



Listing and Technical Evaluation Report™

A Duly Authenticated Report from an Approved Agency

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Starborn® Structural H23 Screws, F23 Screws, and F23 Stainless Screws: Deck Ledger and Ledger to Stud Applications

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CSI Designations:

DIVISION: 06 00 00 - WOOD, PLASTICS AND COMPOSITES

Section: 06 11 00 - Wood Framing

Section: 06 05 23 - Wood, Plastic, and Composite Fastenings

Section: 06 15 00 - Wood Decking

1 Innovative Products Evaluated¹

1.1 Starborn Structural Screws:

1.1.1 Starborn Structural H23 Screws

1.1.2 Starborn Structural F23 Screws

1.1.2.1 1/2" galvanized lag screws for comparative, equivalency, and code compliance purposes.

1.1.3 Starborn Structural F23 Stainless Screws

2 Product Description and Materials

2.1 The innovative products evaluated in this report are shown in **Figure 1** through **Figure 3**, and are described in **Table 1**.

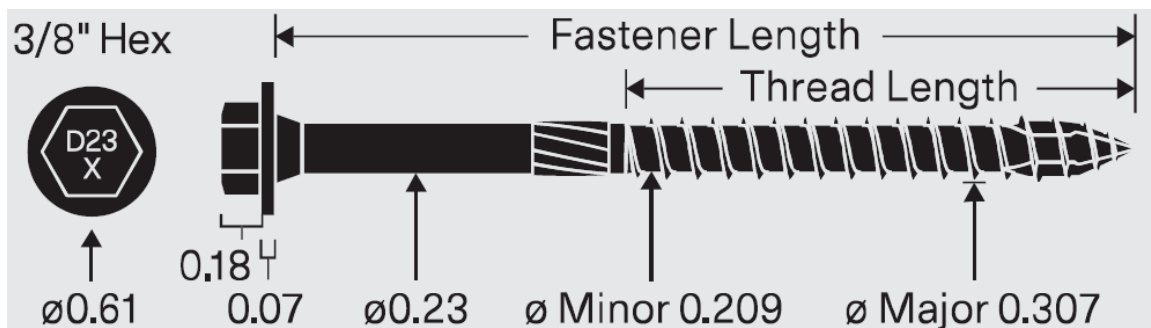


Figure 1. Starborn Structural H23 Screw

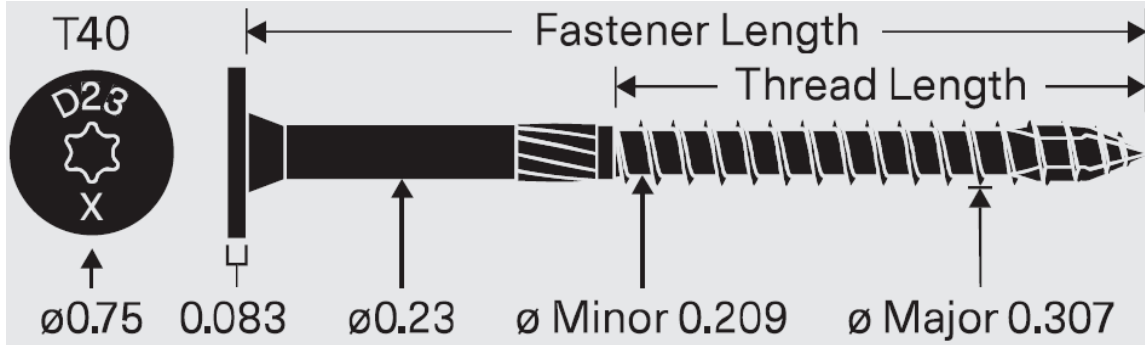


Figure 2. Starborn Structural F23 Screw

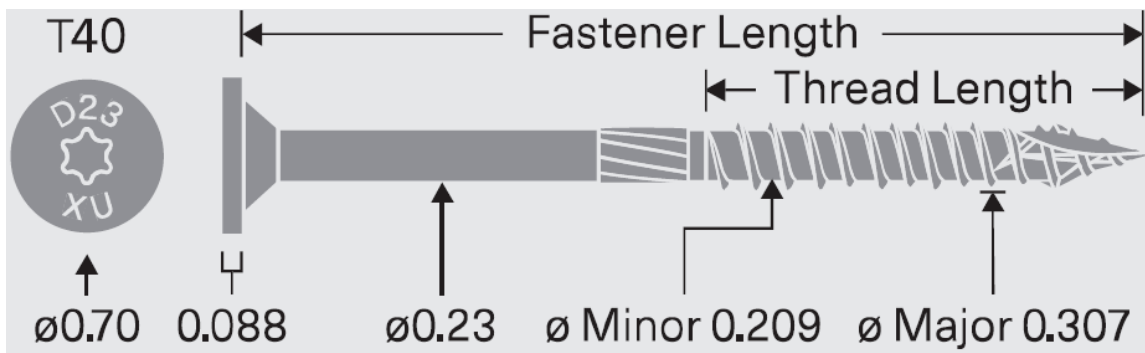


Figure 3. Starborn Structural F23 Stainless Screw

Table 1. Starborn Structural Screws Designation and Product Name

Product Name	Unthreaded Shank Diameter ¹ (in)	Head Type	Coating Type (Application)
Structural H23	0.23	Hex (³ / ₈ "	Exterior Use
Structural F23		Flat (T-40)	
Structural F23 Stainless			
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.			

2.2 General

2.2.1 Starborn Structural Screws are partially threaded dowel-type fasteners designed for use in wood-to-wood connections or steel-to-wood connections in ledger applications.

2.2.1.1 Starborn Structural H23 Screws are hex-driven (³/₈"

2.2.1.2 Starborn Structural F23 and F23 Stainless Screws are Torx-driven flat head screws.



2.3 Fastener Material

- 2.3.1 With the exception of Starborn Structural F23 Stainless Screws, Starborn Structural Screws are manufactured with heat-treated carbon steel grade 10B21 wire using a standard cold-forming process.
 - 2.3.1.1 Starborn Structural H23 and F23 Screws are coated with a proprietary black exterior coating.
- 2.3.2 Starborn Structural F23 Stainless Screws are manufactured with Grade 316 stainless steel.
- 2.3.3 All fasteners are produced in accordance with the approved quality control procedures referred to in **Section 12**.

2.4 Corrosion Resistance

- 2.4.1 With the exception of Starborn Structural F23 Stainless Screws, Starborn Structural Screws are zinc plated and overcoated with a proprietary epoxy coating.
- 2.4.2 Starborn Structural 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 12**.
 - 2.4.2.1 Starborn H23 and F23 Screws are alternatives to hot-dipped galvanized fasteners with a coating weight in compliance with ASTM A153, Class D.
 - 2.4.2.1.1 Starborn H23 and F23 Screws were evaluated for use in wood that is chemically treated with waterborne Alkaline Copper Quaternary, Type D (ACQ-D).
 - 2.4.2.1.2 The proprietary coating system meets or exceeds the corrosion protection of hot-dipped galvanizing per ASTM A153 in accordance with IBC Section 2304.10 and IRC Section R317.3.
 - 2.4.2.2 Starborn F23 Stainless Screws meet the material requirements in ASTM F1667 per IBC Section 2304.10.6 and IRC Section R317.3. Starborn F23 Stainless Screws are recognized for use in untreated, preservative treated, and fire-retardant treated wood in interior and exterior applications.

2.5 Pressure-Preservative Treated (PPT) Wood Applications

- 2.5.1 Starborn Structural Screws with the proprietary coating, or that are manufactured from stainless steel, are recognized for use in PPT lumber provided the conditions set forth by the PPT lumber manufacturer be met, including appropriate strength reductions.

2.6 Fire-Retardant Treated (FRT) Wood Applications

- 2.6.1 Starborn Structural Screws with the proprietary coating, or that are manufactured from stainless steel, are recognized for use in FRT lumber provided the conditions set forth by the FRT lumber manufacturer be met, including appropriate strength reductions.

2.7 Framing Members

- 2.7.1 Solid sawn wood members connected with Starborn Structural Screws shall consist of lumber species or species combinations having a specific gravity of 0.42 to 0.55.
- 2.7.2 Structural composite lumber (e.g., LVL, LSL, PSL, etc.) connected with Starborn Structural Screws, shall be recognized in evaluation reports having published equivalent specific gravities for lateral and withdrawal resistance.
 - 2.7.2.1 Equivalent specific gravities for structural composite lumber may be used in the design of connections using the specific gravities of the sawn lumber specified in **Table 3** and **Table 4**, and **Table 6** through **Table 9**.
- 2.7.3 Owens Corning® Lumber Structural Framing (Report Number 2302-42) connected with Starborn Structural Screws may be used with Starborn Structural Screws as shown in **Table 5**.



2.8 Cold-Formed Steel (CFS) Members

2.8.1 CFS members connected with Starborn Structural Screws shall conform to the material specifications stated in Section A3 of AISI S240 as specified in IRC Section R505.2.1.

2.8.2 CFS members connected with Starborn Structural Screws shall have corrosion protection in compliance with Section A4 of AISI S240 as specified in IRC Section R505.2.2.

2.9 Fastener Specifications

2.9.1 **Table 2** lists the dimensions and mechanical properties of Starborn Structural Screws that are evaluated in this report.

Table 2. Fastener Specifications

Product Name	Head Marking	Fastener Length ¹ (in)	Thread Length ² (in)	Unthreaded Shank Diameter ³ (in)	Thread Diameter (in)		Nominal Bending Yield, ⁵ F _{yb} (psi)	Allowable Fastener Strength (lb)	
					Minor ⁴	Major		Tensile	Shear
Structural H23	D23, 4	4	2 ³ / ₈	0.23	0.209	0.307	183,155	1,980	1,490
	D23, 5	5	3						
Structural F23	D23, 2.9	2 ⁷ / ₈	1 ² / ₅						
	D23, 4	4	2 ³ / ₈						
	D23, 5	5	3						
	D23, 6	6	2 ³ / ₄						
	D23, 8	8							
	D23, 10	10							
Structural F23 Stainless	D23, 2.9 XU	2 ⁷ / ₈	1.4	0.23	0.209	0.307	107,000	695	970
	D23, 4 XU	4	2 ³ / ₈						
	D23, 5 XU	5	3						
	D23, 6 XU	6	2 ³ / ₄						

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

- Measured from the underside of the head to the tip.
- Includes tip.
- Unthreaded shank diameter is measured on uncoated parts. Finished part dimensions are larger due to the thickness of the proprietary coating.
- Minor thread diameter is calculated as the average value of upper and lower manufacturing tolerances.
- Bending yield strength is determined in accordance with ASTM F1575 and based on the minor diameter.

