with the UES Review Procedures for Certified Manufacturer's Quality Management Systems (UES-010) or equivalent shall be submitted.

5.2 Inspections of manufacturing facilities are required for this product by the evaluation service agency or an accredited inspection agency. The inspection agency shall be accredited in accordance with ISO/IEC 17020 by an accreditation body conforming to ISO/IEC 17011.

6.0 EVALUATION REPORT RECOGNITION

Evaluation reports shall include the following information:

6.1 Basic summary product information, including assembly and component description, installation procedures, and packaging and identification. Identification shall include, as a minimum, the manufacturer's name and address, product name, the evaluation service agency logo, and the evaluation report number,

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- 6.2** Structural design values for use with Allowable Stress Design (ASD), or Load and Resistance Factor Design (LFRD) with the appropriate limits and exceptions. Values shall address uniform, optional concentrated vertical live loads and deflections and in-plane shear load and deflection capacities for each assembly type proposed.
 - 6.3** Equations to determine diaphragm deflection with contributing terms appropriate for the specific products and influence of aspect ratios, framing member spacing, the thickness of steel in flat sheet and framing members, type and location of fasteners, fastener slip and beam characteristics of the horizontal diaphragm, and material strengths.
 - 6.4** Statement that diaphragm analysis shall comply with applicable requirements in Chapters 16, 17, and 23 of the IBC or CBC.
 - 6.5** Surface burning characteristics.
 - 6.6** Optional fire-resistance rating, roof classification, combustibility, and sound control properties if tested and limits of construction type and uses if not tested.