



CERTIFICATION



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Technical Evaluation Report

TER 1703-02

Starborn® Structural H19 Screws: Truss
or Rafter to Top Plate and Bottom Plate
to Rim Board

Starborn® Industries, Inc.

Product:

Starborn® Structural H19 screws

Issue Date:

November 7, 2019

Revision Date:

October 11, 2020

Subject to Renewal:

January 1, 2021

**COMPANY
INFORMATION:**

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DIVISION: 06 00 00 - WOOD, PLASTICS AND COMPOSITES

SECTION: 06 05 23.13 - Nails

1 PRODUCT EVALUATED¹

- 1.1 Starborn® Structural H19 screws

2 APPLICABLE CODES AND STANDARDS^{2,3}**2.1 Codes**

- 2.1.1 *IBC—12, 15, 18: International Building Code®*
- 2.1.2 *IRC—12, 15, 18: International Residential Code®*

2.2 Standards and Referenced Documents

- 2.2.1 *AISI S904: Standard Test Methods for Determining the Tensile and Shear Strengths of Screws*
- 2.2.2 *ANSI/AWC NDS: National Design Specification (NDS) for Wood Construction*
- 2.2.3 *ASTM A153: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware*
- 2.2.4 *ASTM A510: Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel*
- 2.2.5 *ASTM D1761: Standard Test Methods for Mechanical Fasteners in Wood*
- 2.2.6 *ASTM F1575: Standard Test Method for Determining Bending Yield Moment of Nails*
- 2.2.7 *AWC TR 12: General Dowel Equations for Calculating Lateral Connection Values*

¹ Building codes require data from valid [research reports](#) be obtained from [approved sources](#). An [approved agency](#), which is an [approved source](#), is defined as “an established and recognized agency that is regularly engaged in...furnishing product certification where such agency has been approved...” Being [approved](#), defined as “acceptable to the [building official](#),” is accomplished via accreditation using ISO/IEC 17065 evaluation procedures meeting code requirements of [independence](#), [adequate equipment](#), and [experienced personnel](#). DrJ is an ISO/IEC 17065 [ANSI-Accredited Product Certification Body – Accreditation #1131](#).

Through ANSI accreditation, DrJ certification can be used to obtain product approval in any country that is an [IAF MLA Signatory](#) and covered by an [IAF MLA Evaluation](#) per the [Purpose of the MLA](#) – “certified once, accepted everywhere.” Manufacturers can go to [jurisdictions](#) in any IAF MLA Signatory Country and have their products readily approved by authorities having jurisdiction using DrJ’s ANSI accreditation.

For more information on any of these topics or our mission, product evaluation policies, product approval process, and engineering law, see drjcertification.org.

² Unless otherwise noted, all references in this TER are from the 2018 version of the codes and the standards referenced therein (e.g., [ASCE 7](#), [NDS](#), [ASTM](#)). This material, design, or method of construction also complies with the 2000-2015 versions of the referenced codes and the standards referenced therein. As required by [code](#), where this TER is not approved, the [building official](#) shall respond in writing stating the reasons this TER was not [approved](#). For any variations in state and local codes, see Section 8.

³ All terms defined in the applicable building codes are italicized.

3 PERFORMANCE EVALUATION

- 3.1 Starborn® Structural H19 screws were evaluated, using assembly tests to derive allowable design values, as an alternate means of attaching metal plate connected wood trusses and rafters to the tops of walls for the purpose of providing uplift and lateral load resistance. Starborn® Structural H19 screws were also evaluated as an alternative means of attaching wall bottom plates to the rim board. The following conditions were evaluated:
 - 3.1.1 Withdrawal strength for use as an alternative to toe-nail connections, metal hurricane and seismic clips/straps, or nails in tension (uplift) loaded applications.
 - 3.1.2 Shear strength for use as an alternative to toe-nail connections, hurricane and seismic clips/straps, or nails in shear (lateral) loaded applications either parallel or perpendicular to wood grain.
 - 3.1.3 Head pull through strength for use as an alternative to toe-nail connections, hurricane and seismic clips/straps or nails in tension (uplift) loaded applications.
- 3.2 Connections other than those addressed in Section 3 are outside the scope of this TER.
- 3.3 Use of fasteners in locations exposed to saltwater or saltwater spray is outside the scope of this TER.
- 3.4 Any code compliance issues not specifically addressed in this section are outside the scope of this TER.
- 3.5 Any engineering evaluation conducted for this TER was performed on the dates provided in this TER and within DrJ's professional scope of work.