2.10 As needed, review material properties for design in **Section 6** and the regulatory evaluation in **Section 8**.



3 Definitions

- 3.1 New Materials² are defined as building materials, equipment, appliances, systems, or methods of construction, not provided for by prescriptive and/or legislatively adopted regulations, known as alternative materials.³ The design strengths and permissible stresses shall be established by tests⁴ and/or engineering analysis.⁵
- 3.2 Duly authenticated reports⁶ and research reports⁷ are test reports and related engineering evaluations that are written by an approved agency⁸ and/or an approved source.⁹
- 3.2.1 These reports contain intellectual property and/or trade secrets, which are protected by the Defend Trade Secrets Act (DTSA).¹⁰
- 3.3 An approved agency is “approved” when it is ANAB ISO/IEC 17065 accredited. DrJ Engineering, LLC (DrJ) is accredited and listed in the ANAB directory.
- 3.4 An approved source is “approved” when a professional engineer (i.e., Registered Design Professional or RDP) is properly licensed to transact engineering commerce. The regulatory authority governing approved sources is the state legislature via its professional engineering regulations.¹¹
- 3.5 Testing and/or inspections conducted for this duly authenticated report were performed by an ISO/IEC 17025 accredited testing laboratory, an ISO/IEC 17020 accredited inspection body, and/or a licensed RDP.
- 3.5.1 The Center for Building Innovation (CBI) is ANAB¹² ISO/IEC 17025 and ISO/IEC 17020 accredited.
- 3.6 The regulatory authority shall enforce¹³ the specific provisions of each legislatively adopted regulation. If there is a non-conformance, the specific regulatory section and language of the non-conformance shall be provided in writing¹⁴ stating the nonconformance and the path to its cure.
- 3.7 The regulatory authority shall accept duly authenticated reports from an approved agency and/or an approved source with respect to the quality and manner of use of new materials or assemblies as provided for in regulations regarding the use of alternative materials, designs, or methods of construction.¹⁵
- 3.8 ANAB is an International Accreditation Forum (IAF) Multilateral Recognition Arrangement (MLA) signatory. Therefore, recognition of certificates and validation statements issued by conformity assessment bodies accredited by all other signatories of the IAF MLA with the appropriate scope shall be approved.¹⁶ Thus, all ANAB ISO/IEC 17065 duly authenticated reports are approval equivalent.¹⁷
- 3.9 Approval equity is a fundamental commercial and legal principle.¹⁸

4 Applicable Standards for the Listing; Regulations for the Regulatory Evaluation¹⁹

- 4.1 *Local, State, and Federal*
- 4.1.1 Approved in all local jurisdictions pursuant to ISO/IEC 17065 duly authenticated report use, which includes, but is not limited to, the following featured local jurisdictions: Austin, Baltimore, Broward County, Chicago, Clark County, Dade County, Dallas, Detroit, Denver, DuPage County, Fort Worth, Houston, Kansas City, King County, Knoxville, Las Vegas, Los Angeles City, Los Angeles County, Miami, Nashville, New York City, Omaha, Philadelphia, Phoenix, Portland, San Antonio, San Diego, San Jose, San Francisco, Seattle, Sioux Falls, South Holland, Texas Department of Insurance, and Wichita.²⁰
- 4.1.2 Approved in all state jurisdictions pursuant to ISO/IEC 17065 duly authenticated report use, which includes, but is not limited to, the following featured states: California, Florida, New Jersey, Oregon, New York, Texas, Washington, and Wisconsin.²¹
- 4.1.3 Approved by the Code of Federal Regulations Manufactured Home Construction: Pursuant to Title 24, Subtitle B, Chapter XX, Part 3282.14²² and Part 3280²³ pursuant to the use of ISO/IEC 17065 duly authenticated reports.
- 4.1.4 Approved means complying with the requirements of local, state, or federal legislation.



4.2 Standards

- 4.2.1 *AISI S340: North American Standard for Cold-Formed Steel Structural Framing*
- 4.2.2 *ANSI/AWC NDS: National Design Specification (NDS) for Wood Construction*
- 4.2.3 *ASTM A153: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware*
- 4.2.4 *ASTM D1761: Standard Test Methods for Mechanical Fasteners in Wood*
- 4.2.5 *AWC Technical Report (TR) 12: General Dowel Equations for Calculating Lateral Connection Values*

4.3 Regulations

- 4.3.1 *IBC – 15, 18, 21: International Building Code®*
- 4.3.2 *IRC – 15, 18, 21: International Residential Code®*

5 Listed²⁴

- 5.1 Equipment, materials, products, or services included in a List published by a nationally recognized testing laboratory (i.e., CBI), an approved agency (i.e., CBI and DrJ), and/or an approved source (i.e., DrJ), or other organization(s) concerned with product evaluation (i.e., DrJ), that maintains periodic inspection (i.e., CBI) of production of listed equipment or materials, and whose listing states either that the equipment or material meets nationally recognized standards or has been tested and found suitable for use in a specified manner.

6 Tabulated Properties Generated from Nationally Recognized Standards

6.1 General

- 6.1.1 Starborn Structural Screws are self-tapping fasteners used for attaching the deck ledger to the band joist of a building in accordance with IBC Section 1604.8.3 and IRC Section R507.9.²⁵ See **Section 9** for installation requirements.
- 6.1.2 The IRC provides prescriptive fastener spacing for the attachment of a deck ledger to a band joist with 1/2" diameter lag screws or through bolts, as shown in IRC Table R507.9.1.3(1).²⁶
- 6.1.3 Starborn Structural Screws can be used for attaching ledger boards to wall studs with zero, one, or two layers of Gypsum Wallboard (GWB) between the ledger and the wall studs.
- 6.1.4 Starborn Structural Screws are installed without lead holes, as prescribed in the NDS.
- 6.1.5 *Design:*
 - 6.1.5.1 The design of Starborn Structural Screws is governed by the applicable code and the provisions for dowel-type fasteners in the NDS.
 - 6.1.5.2 Unless otherwise noted, adjustment of the design stresses for duration of load shall be in accordance with the applicable code.

6.2 Wood Ledger to Wood Band Joist Connection

- 6.2.1 Starborn Structural Screws are designed specifically for attaching the deck ledger to the band joist of a building in accordance with IBC Section 1604.8.3 and IRC Section R507.9.²⁷
 - 6.2.1.1 As in some truss installations where a band joist is not used, an engineered design is required. See **Appendix A** for additional code requirements for ledger attachments.
- 6.2.2 The IRC provides prescriptive fastener spacing for the attachment of a deck ledger to a rim joist with 1/2" diameter lag screws or through bolts as shown in IRC Table R507.9.1.3(1).²⁸



- 6.2.3 **Table 3** and **Table 4** provide the Starborn Structural Screws spacing required to provide performance at least equivalent to the lag screws found in IRC Table R507.9.1.3(1),²⁹ in accordance with IBC Section 104.11, IBC Section 1604.8.3, IRC Section R104.11, and IRC Section R507.9,³⁰ in addition to generally accepted engineering practice.
- 6.2.3.1 **Table 3** and **Table 4** provide Starborn Structural Screws spacing for items found in IRC Table R507.9.1.3(1),³¹ as well as a wider range of materials commonly used for band joists.
- 6.2.3.2 Screw spacing for a deck live load of 40 psf in accordance with IRC Section R301.5 and a deck dead load of 10 psf.
- 6.2.3.3 In addition, an alternate loading condition (i.e., deck live load = 60 psf, deck dead load = 10 psf) required by some jurisdictions is shown.
- 6.2.4 When installed in accordance with the spacing requirements of **Table 3** and **Table 4**, Starborn Structural Screws provide equivalent performance to IRC Section R507.9.³²



Table 3. Starborn Structural H23 or F23 Screws Spacing for Items in IRC Table 507.9.1.3(1)³³ and Other Materials and Loading Conditions^{3,6,7}

Loading Condition ¹	Fastener Length ⁴ (in)	Band Joist Material ^{5,9}	2x Nominal Ledger Species ^{2,8}	Maximum Deck Joist Spans (ft)						
				Up to 6'	Up to 8'	Up to 10'	Up to 12'	Up to 14'	Up to 16'	Up to 18'
				Maximum On-Center Spacing of Ledger Board Fasteners (in)						
LL + DL 40+10 (psf)	4	Sawn Lumber	DF/SP	30	22	18	15	12	11	10
			HF/SPF	22	17	13	11	9	8	7
		SCL	DF/SP	28	21	17	14	12	10	9
			HF/SPF	24	18	14	12	10	9	8
	5	Sawn Lumber	DF/SP	30	23	18	15	13	11	10
			HF/SPF	24	18	14	12	10	9	8
		SCL	DF/SP	30	23	18	15	13	11	10
			HF/SPF	26	19	15	13	11	9	8
LL + DL 60+10 (psf)	4	Sawn Lumber	DF/SP	21	16	12	10	9	8	7
			HF/SPF	16	12	9	8	6	6	5
		SCL	DF/SP	20	15	12	10	8	7	6
			HF/SPF	17	13	10	8	7	6	5
	5	Sawn Lumber	DF/SP	23	17	13	11	9	8	7
			HF/SPF	17	13	10	8	7	6	5
		SCL	DF/SP	22	16	13	11	9	8	7
			HF/SPF	18	14	11	9	8	7	6

SI: 1 in = 25.4 mm, 1 ft = 0.305 m, 1 psf = 0.0479 kN/m²

SCL = Structural Composite Lumber, DF = Douglas Fir, SP = Southern Pine, HF = Hem-Fir, SPF = Spruce Pine Fir

- 10 pounds (psf) added for typical dead load requirements. Additional dead loads are not accounted for.
- Ledger materials assumed to be in wet service condition.
- Load duration of 1.00. Spacing may be adjusted by the applicable load duration as specified in NDS. All adjustment factors shall be applied per NDS. For in-service moisture content greater than nineteen percent (19%), use Wet Service Factor (C_M) = 0.70.
- Fasteners are required to have full penetration into the band joist and shall be staggered from the top to the bottom along the length of the ledger while maintaining the required edge and end distances shown in **Figure 6**.
- Solid sawn band joists shall be HF/SPF or DF/SP species (Specific gravity of 0.42 and 0.50, respectively).
- Fastener spacing based on tested loads. The design values are the lesser of a $1/8$ " deflection or a factor of safety equivalent to or greater than that of the code compliant lag screw application as defined in **Figure 5**.
- A maximum $1/2$ " structural sheathing may be installed between the ledger and the band joist.
- Minimum ledger board requirements: 1.5" thick and 7.25" depth.
- Minimum band joist requirements: Specific gravity of 0.42 for sawn lumber and equivalent specific gravity of 0.50 for SCL; sawn lumber band joist 1.5" thick and 7.25" depth; SCL band joist 1.0" thick and 7.25" depth.



Table 4. Starborn Structural F23 Stainless Screws Spacing for Items in IRC Table 507.9.1.3(1)³⁴ and Other Materials and Loading Conditions^{3,6,7}

Loading Condition ¹	Fastener Length ⁴ (in)	Band Joist Material ^{5,9}	2x Nominal Ledger Species ^{2,8}	Maximum Deck Joist Spans (ft)						
				Up to 6'	Up to 8'	Up to 10'	Up to 12'	Up to 14'	Up to 16'	Up to 18'
				Maximum On-Center Spacing of Ledger Board Fasteners (in)						
LL + DL 40+10 (psf)	4	Sawn Lumber	DF/SP	21	15	12	10	9	7	7
			HF/SPF	20	15	12	10	8	7	6
		SCL	DF/SP	23	17	13	11	9	8	7
			HF/SPF	20	15	12	10	8	7	6
	5	Sawn Lumber	DF/SP	21	15	12	10	9	7	7
			HF/SPF	20	15	12	10	8	7	6
		SCL	DF/SP	23	17	13	11	9	8	7
			HF/SPF	20	15	12	10	8	7	6
LL + DL 60+10 (psf)	4	Sawn Lumber	DF/SP	15	11	9	7	6	5	5
			HF/SPF	14	11	8	7	6	5	4
		SCL	DF/SP	16	12	9	8	7	6	5
			HF/SPF	14	10	8	7	6	5	4
	5	Sawn Lumber	DF/SP	15	11	9	7	6	5	5
			HF/SPF	14	11	8	7	6	5	4
		SCL	DF/SP	16	12	9	8	7	6	5
			HF/SPF	14	10	8	7	6	5	4

SI: 1 in = 25.4 mm, 1 ft = 0.305 m, 1 psf = 0.0479 kN/m²

SCL = Structural Composite Lumber, DF = Douglas Fir, SP = Southern Pine, HF = Hem-Fir, SPF = Spruce Pine Fir

- 10 pounds (psf) added for typical dead load requirements. Additional dead loads are not accounted for.
- Ledger materials assumed to be in wet service condition.
- Load duration of 1.00. Spacing may be adjusted by the applicable load duration as specified in NDS. All adjustment factors shall be applied per NDS. For in-service moisture content greater than nineteen percent (19%), use Wet Service Factor (C_M) = 0.70.
- Fasteners are required to have full penetration into the band joist and shall be staggered from the top to the bottom along the length of the ledger while maintaining the required edge and end distances shown in **Figure 6**.
- Solid sawn band joists shall be HF/SPF or DF/SP species (Specific gravity of 0.42 and 0.50, respectively).
- Fastener spacing based on tested loads. The design values are the lesser of a $1/8$ " deflection or a factor of safety equivalent to or greater than that of the code compliant lag screw application as defined in **Figure 5**.
- A maximum $1/2$ " structural sheathing may be installed between the ledger and the band joist.
- Minimum ledger board requirements: 1.5" thick and 7.25" depth.
- Minimum band joist requirements: Specific gravity of 0.42 for sawn lumber and equivalent specific gravity of 0.50 for SCL; sawn lumber band joist 1.5" thick and 7.25" depth; SCL band joist 1.0" thick and 7.25" depth.



6.3 Owens Corning Lumber Structural Framing Ledger to Wood Band Joist Connection

- 6.3.1 Starborn Structural Screws are permitted for use in attaching the Owens Corning Lumber Structural Framing deck ledger to the band joist of a building in accordance with IBC Section 1604.8.3 and IRC Section R507.9.³⁵
 - 6.3.1.1 As in some truss installations where a band joist is not used, an engineered design is required. See **Appendix A** for additional code requirements for ledger attachments.
- 6.3.2 The IRC provides prescriptive fastener spacing for the attachment of a deck ledger to a rim joist with 1/2" diameter lag screws or through bolts as shown in IRC Table 507.9.1.3(1).³⁶
- 6.3.3 **Table 5** provides the Starborn Structural Screws spacing required to provide performance at least equivalent to the lag screws found in IRC Table 507.9.1.3(1),³⁷ in accordance with IBC Section 104.11, IBC Section 1604.8.3, IRC Section R104.11, and IRC Section R507.9,³⁸ in addition to generally accepted engineering practice.
 - 6.3.3.1 **Table 5** provides Starborn Structural Screws spacing for items found in IRC Table 507.9.1.3(1),³⁹ as well as a wider range of materials commonly used for band joists.
 - 6.3.3.2 Screw spacing for a deck live load of 40 psf in accordance with IRC Section R301.5 and a deck dead load of 10 psf.
 - 6.3.3.3 In addition, an alternate loading condition (i.e., deck live load = 60 psf, deck dead load = 10 psf) required by some jurisdictions is shown.
- 6.3.4 When installed in accordance with the spacing requirements of **Table 5**, Starborn Structural Screws provide equivalent performance to IRC Section R507.9.⁴⁰



Table 5. Starborn Structural F23 Stainless, F23, or H23 Screws Spacing for Items in IRC Table 507.9.1.3(1)⁴¹ and Other Materials and Loading Conditions^{2,5,6}

Loading Condition ¹	Fastener Length ³ (in)	Band Joist Material ^{4,8}	Ledger Material ⁷	Maximum Deck Joist Spans (ft)						
				Up to 6'	Up to 8'	Up to 10'	Up to 12'	Up to 14'	Up to 16'	Up to 18'
				Maximum On-Center Spacing of Ledger Board Fasteners (in)						
LL + DL 40+10 (psf)	4 or 5	Sawn Lumber	Owens Corning Lumber Structural Framing ⁹	31	23	18	15	13	11	10
		SCL		35	26	21	17	15	13	11
LL + DL 60+10 (psf)	4 or 5	Sawn Lumber		22	16	13	11	9	8	7
		SCL		25	19	15	12	11	9	8

SI: 1 in = 25.4 mm, 1 ft = 0.305 m, 1 psf = 0.0479 kN/m²

SCL = Structural Composite Lumber

- 10 pounds (psf) added for typical dead load requirements. Additional dead loads are not accounted for.
- For the wood-based component(s), load duration of 1.00. Spacing may be adjusted by the applicable load duration as specified in NDS. All adjustment factors shall be applied per NDS. For in-service moisture content greater than nineteen percent (19%), use Wet Service Factor (C_M) = 0.70.
- Fasteners are required to have full penetration into the band joist and shall be staggered from the top to the bottom along the length of the ledger while maintaining the required edge and end distances shown in **Figure 6**.
- Solid sawn band joists shall be minimum SPF, having a specific gravity of 0.42.
- Fastener spacing based on tested loads. The design values are the lesser of a $1/8$ " deflection or a factor of safety equivalent to or greater than that of the code compliant lag screw application as defined in **Figure 5**.
- A maximum $1/2$ " structural sheathing may be installed between the ledger and the band joist.
- Minimum ledger board requirements: $1\frac{1}{2}$ " thick and $7\frac{1}{2}$ " depth.
- Minimum band joist requirements: Specific gravity of 0.42 for sawn lumber and equivalent specific gravity of 0.50 for SCL; sawn lumber band joist $1\frac{1}{2}$ " thick and $7\frac{1}{2}$ " depth; SCL band joist $1\frac{1}{8}$ " thick and $7\frac{1}{2}$ " depth.
- Refer to Report Number 2302-42 for properties of Owens Corning Lumber Structural Framing.



6.4 Wood Ledger Board to Wood Stud Connection

6.4.1 Allowable lateral loads for deck ledger to stud connections installed with Starborn Structural Screws are presented in **Table 6**.

6.4.1.1 Values in **Table 6** apply where the ledger is installed, either directly over the studs or with up to two layers of $\frac{5}{8}$ " gypsum wallboards between the ledger and studs.

Table 6. Starborn Structural Screws Allowable Load Per Stud Connection With or Without GWB (lb)^{1,2,3,4,5,6,7}

Product Name	Head Marking	Fastener Length (in)	Minimum Penetration Into Main Member (in)	Layers of GWB ⁸	Ledger Size		
					2 x 6	2 x 8	2 x 10
Starborn Structural Screws (F23 and H23)	D23, 4	4	2 $\frac{1}{2}$	0	915	915	1,190
			1 $\frac{7}{8}$	1	815	815	1,070
	D23, 5	5	2 $\frac{1}{4}$	2	845	845	1,095

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

- Nominal 2 x 6 and 2 x 8 ledgers require two (2) fasteners per stud location. Nominal 2 x 10 ledgers require three (3) fasteners per stud location. Additional fasteners prohibited.
- SPF ledger with minimum specific gravity of 0.42.
- The tabulated values apply where the ledger is installed either directly over the studs or with up to two layers of $\frac{5}{8}$ " gypsum between the ledger and studs.
- Allowable loads shall be limited to parallel-to-grain loaded solid sawn main members (minimum 2" nominal studs). Wood side members (ledger) shall be loaded perpendicular to grain.
- Allowable loads are shown at the wood load duration factor (C_D) = 1.00. Loads may be increased for load duration as permitted by the building code up to a C_D = 1.60. All adjustment factors shall be applied per NDS. For in-service moisture content greater than nineteen percent (19%), use Wet Service Factor (C_M) = 0.70.
- Fasteners shall be centered in the stud and spaced as shown in **Figure 7** through **Figure 15** in **Section 9**. The stud minimum end distance is 6 $\frac{3}{4}$ " when loaded toward the end and 4" when loaded away from the end. The ledger end distance is 6" for full values. For ledger end distances between 2" and 6", use fifty percent (50%) of the table loads. For end distances between 2" and 4", predrill using a $\frac{5}{32}$ " bit to prevent splitting.
- For Load Resistance Factor Design (LRFD) values, the reference connection design values shall be adjusted in accordance with NDS Section 11.3.
- GWB must be attached as required per the applicable building code.

6.5 CFS Ledger to Wood Band Joist Connection

6.5.1 Starborn Structural Screws may be used for attaching CFS deck ledger to wood band joist of a building as an alternative to the provisions specified in [IBC Section 1604.8.3](#) and [IRC Section R507.9](#).⁴²

6.5.2 **Table 7** and **Table 8** provide the Starborn Structural Screws spacing required to provide performance at least equivalent to the lag screws found in [IRC Table R507.9.1.3\(1\)](#),⁴³ in accordance with [IBC Section 104.11](#), [IBC Section 1604.8.3](#), [IRC Section R104.11](#), and [IRC Section R507.9](#),⁴⁴ and with generally accepted engineering practice.

6.5.2.1 **Table 7** and **Table 8** provide Starborn Structural Screws spacing for items found in [IRC Table R507.9.1.3\(1\)](#),⁴⁵ as well as a wider range of materials commonly used for band joists.

6.5.2.2 Screw spacing for a deck live load of 40 psf in accordance with [IRC Section R301.5](#) and a deck dead load of 10 psf.

6.5.2.3 In addition, an alternate loading condition (i.e., deck live load = 60 psf, deck dead load = 10 psf) required by some jurisdictions, is shown.

6.5.3 When installed in accordance with the spacing requirements of **Table 7** and **Table 8**, Starborn Structural Screws provide equivalent performance to [IRC Section R507.9](#).⁴⁶



Table 7. Starborn Structural F23 and H23 Screws Spacing for Listed CFS Ledgers and Loading Conditions^{1,2,4}

Loading Condition	Ledger ⁶		Band Joist Material ^{3,5}	Maximum Deck Joist Spans (ft)						
				Up to 6'	Up to 8'	Up to 10'	Up to 12'	Up to 14'	Up to 16'	Up to 18'
				Maximum On-Center Spacing of Ledger Board Fasteners (in)						
LL + DL 40+10 (psf)	F _y = 33 ksi	12-gauge	DF/SP/SCL	14	11	8	7	6	5	4
			HF/SPF	10	8	6	5	4	4	3
		14-gauge	DF/SP/SCL	14	10	8	7	6	5	4
			HF/SPF	10	8	6	5	4	4	3
		16-gauge	DF/SP/SCL	14	10	8	7	6	5	4
			HF/SPF	10	7	6	5	4	3	3
	F _y = 50 ksi	12-gauge	DF/SP/SCL	15	11	9	7	6	5	5
			HF/SPF	11	8	6	5	4	4	3
		14-gauge	DF/SP/SCL	14	11	8	7	6	5	4
			HF/SPF	10	8	6	5	4	4	3
		16-gauge	DF/SP/SCL	14	11	8	7	6	5	4
			HF/SPF	10	8	6	5	4	4	3
SL + DL 60+10 (psf)	F _y = 33 ksi	12-gauge	DF/SP/SCL	12	9	7	6	5	4	4
			HF/SPF	8	6	5	4	3	3	2
		14-gauge	DF/SP/SCL	11	8	7	5	5	4	3
			HF/SPF	8	6	5	4	3	3	2
		16-gauge	DF/SP/SCL	11	8	7	5	5	4	3
			HF/SPF	8	6	5	4	3	3	2
	F _y = 50 ksi	12-gauge	DF/SP/SCL	12	9	7	6	5	4	4
			HF/SPF	9	6	5	4	3	3	3
		14-gauge	DF/SP/SCL	12	9	7	6	5	4	4
			HF/SPF	8	6	5	4	3	3	2
		16-gauge	DF/SP/SCL	12	9	7	6	5	4	4
			HF/SPF	8	6	5	4	3	3	2

SL: 1 in = 25.4 mm, 1 ft = 0.305 m, 1 psf = 0.0479 kN/m²

LL = Live Load, DL = Dead Load, SL = Snow Load

- Based on load duration, C_d, of 1.00 for live load conditions, and 1.15 for snow load conditions. Spacing may be adjusted by the applicable load duration for other conditions as specified in the NDS.
- Fasteners are required to have full thread penetration into the main member. Minimum fastener length to be used is 2⁷/₈".
- Solid sawn band joists shall be HF/SPF or SP/DF species (Specific gravity of 0.42 and 0.50, respectively). Sawn lumber band joist 1.5" thick and 7.25" depth, SCL band joist 1.0" thick and 7.25" depth.
- Similar to the wood-ledger application, fasteners shall be staggered from the top to the bottom along the length of the ledger while maintaining the required edge and end distances shown in **Figure 6**.
- A maximum 1/2" structural sheathing may be installed between the ledger and the band joist.
- Minimum CFS ledger board requirements: 1.5" flange thickness and 8" depth.