4 PRODUCT DESCRIPTION AND MATERIALS

4.1 General

- 4.1.1 Starborn® Structural H19 screws are alternate dowel-type threaded fasteners designed for use in wood to-wood connections. The following fasteners are evaluated in this TER:

TABLE 1. STARBORN® STRUCTURAL FASTENER DESIGNATION AND PRODUCT NAME

Product Name	Unthreaded Shank Diameter ¹ (in)	Head Type	Coating Type (Application)
Structural H19	0.19	Hex (5/16 in)	Exterior Use
SI: 1 in = 25.4 mm 1. Unthreaded shank diameter is measured on uncoated parts. Finished part dimensions are larger due to the thickness of the proprietary coating.			

4.2 Fastener Material

- 4.2.1 Starborn® Structural H19 screws are manufactured with heat-treated carbon steel grade 10B21 wire using a standard cold-forming process. All fasteners are produced in accordance with the approved quality control procedures referred to in Section 9.

4.3 Fastener Coatings

- 4.3.1 Starborn® H19 screws are designed for exterior use and may be used where fasteners are required to exhibit corrosion resistance when exposed to adverse environmental conditions and/or in preservative treated wood subject to the limitations of Section 9. These fasteners are alternates to hot-dip-zinc galvanized fasteners. They feature a proprietary coating system that meets or exceeds the corrosion protection of hot dipped galvanizing per *ASTM A153* in accordance with *IBC Section 2304.10⁴* and *IRC Section R317.3*.
 - 4.3.1.1 Starborn® H19 screws were evaluated for use in wood chemically treated with waterborne alkaline copper quaternary, type D (ACQ-D).
 - 4.3.1.2 Starborn® H19 screws are approved for use in fire-retardant-treated lumber, provided the conditions set forth by the fire-retardant-treated lumber manufacturer are met, including appropriate strength reductions.

⁴ 2012 IBC Section 2304.9

4.4 Wood Members

- 4.4.1 Solid sawn wood members connected with Starborn® Structural H19 screws shall consist of lumber species or species combinations having a specific gravity of 0.42 to 0.55.
- 4.4.2 Structural composite lumber (e.g., LVL, PSL, LSL, etc.) connected with Starborn® Structural H19 screws shall be recognized in evaluation reports having published equivalent specific gravities for lateral and withdrawal resistance. Equivalent specific gravities for structural composite lumber may be used in the design of connections using the specific gravities of the sawn lumber shown in Table 3 and Table 4.

4.5 Fastener Specifications

- 4.5.1 The fasteners evaluated in this TER are specified in Table 2 and Figure 1.

TABLE 2. FASTENER SPECIFICATIONS

Product Name	Head Marking	Fastener Length (in)	Thread Length (in)	Unthreaded Shank Diameter ¹ (in)	Thread Diameter (in)		Nominal Bending Yield, f_{yb} (psi)	Allowable Fastener Strength (lbf)	
					Minor ²	Major		Tensile	Shear
Structural H19	D19 4	4	2¼	0.189	0.169	0.260	196,700	1,280	1,085
	D19 6	6	2½						
	D19 8	8							
	D19 10	10							

SI: 1 in = 25.4 mm, 1 lb = 4.45 N, 1 psi = 0.00689 MPa

1. Unthreaded shank diameter is measured on uncoated parts. Finished part dimensions are larger due to the thickness of the proprietary coating.
2. Minor thread diameter is calculated as the average value of upper and lower manufacturing tolerances.

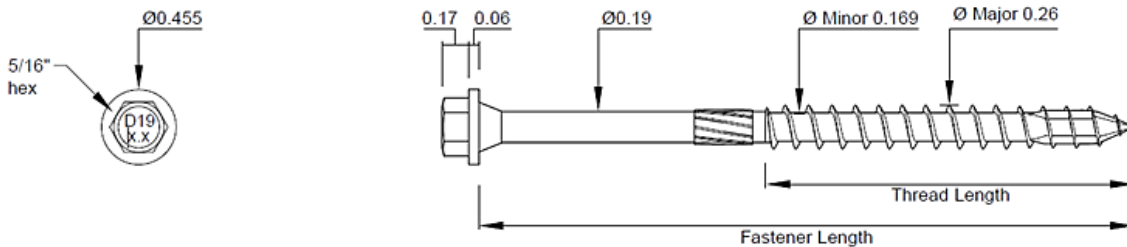


FIGURE 1. STARBORN® STRUCTURAL H19 SCREW

5 APPLICATIONS

5.1 General

- 5.1.1 Starborn® Structural H19 screws are self-tapping fasteners used for connections in conventional light frame wood construction and provide resistance against withdrawal, head pull-through, axial and shear loads. See Section 6 for installation requirements.
- 5.1.2 Starborn® Structural H19 screws are used to attach minimum 1½" wide wood trusses and sawn lumber rafters to wood wall top plates and wall bottom plates to rim board in the construction of walls that meet the requirements of IRC Section R602 or IBC Section 2308 for wood structural framing members. The fasteners provide resistance to uplift or lateral loads applied parallel and/or perpendicular to the wall or structural framing member.
 - 5.1.2.1 Walls shall consist of a single or double top plate designed in accordance with IRC Section R602.3.2 or IBC Section 2308.5.3.2⁵.
 - 5.1.2.2 See Table 3 and Table 4 for the design procedure and the Starborn® Structural H19 screws' allowable design values.
 - 5.1.2.3 See Section 6 for installation requirements.
 - 5.1.2.4 Starborn® Structural H19 screws are used in buildings requiring wind analysis in accordance with IRC Section R301.2.1, or design in accordance with IBC Section 1609.
 - 5.1.2.5 Starborn® Structural H19 screws are used in buildings requiring seismic analysis in accordance with IRC Section R301.2.2, or design in accordance with IBC Section 1613.
- 5.1.3 Starborn® Structural H19 screws are installed without lead holes, as prescribed in *NDS*.
- 5.1.4 Where the application exceeds the limitations set forth herein, design shall be permitted in accordance with accepted engineering procedures, experience, and technical judgment.

5.2 Design Concepts and Allowable Design Loads

- 5.2.1 Allowable design loads for uplift and lateral resistance (F1 Parallel to Wall and F2 Perpendicular to Wall, Figure 2) are provided in Table 3 for Starborn® Structural H19 screws. Allowable design loads are applicable to fasteners installed in accordance with the procedures described in Section 6. Allowable design loads are applicable for both single and double top plate applications as shown in Figure 3 and Figure 4.

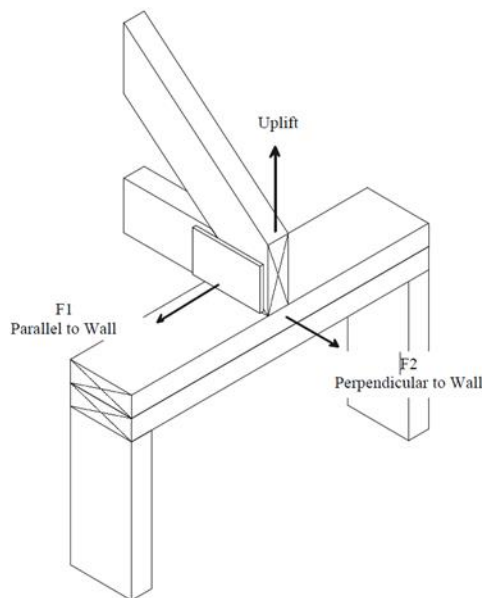


FIGURE 2. UPLIFT & LATERAL LOAD (F1 & F2) ORIENTATIONS

⁵ 2012 IBC Section 2308.9.2.1

TABLE 3. ALLOWABLE LOADS FOR UPLIFT & LATERAL RESISTANCE FOR SELECTED LOAD DURATIONS & WOOD-SPECIFIC GRAVITIES^{1,2}

Product Name	Species Group (Specific Gravity) ^{3,4}	Fastener Length (in)	Top Plate	Fastener Angle to Truss ⁶	Uplift (lbf) ⁵	Lateral (lbf) ⁵	
						F1 – Parallel to Wall	F2 – Perpendicular to Wall
Structural H19	Spruce-Pine-Fir (0.42)	4.0	Single Top Plate	22.5°	340	230	270
				90°	325	195	375
		6.0	Double Top Plate	22.5°	415	170	335
				90°	295	280	395