Table 8. Starborn Structural F23 Stainless Screws Spacing for Listed CFS Ledgers and Loading Conditions^{1,2,4}

Loading Condition	Ledger ⁶		Band Joist Material ^{3,5}	Maximum Deck Joist Spans (ft)						
				Up to 6'	Up to 8'	Up to 10'	Up to 12'	Up to 14'	Up to 16'	Up to 18'
				Maximum On-Center Spacing of Ledger Board Fasteners (in)						
LL + DL 40+10 (psf)	F _y = 33 ksi	12-gauge	DF/SP/SCL	13	10	8	6	5	5	4
			HF/SPF	10	8	6	5	4	4	3
		14-gauge	DF/SP/SCL	13	10	8	6	5	5	4
			HF/SPF	10	8	6	5	4	4	3
		16-gauge	DF/SP/SCL	13	10	8	6	5	5	4
			HF/SPF	10	7	6	5	4	3	3
	F _y = 50 ksi	12-gauge	DF/SP/SCL	14	10	8	7	6	5	4
			HF/SPF	11	8	6	5	4	4	3
		14-gauge	DF/SP/SCL	13	10	8	6	5	5	4
			HF/SPF	10	8	6	5	4	4	3
		16-gauge	DF/SP/SCL	13	10	8	6	5	5	4
			HF/SPF	10	8	6	5	4	4	3
SL + DL 60+10 (psf)	F _y = 33 ksi	12-gauge	DF/SP/SCL	11	8	6	5	4	4	3
			HF/SPF	8	6	5	4	3	3	2
		14-gauge	DF/SP/SCL	11	8	6	5	4	4	3
			HF/SPF	8	6	5	4	3	3	2
		16-gauge	DF/SP/SCL	11	8	6	5	4	4	3
			HF/SPF	8	6	5	4	3	3	2
	F _y = 50 ksi	12-gauge	DF/SP/SCL	11	8	7	5	5	4	3
			HF/SPF	9	6	5	4	3	3	3
		14-gauge	DF/SP/SCL	11	8	6	5	4	4	3
			HF/SPF	8	6	5	4	3	3	2
		16-gauge	DF/SP/SCL	11	8	6	5	4	4	3
			HF/SPF	8	6	5	4	3	3	2

SI: 1 in = 25.4 mm, 1 ft = 0.305 m, 1 psf = 0.0479 kN/m²

LL = Live Load, DL = Dead Load, SL = Snow Load

- Based on load duration, C_d, of 1.00 for live load conditions, and 1.15 for snow load conditions. Spacing may be adjusted by the applicable load duration for other conditions as specified in the NDS.
- Fasteners are required to have full thread penetration into the main member. Minimum fastener length to be used is 2⁷/₈".
- Solid sawn band joists shall be HF/SPF or SP/DF species (Specific gravity of 0.42 and 0.50, respectively). Sawn lumber band joist 1.5" thick and 7.25" depth, SCL band joist 1.0" thick and 7.25" depth.
- Similar to the wood-ledger application, fasteners shall be staggered from the top to the bottom along the length of the ledger while maintaining the required edge and end distances shown in **Figure 6**.
- A maximum 1/2" structural sheathing may be installed between the ledger and the band joist.
- Minimum CFS ledger board requirements: 1.5" flange thickness and 8" depth.



6.6 CFS Ledger Board to Wood Stud Connection

6.6.1 Allowable lateral loads for deck ledger to stud connections installed with Starborn Structural Screws are presented in **Table 9**.

6.6.1.1 Values in **Table 9** apply where the ledger is installed, either directly over the studs or with up to two layers of $\frac{5}{8}$ " GWB between the ledger and studs.

Table 9. Starborn Structural Screws Allowable Load Per Stud Connection With or Without GWB (lb)^{1,2,3,4,5,6,7}

Product Name	Fastener Length (in)	Penetration Into Main Member (in)	Layers of GWB ⁸	Ledger		Ledger Depth		
						5½" – 6"	8" – 9¼"	10" – 12"
Starborn Structural Screws) (F23 and H23)	≥ 27/8	2.78	0	F _y = 33 ksi	12-gauge	450	675	900
		2.15	1			220	330	440
		1.53	2			120	180	240
	≥ 4	2.65	2			130	195	260
		2.81	0	F _y = 33 ksi	14-gauge	440	660	880
		2.18	1			220	330	440
		1.56	2			130	195	260
	≥ 4	2.68	2			130	195	260
		2.82	0	F _y = 33 ksi	16-gauge	430	645	860
		2.20	1			210	315	420
		1.57	2			130	195	260
	≥ 4	2.70	2			130	195	260
		2.78	0	F _y = 50 ksi	12-gauge	460	690	920
		2.15	1			230	345	460
		1.53	2			130	195	260
	≥ 4	2.65	2			140	210	280
		2.81	0	F _y = 50 ksi	14-gauge	450	675	900
		2.18	1			220	330	440
		1.56	2			130	195	260
	≥ 4	2.68	2			130	195	260
		2.82	0	F _y = 50 ksi	16-gauge	450	675	900
		2.20	1			220	330	440
		1.57	2			130	195	260
	≥ 4	2.70	2			130	195	260



Table 9. Starborn Structural Screws Allowable Load Per Stud Connection With or Without GWB (lb)^{1,2,3,4,5,6,7}

Product Name	Fastener Length (in)	Penetration Into Main Member (in)	Layers of GWB ⁸	Ledger	Ledger Depth		
					5½" – 6"	8" – 9¼"	10" – 12"
SI: 1 in = 25.4 mm, 1 lb = 4.45 N							
1. Additional fasteners prohibited.							
2. Band joist shall have minimum specific gravity of 0.42.							
3. The tabulated values apply where the ledger is installed either directly over the studs or with up to two layers of 5⁄8" gypsum between the ledger and studs.							
4. Allowable loads shall be limited to parallel-to-grain loaded solid sawn main members (minimum 2" nominal studs).							
5. Allowable loads are shown at the wood load duration factor (C _D) = 1.00. Loads may be increased for load duration as permitted by the building code up to a C _D = 1.60. All adjustment factors shall be applied per NDS. For in-service moisture content greater than nineteen percent (19%), use Wet Service Factor (C _M) = 0.70.							
6. Similar to the wood-ledger application, fasteners shall be centered in the stud and spaced as shown in Figure 7 through Figure 15 in Section 9 .							
7. For Load Resistance Factor Design (LRFD) values, the reference connection design values shall be adjusted in accordance with NDS Section 11.3.							
8. Gypsum board must be attached as required per the applicable building code.							

- 6.7 Where the application falls outside of the performance evaluation, conditions of use, and/or installation requirements set forth herein, alternative techniques shall be permitted in accordance with accepted engineering practice and experience. This includes but is not limited to the following areas of engineering: mechanics or materials, structural, building science, and fire science.

7 Certified Performance⁴⁷

- 7.1 All construction methods shall conform to accepted engineering practices to ensure durable, livable, and safe construction and shall demonstrate acceptable workmanship reflecting journeyman quality of work of the various trades.⁴⁸
- 7.2 The strength and rigidity of the component parts and/or the integrated structure shall be determined by engineering analysis or by suitable load tests to simulate the actual loads and conditions of application that occur.⁴⁹

8 Regulatory Evaluation and Accepted Engineering Practice

- 8.1 Starborn Structural Screws comply with the following legislatively adopted regulations and/or accepted engineering practice for the following reasons:
- 8.1.1 Starborn Structural Screws were tested and evaluated to determine their ability to provide code complying attachment of ledger boards to the building structure in the following applications:
- 8.1.1.1 Use for the attachment of wood deck ledgers or Owens Corning Lumber Structural Framing deck ledgers to the building structure in accordance with ASTM D1761. This application includes attachments to Spruce Pine Fir (SPF) band joists⁵⁰ and Structural Composite Lumber (SCL) band joists.
- 8.1.1.2 Attachment of ledger boards to wood framed wall studs in accordance with ASTM D1761. This application includes zero, one, or two layers of 5/8" GWB between the ledger and the wall studs (see **Figure 7** through **Figure 15** in **Section 9**).
- 8.1.1.3 Use for the attachment of CFS deck ledgers to the building structure in accordance with engineering calculations from the NDS.
- 8.1.1.4 Attachment of CFS ledger tracks to wood framed wall studs in accordance with engineering calculations from NDS. This application includes zero, one, or two layers of 5/8" GWB between the ledger and the wall studs.



- 8.2 For conventionally framed buildings, the ledger is required to be attached to the band joist in accordance with IBC Section 1604.8.3, IRC Section R507.9,⁵¹ or as applicable.
- 8.3 Ultimate connection capacities and deflections of typical ledger board connections were match tested and evaluated pursuant to the provisions of the IRC and IBC. See **Appendix B** for a description of testing methods.
- 8.4 Use of fasteners in locations exposed to saltwater or saltwater spray is outside the scope of this report.
- 8.5 Any building code, regulation and/or accepted engineering evaluations (i.e., research reports, duly authenticated reports, etc.) that are conducted for this Listing were performed by DrJ Engineering, LLC (DrJ), which is an ISO/IEC 17065 accredited certification body and a professional engineering company operated by RDP/approved sources. DrJ is qualified⁵² to practice product and regulatory compliance services within its scope of accreditation and engineering expertise, respectively.
- 8.6 Engineering evaluations are conducted with DrJ's ANAB accredited ICS code scope of expertise, which is also its areas of professional engineering competence.
- 8.7 Any regulation specific issues not addressed in this section are outside the scope of this report.

9 Installation

- 9.1 Installation shall comply with the approved construction documents, the manufacturer installation instructions, this report, and the applicable building code.
- 9.2 In the event of a conflict between the manufacturer installation instructions and this report, the more restrictive shall govern.
- 9.3 For applications outside the scope of this report, an engineered design is required.
- 9.4 *General*
 - 9.4.1 Fasteners shall be installed with the topside of the head flush to the surface of the wood member.
 - 9.4.2 Fasteners shall not be overdriven.
 - 9.4.3 Fasteners shall not be struck with a hammer during installation.
 - 9.4.4 Lead holes are not required but may be used where lumber is prone to splitting using the provisions in the NDS.
 - 9.4.5 Unless otherwise stated, fastener spacing, edge distance, and end distance shall be in accordance with **Table 10**. Location of the distances are shown in **Figure 4**.

Table 10. Starborn Structural Screw Edge and End Distance Requirements for 0.23" Diameter Screw

Item Number from Figure 4	Installed Condition	Minimum Distance or Spacing ^{1,2} (in)		
		Face	Edge	End
1	Minimum End Distance	6	3	1 ³ / ₄
2	Minimum Edge Distance	1 ³ / ₄	3 ⁴ / ₄	3 ⁴ / ₄
3	Minimum Spacing Between Fasteners in a Row	3 ¹ / ₂	3 ¹ / ₂	3 ¹ / ₂
4	Minimum Spacing Between Non-Staggered Rows	3 ¹ / ₂	NA	NA
5	Minimum Spacing Between Staggered Rows	5 ⁸ / ₈	NA	NA
6	Minimum Stagger Between Fasteners in Adjacent Rows	5 ⁸ / ₈	NA	NA

SI: 1 in = 25.4 mm

1. Edge distances, end distances, and spacing of fasteners shall be sufficient to prevent splitting of the wood or as shown in this table, whichever is more restrictive.

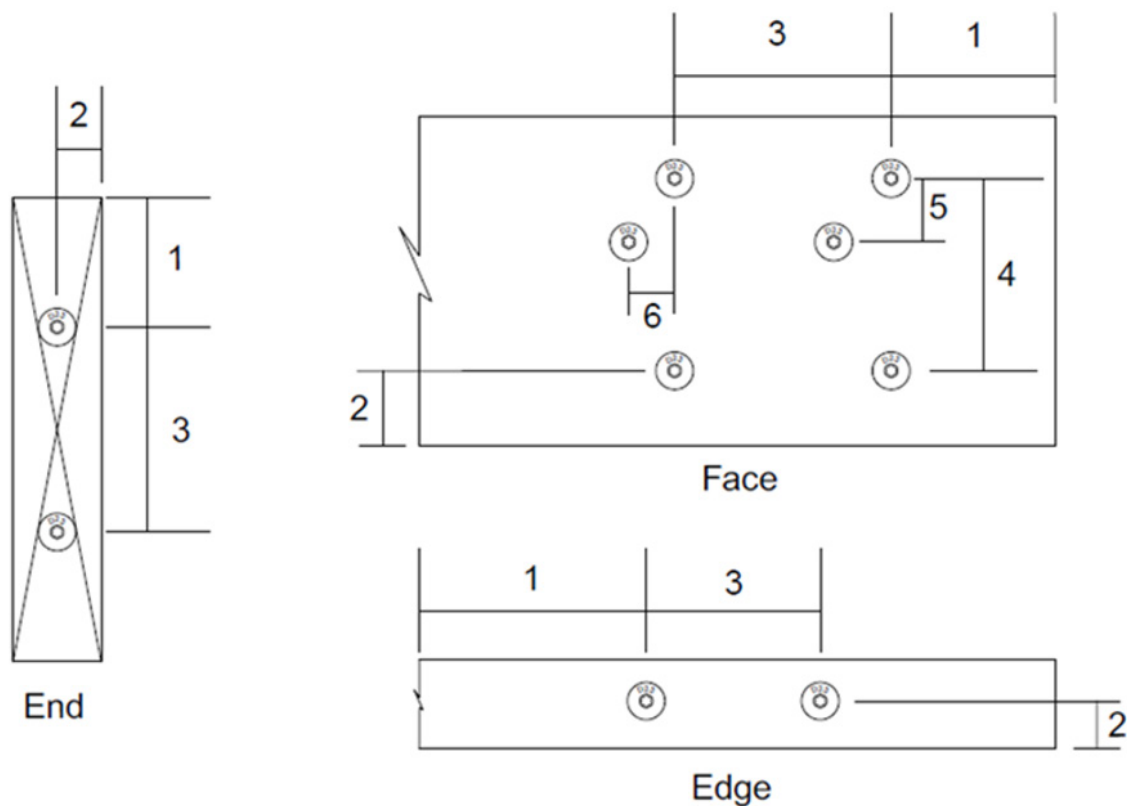


Figure 4. Starborn Structural Screws Spacing Diagram

9.5 Deck Ledger to Band Joist Installation Procedure

- 9.5.1 Choose 4" or 5" Starborn Structural Screws, so that the threads fully engage the band joist material and the fastener tip extends beyond the back face of the band joist material when fully seated against the installed ledger board. There is a minimum penetration of 1" unless otherwise stated in this report.
- 9.5.2 Using a high-torque low-speed drill, drive the fasteners through the ledger and sheathing. Continue into the band joist until the built-in washer head is drawn firm and flush to the ledger board. Do not overdrive.
- 9.5.3 The screws must be installed using a $\frac{3}{8}$ " hex or Torx® T-40 star driver bit. Pre-drilling of pilot holes is not required, but may be used where lumber is prone to splitting.
 - 9.5.3.1 Pre-drilling of pilot holes may be required for steel side members. The hole shall be drilled with a $\frac{7}{32}$ " or $\frac{15}{64}$ " drill bit.
- 9.5.4 All fastener spacing, edge distance, and end distance shall be as shown in **Table 3**, **Table 4**, **Table 5**, **Table 7**, or **Table 8**, and **Figure 5** and **Figure 6**.
 - 9.5.4.1 Stagger the fasteners from the top to the bottom along the length of the ledger while maintaining the required edge and end distances.
 - 9.5.4.2 As an example, **Figure 5** and **Figure 6** present details of the Starborn Structural Screws deck connection, including minimum edge and end distances.
 - 9.5.4.3 **Figure 5** depicts a wood ledger to stud installation. For CFS ledger, installation is in the same manner, but the web of the CFS ledger shall be against the exterior sheathing or the band joist.

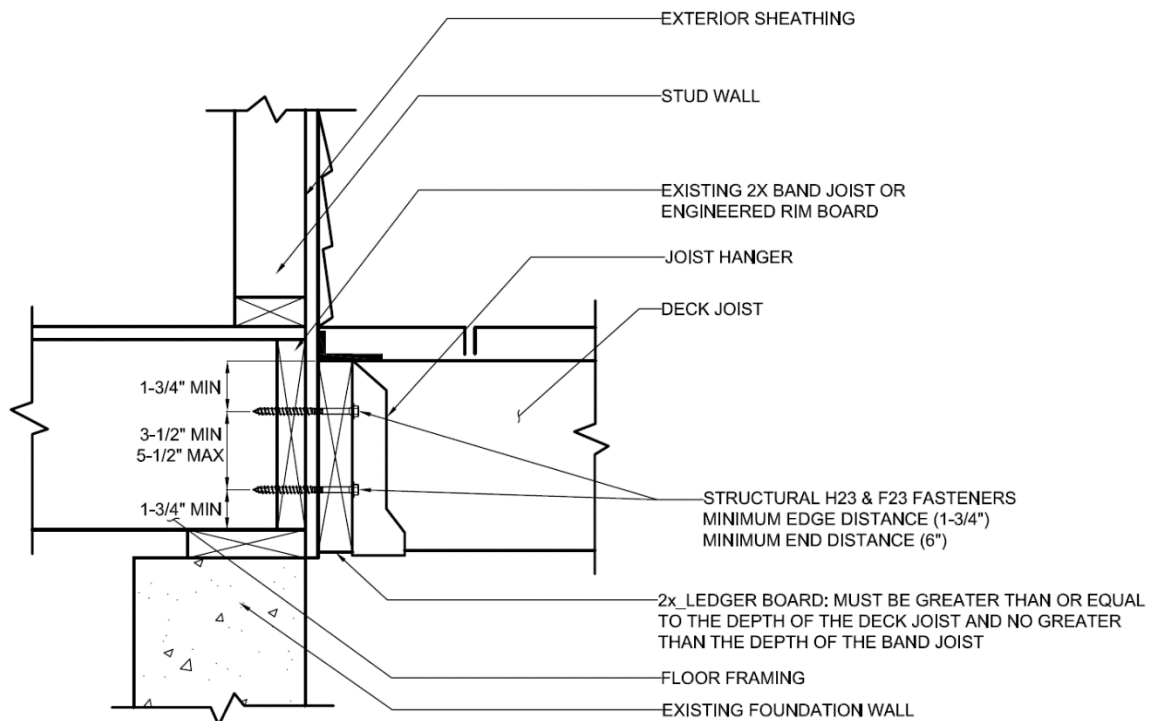


Figure 5. Starborn Structural Screws Deck Connection

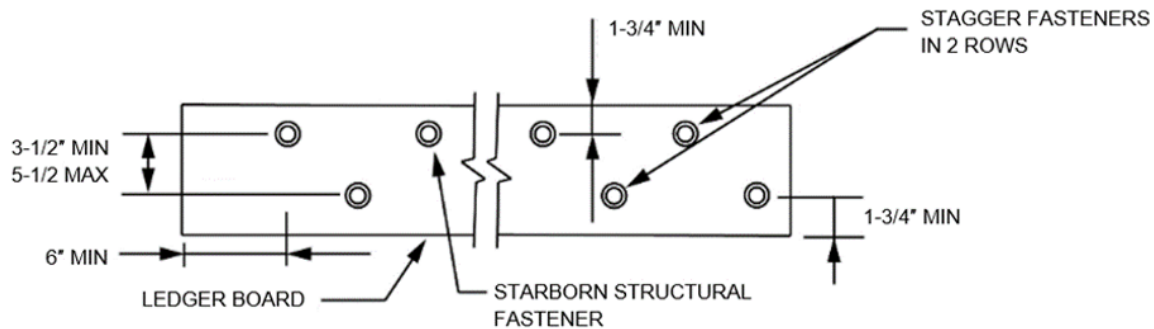


Figure 6. Starborn Structural Screws Ledger Connection

9.6 Ledger to Stud Installation Procedure

9.6.1 Choose one of the Starborn Structural Screws, H23 or F23, as listed in **Table 6** or **Table 9**.

9.6.2 Fasteners shall be centered in the stud.

9.6.2.1 The stud minimum end distance is $6\frac{3}{4}$ " when loaded toward the end and 4" when loaded away from the end.

9.6.2.2 Fasteners shall be installed with a minimum end distance of 6" on the ledger.

9.6.3 **Figure 7** through **Figure 15** show wood ledger to stud installation. For CFS ledger, installation is in the same manner, but the web of the CFS ledger shall be against the stud or the GWB sheathing.

9.6.4 *Without GWB Interlayer:*

9.6.4.1 Installation details for ledger to stud connections without GWB for 2 x 6, 2 x 8, and 2 x 10 ledgers are shown in **Figure 7**, **Figure 8**, and **Figure 9**, respectively.