SI: 1 in = 25.4 mm, 1 lb = 4.45 N

1. Wood truss and rafter members shall be a minimum of 2" nominal thickness. Design of truss and rafter members by others.
2. Minimum screw penetration into truss/rafter members is 2".
3. Equivalent specific gravity of structural composite lumber (SCL) shall be equal to or greater than the specific gravities provided in this table. Refer to product information from SCL manufacturer.
4. For applications involving members with different specific gravities, use the allowable load corresponding to the lowest specific gravity.
5. Includes 1.6 Duration of Load increase. No further duration of load increases permitted.
6. Install screw at an upward angle from vertical of 20°-30° (22.5° is optimal) or 90° angle and should penetrate the wood truss or rafter within ¼" of the centerline. For installation between 20°-30°, design values for 22.5° may be used.

5.2.2 For bottom plate to rim board connections, allowable design loads are provided in Table 4 and are applicable for single bottom plates with wood structural sheathing subfloor to blocking/rim board applications as shown in Figure 5.

TABLE 4. ALLOWABLE DESIGN VALUE IN PLATE TO RIM BOARD CONFIGURATIONS USING STARBORN® STRUCTURAL H19 SCREWS (LBS)^{1,2,3}

Product Name	Load Direction	Configuration	Rim Board Species (Specific Gravity)	
			HF/SPF (0.42)	DF/SP (0.50)
Structural H19	Uplift	Single Bottom Plate to Rim Board	365	405
	Lateral – Parallel to Grain		370	360
	Lateral – Perpendicular to Grain		365	395

SI: 1 lb = 4.45 N

1. For applications involving members with different specific gravities, use the allowable load corresponding to the lowest specific gravity. For EWP rim boards (i.e. OSB, LSL, & LVL), the bottom plates shall be minimum SPF dimensional lumber. Dimensional lumber members shall be minimum of 2" nominal thickness.
2. Design values are based on a duration of load of 1.6. No further duration of load increases permitted. Reduce design values for other load durations as applicable.
3. Fastener length shall be at least 4" to insure minimum thread penetration of 1.75"

5.2.3 Where it is anticipated that loads will be applied to a single fastener simultaneously in more than one direction, additional evaluation is required to account for the combined effect of these loads using accepted engineering practice.

5.2.3.1 Consult a Registered Design Professional, as needed, for complex design conditions.

6 INSTALLATION

6.1 Installation shall comply with the manufacturer's installation instructions and this TER. In the event of a conflict between the manufacturer's installation instructions and this TER, the more restrictive shall govern.

6.2 Installation Procedure

6.2.1 General:

- 6.2.1.1 Starborn® Structural H19 screws shall be installed using a high-torque low speed drill in accordance with the manufacturer's installation instructions, applicable code, the approved construction documents, this TER, *NDS*, and standard framing practice as applied to wood fasteners.
- 6.2.1.2 The fasteners must be installed using a 5/16" hex driver bit. Pre-drilling of pilot holes is not required but may be used where lumber is prone to splitting.
- 6.2.1.3 Minimum penetration is 2" unless otherwise stated in this TER. Install screw head flush to the surface of the connected member.
- 6.2.1.4 Ensure angle of fastener is such that fastener does not protrude out of the wood truss or rafter.

6.2.2 *Top Plate to Truss*

6.2.2.1 Install one (1) Starborn® Structural H19 screw upward through the wall top plates or wood structural framing member at the bottom corner of the top plate(s) and into the center of the wood truss or rafter. The fastener should be installed at an upward angle from vertical of 20°-30° (22.5° is optimal) and should penetrate the wood truss or rafter within 1/4" of the centerline. Fasteners located between studs may be installed at a 90° angle. See Figure 3 and Figure 4. Fastener heads may be countersunk to avoid interfering with interior finishes.

6.2.2.1.1 If the wood truss or rafter is located directly over a top plate splice, offset the screw 1/4" to one side of the splice and insert the screw upward through the wall top plates or wood structural framing member at the bottom corner of the top plates and into the truss or rafter, as close to the centerline as possible. Note that the splice may be in either top plate.

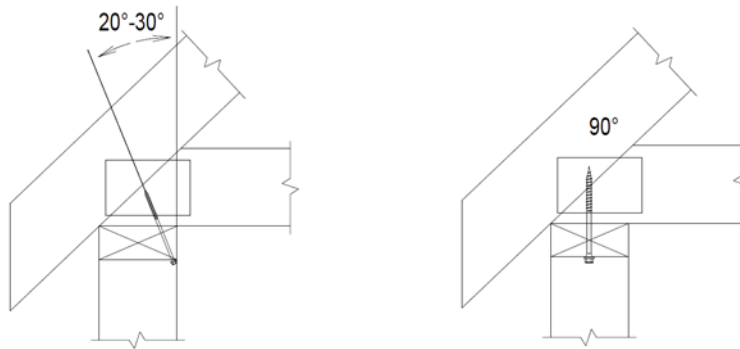


FIGURE 3. INSTALLATION OF STARBORN® STRUCTURAL H19 SCREW INTO WOOD TRUSS OR RAFTER THROUGH SINGLE TOP PLATE

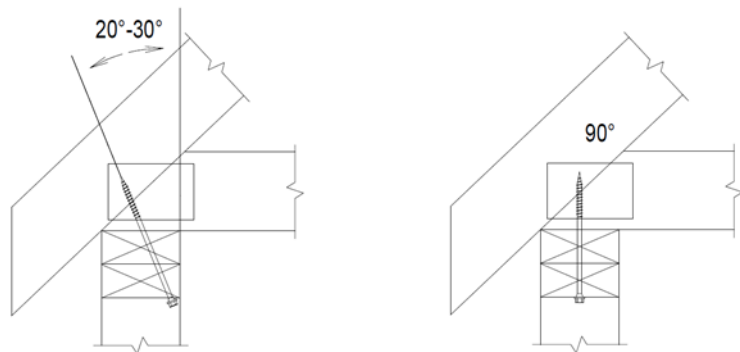


FIGURE 4. INSTALLATION OF STARBORN® STRUCTURAL H19 SCREW INTO WOOD TRUSS OR RAFTER THROUGH DOUBLE TOP PLATE

6.2.3 *Bottom Plate to Rim Board*

6.2.3.1 Install one (1) Starborn® Structural H19 screw downward at a 90° angle, a minimum of 1/2" from outside face of wall, through the plate and into the rim board. See Figure 5. Do not countersink screw heads.

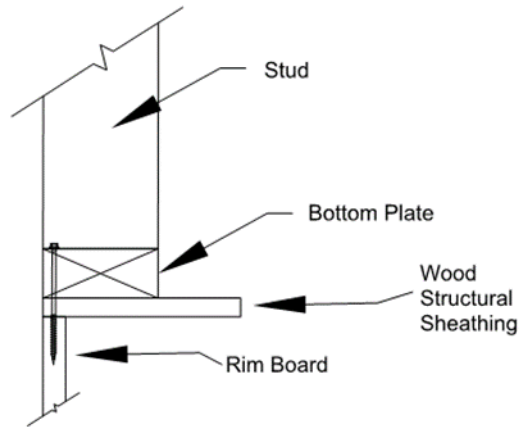


FIGURE 5. INSTALLATION OF STARBORN® STRUCTURAL H19 SCREW THROUGH BOTTOM PLATE INTO RIM BOARD

7 TEST ENGINEERING SUBSTANTIATING DATA

- 7.1 Testing for withdrawal and head pull-through by SBC Research Institute (SBCRI), under contract with Qualtim, Inc., in accordance with *ASTM D1761*.
- 7.2 Testing for shear strength by SBCRI, under contract with Qualtim, Inc., in accordance with *ANSI-AISI S904-13*.
- 7.3 *ANSI/AWC NDS: National Design Specification (NDS) for Wood Construction*
- 7.4 Some information contained herein is the result of testing and/or data analysis by other sources which conform to *IBC Section 1703* and relevant professional engineering law. DrJ relies on accurate data from these sources to perform engineering analysis. DrJ has reviewed and found the data provided by other professional sources to be credible.
- 7.5 Where appropriate, DrJ's analysis is based on design values that have been codified into law through codes and standards (e.g., *IBC*, *IRC*, *NDS*®, and *SDPWS*). This includes review of code provisions and any related test data that aids in comparative analysis or provides support for equivalency to an intended end-use application. Where the accuracy of design values provided herein is reliant upon the published properties of commodity materials (e.g., lumber, steel, and concrete), DrJ relies upon the grade mark, stamp, and/or design values provided by raw material suppliers to be accurate and conforming to the mechanical properties defined in the relevant material standard.