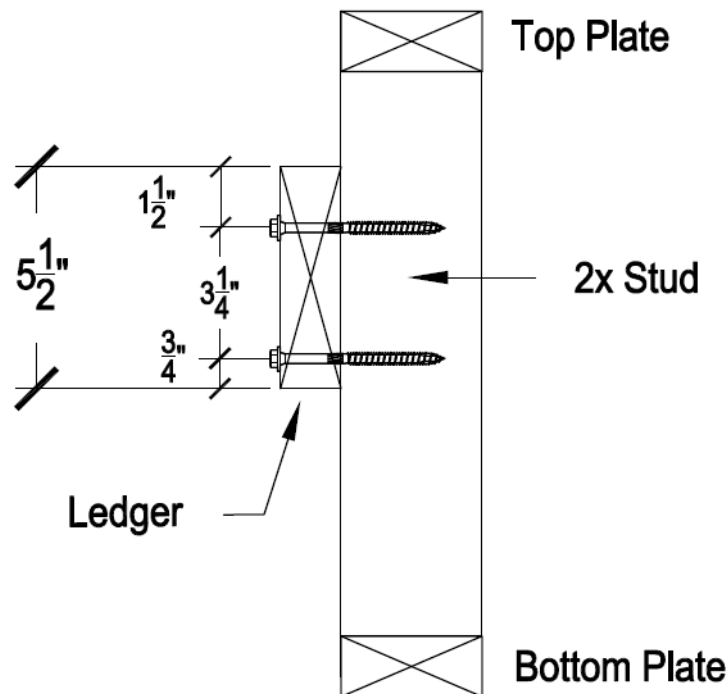


Figure 7. 2 x 6 Ledger with No GWB

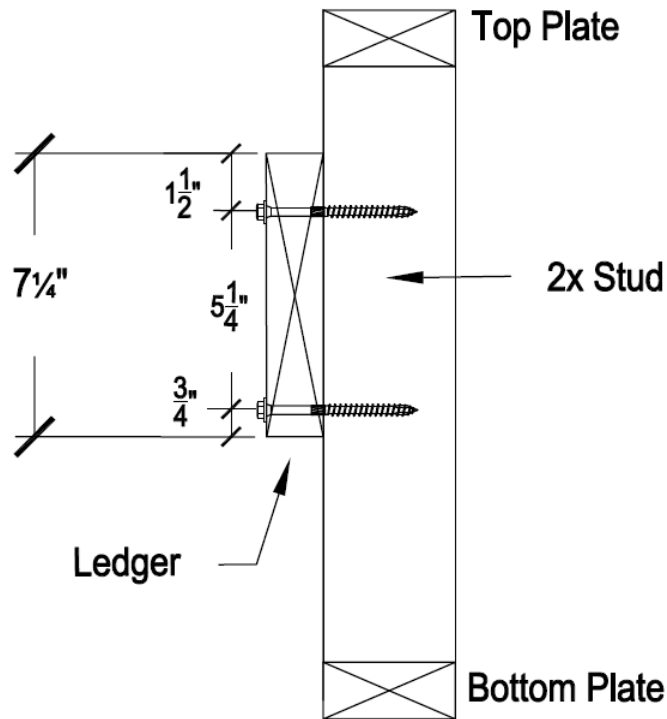


Figure 8. 2 x 8 Ledger with No GWB

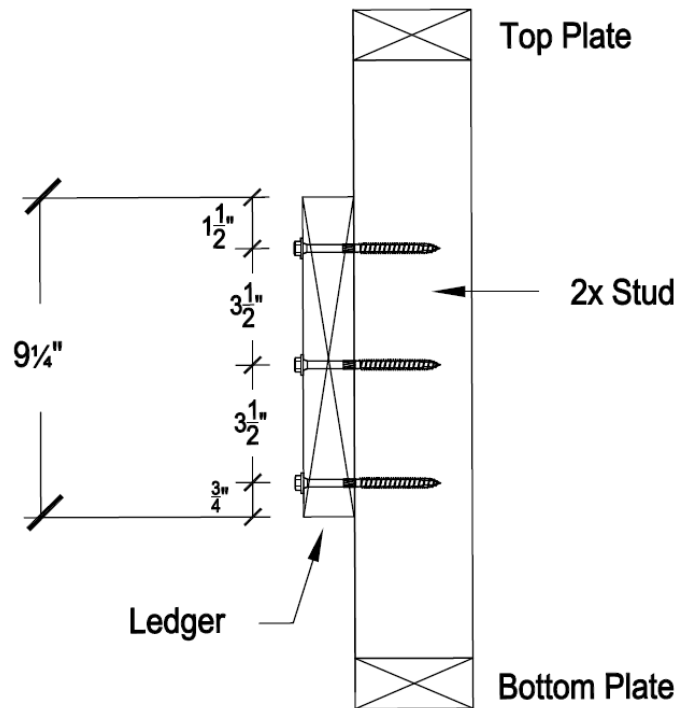


Figure 9. 2 x 10 Ledger with No GWB

9.6.5 With One Layer *GWB Interlayer*:

- 9.6.5.1 Installation details for ledger to stud connections with a single layer of *GWB* for 2 x 6, 2 x 8, and 2 x 10 ledgers are shown in **Figure 10**, **Figure 11**, and **Figure 12**, respectively.

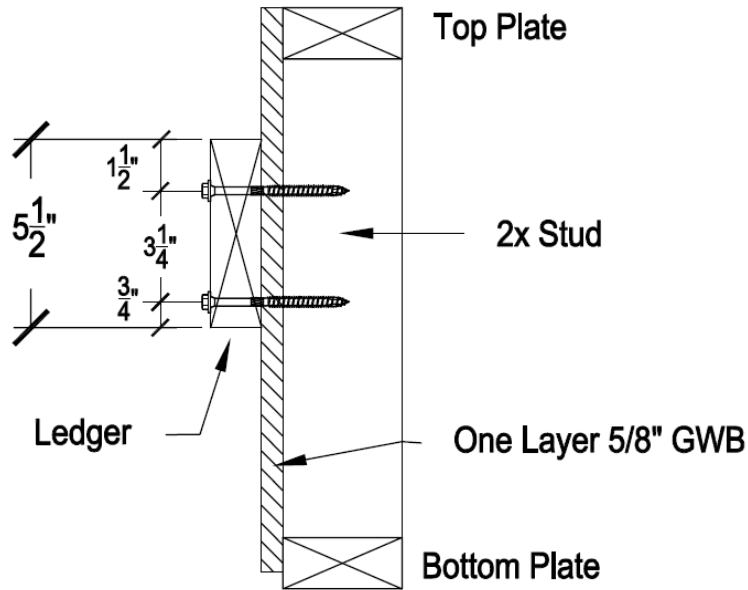


Figure 10. 2 x 6 Ledger with One Layer *GWB*

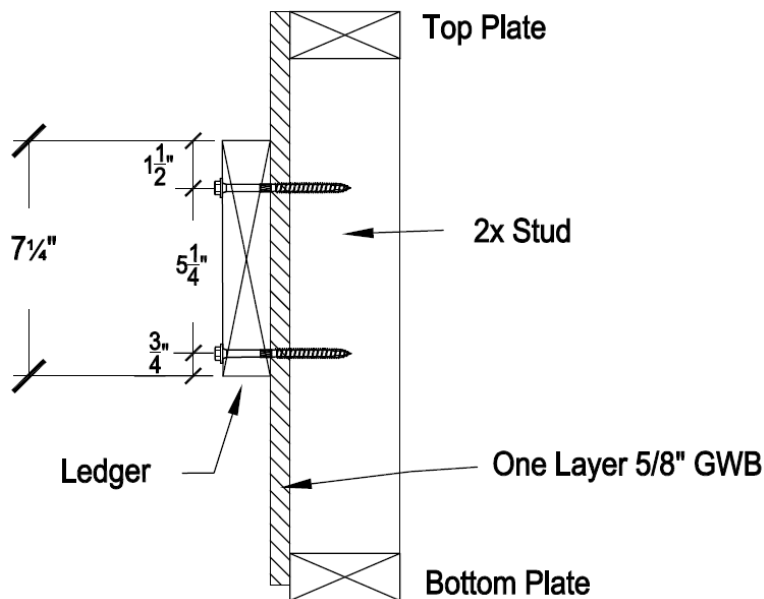


Figure 11. 2 x 8 Ledger with One Layer *GWB*

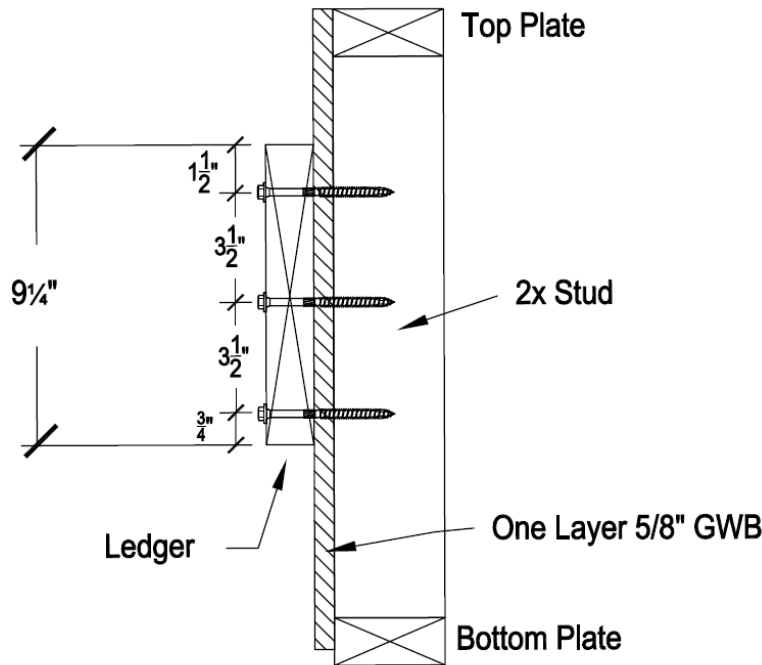


Figure 12. 2 x 10 Ledger with One Layer GWB

9.6.6 *With Two Layers GWB Interlayer:*

- 9.6.6.1 Installation details for ledger to stud connections with a double layer of GWB for 2 x 6, 2 x 8, and 2 x 10 ledgers are shown in **Figure 13**, **Figure 14**, and **Figure 15**, respectively.