8 FINDINGS

- 8.1 When used and installed in accordance with this TER and the manufacturer's installation instructions, the product(s) listed in Section 1.1 are approved for the following:
 - 8.1.1 Alternative to toe-nail connections, metal hurricane and seismic clips/straps, or nails to resist the uplift and lateral loads due to wind and seismic conditions as provided for in Table 3.
 - 8.1.2 Resistance to uplift loads due to wind negative pressure applied from the truss above lifting up on the top plate of the wall, per Table 3.
 - 8.1.3 Resistance to lateral loads due to wind or seismic loads applied parallel or perpendicular to the wall, per Table 3.
 - 8.1.4 Alternative fastening of single bottom plate to blocking/rim board per Table 4.
- 8.2 IBC Section 104.11 (IRC Section R104.11 and IFC Section 104.9 are similar) states:

104.11 Alternative materials, design and methods of construction and equipment. The provisions of this code are not intended to prevent the installation of any material 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, not less than the equivalent of that prescribed in this code...Where the alternative material, design or method of construction is not *approved*, the *building official* shall respond in writing, stating the reasons the alternative was not *approved*.
- 8.3 This product has been evaluated in the context of the codes listed in Section 2 and is compliant with all known state and local building codes. Where there are known variations in state or local codes applicable to this evaluation, they are listed here.
 - 8.3.1 No known variations

9 CONDITIONS OF USE

- 9.1 The Starborn® Structural H19 screws covered in this TER shall be installed in accordance with this TER and the manufacturer's installation instructions.
- 9.2 For conditions not covered in this TER, connections shall be designed in accordance with generally accepted engineering practice. When the capacity of a connection is controlled by fastener metal strength rather than wood strength, the metal strength must not be multiplied by the adjustment factors specified in the *NDS*.
- 9.3 Use of fasteners in locations exposed to saltwater or saltwater spray is outside the scope of this evaluation report
- 9.4 Manufacturer's installation instructions shall be followed as provided in Section 6.
- 9.5 Starborn® Structural H19 screws are produced by Starborn® Industries, Inc. at its facilities located in Edison, NJ.
- 9.6 Starborn® Structural H19 screws are produced under a quality control program subject to periodic inspections performed by an approved agency in accordance with IBC Section 1703.5.2.
- 9.7 Where required by the building official, also known as the authority having jurisdiction (AHJ) in which the project is to be constructed, this TER and the installation instructions shall be submitted at the time of permit application.
- 9.8 Any generally accepted engineering calculations needed to show compliance with this TER shall be submitted to the AHJ for review and approval.
- 9.9 Design loads shall be determined in accordance with the building code adopted by the jurisdiction in which the project is to be constructed and/or by the Building Designer (e.g., owner or registered design professional).
- 9.10 At a minimum, this product shall be installed per Section 6 of this TER.
- 9.11 This product is manufactured under a third-party quality control program in accordance with IBC Section 104.4 and 110.4 and IRC Section R104.4 and R109.2.
- 9.12 The actual design, suitability, and use of this TER, for any particular building, is the responsibility of the owner or the owner's authorized agent. Therefore, the TER shall be reviewed for code compliance by the building official for acceptance.
- 9.13 The use of this TER is dependent on the manufacturer's in-plant QC, the ISO/IEC 17020 third-party quality assurance program and procedures, proper installation per the manufacturer's instructions, the building official's inspection, and any other code requirements that may apply to demonstrate and verify compliance with the applicable building code.

10 IDENTIFICATION

- 10.1 The product(s) listed in Section 1.1 are identified by a label on the board or packaging material bearing the manufacturer's name, product name, TER number, and other information to confirm code compliance.
- 10.2 Additional technical information can be found at starbornindustries.com.

11 REVIEW SCHEDULE

- 11.1 This TER is subject to periodic review and revision. For the most recent version of this TER, visit drjcertification.org.
- 11.2 For information on the current status of this TER, contact DrJ Certification.