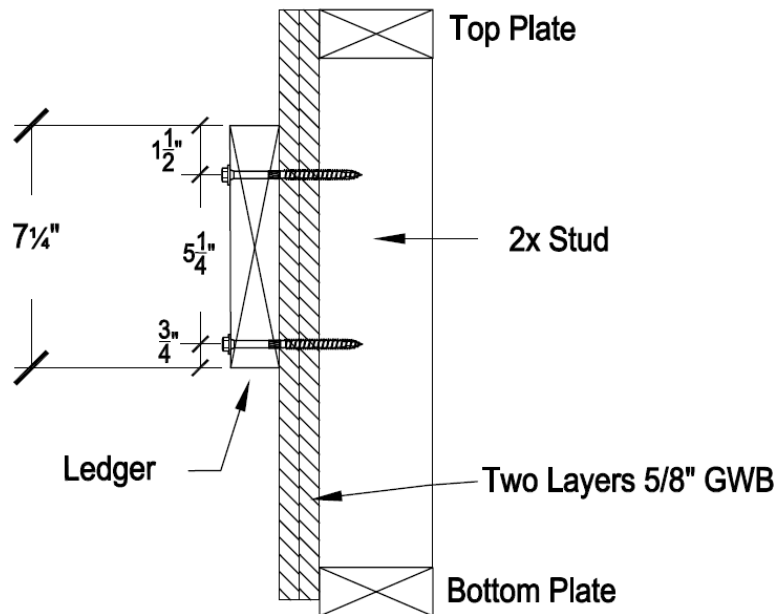


Figure 13. 2 x 6 Ledger with Two Layers GWB

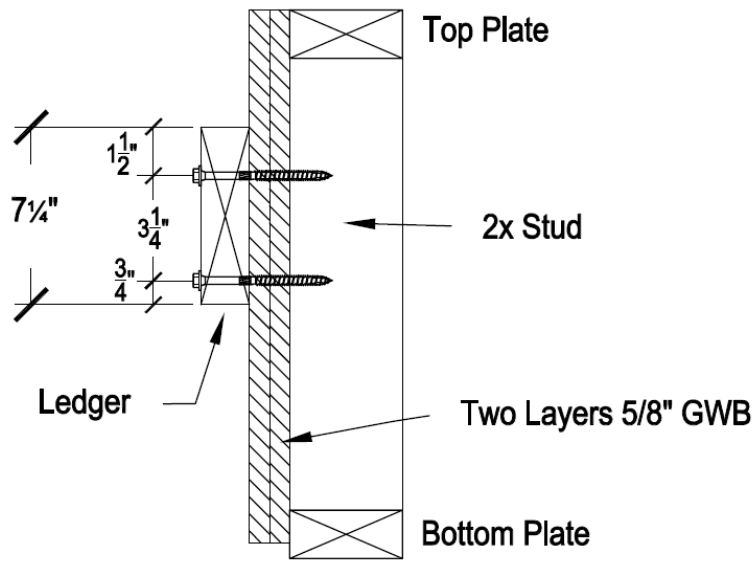


Figure 14. 2 x 8 Ledger with Two Layers GWB

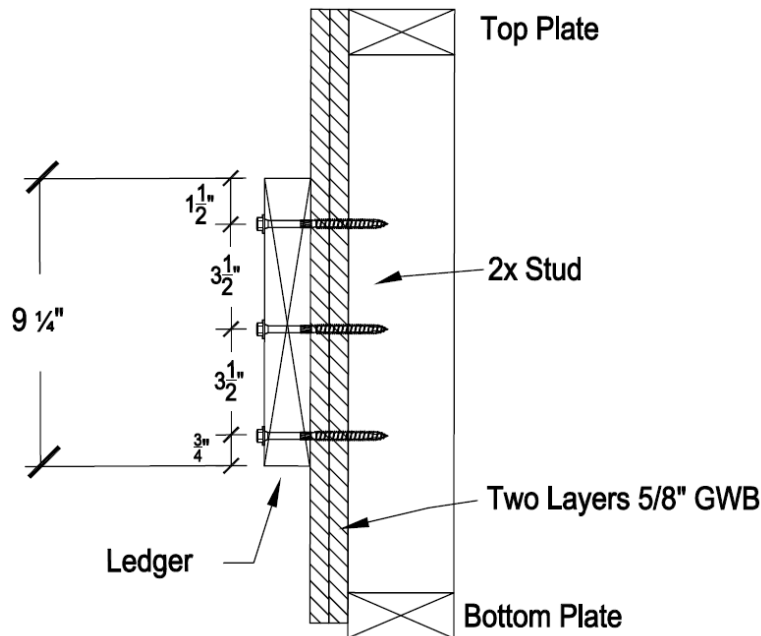


Figure 15. 2 x 10 Ledger with Two Layers GWB



10 Substantiating Data

- 10.1 Testing has been performed under the supervision of a professional engineer and/or under the requirements of ISO/IEC 17025 as follows:
- 10.1.1 Deck ledger assembly testing in accordance with ASTM D1761
 - 10.1.2 Calculations in accordance with NDS and AWC TR12 by DrJ Engineering LLC
 - 10.1.3 Material properties and design values in accordance with Report Number 1703-05
 - 10.1.4 DCA 6, Prescriptive Residential Wood Deck Construction Guide; AF&PA; 2010
- 10.2 Information contained herein may include the result of testing and/or data analysis by sources that are approved agencies, approved sources, and/or an RDP. Accuracy of external test data and resulting analysis is relied upon.
- 10.3 Where applicable, testing and/or engineering analysis are based upon provisions that have been codified into law through state or local adoption of regulations and standards. The developers of these regulations and standards are responsible for the reliability of published content. DrJ's engineering practice may use a regulation-adopted provision as the control. A regulation-endorsed control versus a simulation of the conditions of application to occur establishes a new material as being equivalent to the regulatory provision in terms of quality, strength, effectiveness, fire resistance, durability, and safety.
- 10.4 The accuracy of the provisions provided herein may be reliant upon the published properties of raw materials, which are defined by the grade mark, grade stamp, mill certificate, or duly authenticated reports from approved agencies and/or approved sources provided by the supplier. These are presumed to be minimum properties and relied upon to be accurate. The reliability of DrJ's engineering practice, as contained in this duly authenticated report, may be dependent upon published design properties by others.
- 10.5 *Testing and Engineering Analysis*
- 10.5.1 The strength, rigidity, and/or general performance of component parts and/or the integrated structure are determined by suitable tests that simulate the actual conditions of application that occur and/or by accepted engineering practice and experience.⁵³
- 10.6 Where additional condition of use and/or regulatory compliance information is required, please search for Starborn Structural Screws on the DrJ Certification website.

11 Findings

- 11.1 As outlined in **Section 6**, Starborn Structural Screws have performance characteristics that were tested and/or meet applicable regulations and are suitable for use pursuant to its specified purpose.
- 11.2 When used and installed in accordance with this duly authenticated report and the manufacturer installation instructions, Starborn Structural Screws shall be approved for the following applications:
- 11.2.1 As an alternative to the requirements of IBC Section 1604.8.3 and IRC Section R507.9.⁵⁴
 - 11.2.2 Connection of ledger boards to wall studs is suitable with zero, one, or two layers of gypsum between the ledger and wall studs in accordance with **Section 6.4** and **Section 6.6**.
- 11.3 Unless exempt by state statute, when Starborn Structural Screws are to be used as a structural and/or building envelope component in the design of a specific building, the design shall be performed by an RDP.
- 11.4 Any application specific issues not addressed herein can be engineered by an RDP. Assistance with engineering is available from Starborn Industries, Inc.



11.5 IBC Section 104.11 (IRC Section R104.11 and IFC Section 104.10⁵⁵ are similar) in pertinent part state:

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. 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.

11.6 **Approved:**⁵⁶ Building regulations require that the building official shall accept duly authenticated reports.⁵⁷

11.6.1 An approved agency is “approved” when it is ANAB ISO/IEC 17065 accredited.

11.6.2 An approved source is “approved” when an RDP is properly licensed to transact engineering commerce.

11.6.3 Federal law, Title 18 US Code Section 242, requires that where the alternative product, material, service, design, assembly, and/or method of construction is not approved, the building official shall respond in writing, stating the reasons why the alternative was not approved. Denial without written reason deprives a protected right to free and fair competition in the marketplace.

11.7 DrJ is a licensed engineering company, employs licensed RDPs and is an ANAB Accredited Product Certification Body – Accreditation #1131.

11.8 Through the IAF Multilateral Arrangement (MLA), this duly authenticated report can be used to obtain product approval in any jurisdiction or country because all ANAB ISO/IEC 17065 duly authenticated reports are equivalent.⁵⁸

12 Conditions of Use

12.1 Material properties shall not fall outside the boundaries defined in **Section 6**.

12.2 As defined in **Section 6**, where material and/or engineering mechanics properties are created for load resisting design purposes, the resistance to the applied load shall not exceed the ability of the defined properties to resist those loads using the principles of accepted engineering practice.

12.3 As listed herein, Starborn Structural Screws shall not be used:

12.3.1 In applications where the loads exceed the allowable values in **Table 6** or **Table 9**.

12.4 When installed in preservative treated wood or fire-retardant treated wood, connections shall be designed using the treatment manufacturer reductions for connections.

12.5 For conditions not covered in this report, 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.

12.6 Use of fasteners in locations exposed to saltwater or saltwater spray is outside the scope of this report.

12.7 When required by adopted legislation and enforced by the building official, also known as the Authority Having Jurisdiction (AHJ) in which the project is to be constructed:

12.7.1 Any calculations incorporated into the construction documents shall conform to accepted engineering practice and, when prepared by an approved source, shall be approved when signed and sealed.

12.7.2 This report and the installation instructions shall be submitted at the time of permit application.

12.7.3 These innovative products have an internal quality control program and a third-party quality assurance program.

12.7.4 At a minimum, these innovative products shall be installed per **Section 9** of this report.

12.7.5 The review of this report by the AHJ shall comply with IBC Section 104 and IBC Section 105.4.



- 12.7.6 These innovative products have an internal quality control program and a third party quality assurance program in accordance with IBC Section 104.4, IBC Section 110.4, IBC Section 1703, IRC Section R104.4, and IRC Section R109.2.
- 12.7.7 The application of these innovative products in the context of this report is dependent upon the accuracy of the construction documents, implementation of installation instructions, inspection as required by IBC Section 110.3, IRC Section R109.2, and any other regulatory requirements that may apply.
- 12.8 The approval of this report by the AHJ shall comply with IBC Section 1707.1, where legislation states in part, *“the building official shall accept duly authenticated reports from approved agencies in respect to the quality and manner of use of new material or assemblies as provided for in Section 104.11”*, all of IBC Section 104, and IBC Section 105.4.
- 12.9 Design loads shall be determined in accordance with the regulations adopted by the jurisdiction in which the project is to be constructed and/or by the building designer (i.e., owner or RDP).
- 12.10 The actual design, suitability, and use of this report for any particular building, is the responsibility of the owner or the authorized agent of the owner.

13 Identification

- 13.1 The innovative products listed in **Section 1.1** are identified by a label on the board or packaging material bearing the manufacturer name, product name, this report number, and other information to confirm code compliance.
- 13.2 Additional technical information can be found at starbornindustries.com.

14 Review Schedule

- 14.1 This report is subject to periodic review and revision. For the latest version, visit www.drjcertification.org.
- 14.2 For information on the status of this report, please contact DrJ Certification.

Appendix A

1 Code Requirements for Ledger Attachments

1.1 For guidance on designing the connection of the deck ledger to trusses where a band joist is not used, see the SBCA Tech Note, *Attachment of Residential Deck Ledger to Metal Plate Connected Wood Truss Floor Systems*.

1.2 IRC Section R507.8⁵⁹ contains the following code requirements (IBC Section 1604.8.3 is similar):

1.2.1 Where supported by attachment to an exterior wall, decks shall be positively anchored to the primary structure and designed for both vertical and lateral loads.

1.2.1.1 Attachment shall not be accomplished by the use of toenails or nails subject to withdrawal.

1.3 IRC Section R507.9.1⁶⁰ details how vertical loads shall be transferred to band joists with ledgers:

1.3.1 IRC Section R507.9.1.1:⁶¹

Deck ledgers shall be a minimum 2-inch by 8-inch (51 mm by 203 mm) nominal, pressure-preservative-treated Southern pine, incised pressure-preservative-treated hem-fir, or approved, naturally durable, No. 2 grade or better lumber...

1.3.2 IRC Section R507.9.1.2:⁶²

Band joists supporting a ledger shall be a minimum 2-inch-nominal (51 mm), solid-sawn, spruce-pine-fir or better lumber or a minimum 1-inch (25 mm) nominal engineered wood rim boards in accordance with Section R502.1.7. Band joists shall bear fully on the primary structure capable of supporting all required loads.

1.3.3 IRC Section R507.9.1.3:⁶³

Fasteners used in deck ledger connections in accordance with Table R507.9.1.3(1) shall be hot-dipped galvanized or stainless steel and shall be installed in accordance with Table R507.9.1.3(2) and Figures R507.9.1.3(1) and R507.9.1.3(2).

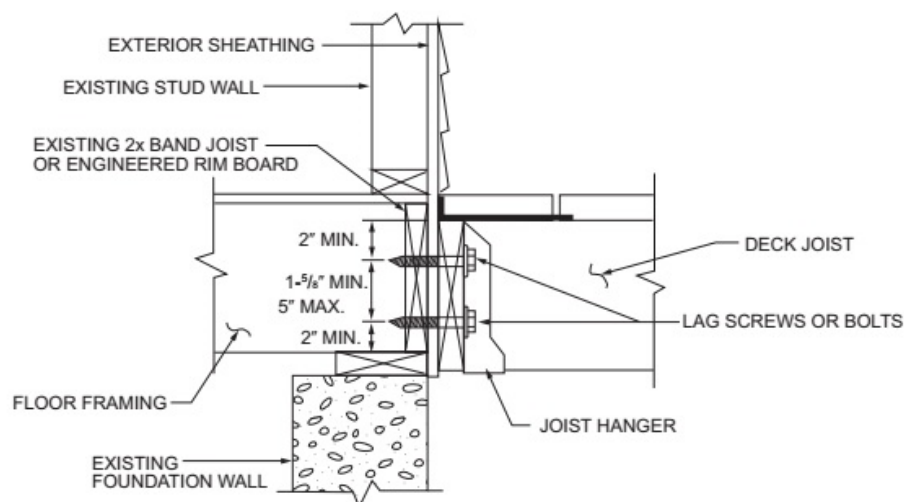


Figure 16. IRC Figure R507.9.1.3(2): Placement of Lag Screws and Bolts in Band Joists

1.3.4 IRC Table R507.9.1.3(1) and IRC Table R507.9.1.3(2)⁶⁴ cover the placement of lag screws or bolts in deck ledgers:

The tip of the lag screw shall fully extend beyond the inside face of the band joist.

Lag screws or bolts shall be staggered from the top to the bottom along the horizontal run of the deck ledger in accordance with Figure R507.9.1.3(1).

The minimum distance from bottom row of lag screws or bolts to the top edge of the ledger shall be in accordance with Figure R507.9.1.3(1).

CONNECTION DETAILS	JOIST SPAN						
	6' and less	6'1" to 8'	8'1" to 10'	10'1" to 12'	12'1" to 14'	14'1" to 16'	16'1" to 18'
	On-center spacing of fasteners						
¹ / ₂ -inch diameter lag screw with ¹ / ₂ -inch maximum sheathing ^{c, d}	30	23	18	15	13	11	10
¹ / ₂ -inch diameter bolt with ¹ / ₂ -inch maximum sheathing ^d	36	36	34	29	24	21	19
¹ / ₂ -inch diameter bolt with 1-inch maximum sheathing ^e	36	36	29	24	21	18	16

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 0.0479 kPa.

- a. Ledgers shall be flashed in accordance with Section R703.4 to prevent water from contacting the house band joist.
- b. Snow load shall not be assumed to act concurrently with live load.
- c. The tip of the lag screw shall fully extend beyond the inside face of the band joist.
- d. Sheathing shall be wood structural panel or solid sawn lumber.
- e. Sheathing shall be permitted to be wood structural panel, gypsum board, fiberboard, lumber or foam sheathing. Up to ¹/₂-inch thickness of stacked washers shall be permitted to substitute for up to ¹/₂ inch of allowable sheathing thickness where combined with wood structural panel or lumber sheathing.

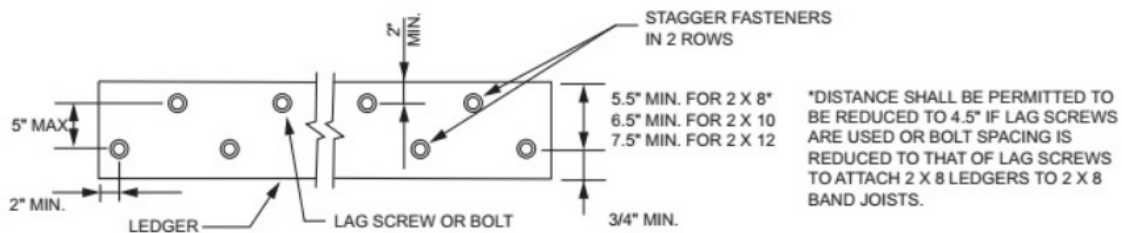
Figure 17. IRC Table R507.9.1.3(1): Deck Ledger Connection to Band Joist^{A,B}
(Deck live load = 40 psf, deck dead load = 10 psf, snow load ≤ 40 psf)

MINIMUM END AND EDGE DISTANCES AND SPACING BETWEEN ROWS				
	TOP EDGE	BOTTOM EDGE	ENDS	ROW SPACING
Ledger ^a	2 inches ^d	3/4 inch	2 inches ^b	1 ⁵ / ₈ inches ^b
Band Joist ^c	3/4 inch	2 inches	2 inches ^b	1 ⁵ / ₈ inches ^b

For SI: 1 inch = 25.4 mm.

- a. Lag screws or bolts shall be staggered from the top to the bottom along the horizontal run of the deck ledger in accordance with Figure R507.9.1.3(1).
- b. Maximum 5 inches.
- c. For engineered rim joists, the manufacturer's recommendations shall govern.
- d. The minimum distance from bottom row of lag screws or bolts to the top edge of the ledger shall be in accordance with Figure R507.9.1.3(1).

Figure 18. IRC Table R507.9.1.3(2): Placement of Lag Screws and Bolts in Deck Ledgers and Band Joists



For SI: 1 inch = 25.4 mm.

Figure 19. Figure IRC R507.9.1.3(1): Placement of Lag Screws and Bolts in Ledgers

Appendix B

1 Testing Procedure and Methodology

- 1.1 To determine the strength and load-deflection performance of the fasteners in a ledger connection, a two-joint assembly with connection of a ledger to a band joist was created. Load was applied to the joists, which transferred load to the ledger via hangers. String potentiometers were placed along the bottom of the ledger to measure vertical deflection during the test, while a load cell attached to an actuator-measured load applied. The band joist was fixed to prevent deflection and rotation during the test. To limit the variability, the comparison product was tested simultaneously with the Starborn Structural Screws with ledgers and band joists cut congruently from the same piece of lumber. Immediately after testing, a section was cut near each fastener location to determine the moisture content and oven-dry specific gravity of each piece of lumber.
- 1.2 The performance of the code-defined lag screw connection was then compared to the performance of the Starborn Structural Screws in the ledger application built per the code requirements.
 - 1.2.1 Testing was undertaken to directly compare fastener performance using matched lumber specimen testing where the Starborn Structural Screws were tested side by side with $\frac{1}{2}$ " diameter lag screws (see **Figure 20** and **Figure 21**).

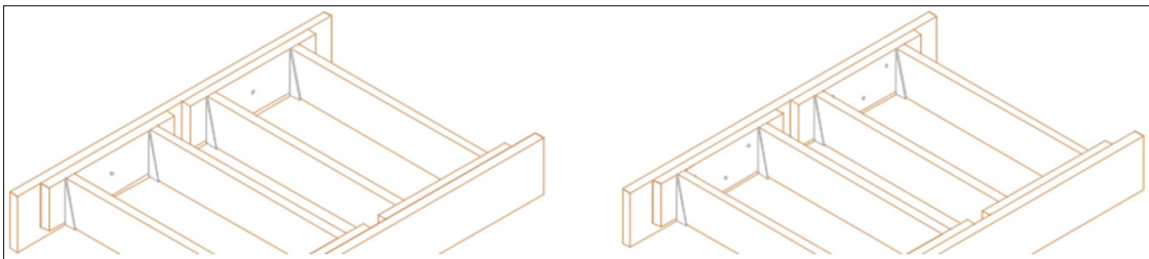


Figure 20. Single and Three-Fastener Setups

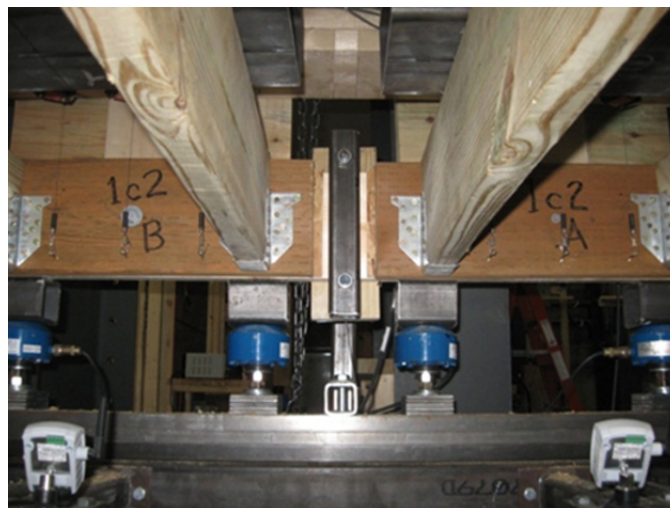


Figure 21. Matched Lumber Specimen Testing of Starborn Structural Screws and $\frac{1}{2}$ " Lag Screw

- 1.2.2 The testing and resulting analysis define comparative performance and the design parameters required for Starborn Structural Screws to be considered an equivalent alternative to the specified fasteners required by the building code in accordance with the provisions of IBC Section 104.11 and IRC Section R104.11.



Notes

For more information, visit drjcertification.org or call us at 608-310-6748.

<https://up.codes/viewer/wyoming/ibc-2021/chapter/17/special-inspections-and-tests#1702>

Alternative Materials, Design and Methods of Construction and Equipment: The provisions of any regulation code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by a regulation. Please review <https://www.justice.gov/atr/mission> and <https://up.codes/viewer/colorado/ibc-2021/chapter/1/scope-and-administration#104.11>

<https://up.codes/viewer/wyoming/ibc-2021/chapter/17/special-inspections-and-tests#1706>:~:text=the%20design%20strengths%20and%20permissible%20stresses%20shall%20be%20established%20by%20tests%20as

The design strengths and permissible stresses of any structural material shall conform to the specifications and methods of design of accepted engineering practice.

<https://up.codes/viewer/wyoming/ibc-2021/chapter/17/special-inspections-and-tests#1706>:~:text=shall%20conform%20to%20the%20specifications%20and%20methods%20of%20design%20of%20accepted%20engineering%20practice

<https://up.codes/viewer/wyoming/ibc-2021/chapter/17/special-inspections-and-tests#1707.1>:~:text=the%20building%20official%20shall%20accept%20duly%20authenticated%20reports%20from%20approved%20agencies

<https://up.codes/viewer/wyoming/ibc-2021/chapter/17/special-inspections-and-tests#1703.4.2>

https://up.codes/viewer/wyoming/ibc-2021/chapter/2/definitions#approved_agency

https://up.codes/viewer/wyoming/ibc-2021/chapter/2/definitions#approved_source

<https://www.law.cornell.edu/uscode/text/18/1832> (b) Any organization that commits any offense described in subsection (a) shall be fined not more than the greater of \$5,000,000 or 3 times the value of the stolen trade secret to the organization, including expenses for research and design and other costs of reproducing the trade secret that the organization has thereby avoided. The federal government and each state have a public records act. To follow DTSA and comply state public records and trade secret legislation requires approval through ANAB ISO/IEC 17065 accredited certification bodies or approved sources. For more information, please review this website: [Intellectual Property and Trade Secrets](https://www.intellectualpropertyandtradesecrets.com/)

<https://www.nspe.org/resources/issues-and-advocacy/professional-policies-and-position-statements/regulation-professional> AND <https://apassociation.org/list-of-engineering-boards-in-each-state-archive/>

<https://www.cbiteest.com/accreditation/>

<https://up.codes/viewer/colorado/ibc-2021/chapter/1/scope-and-administration#104>:~:text=to%20enforce%20the%20provisions%20of%20this%20code

<https://up.codes/viewer/colorado/ibc-2021/chapter/1/scope-and-administration#104.11>:~:text=Where%20the%20alternative%20material%2C%20design%20or%20method%20of%20construction%20is%20not%20approved%2C%20the%20building%20official%20shall%20respond%20in%20writing%2C%20stating%20the%20reasons%20why%20the%20alternative%20was%20not%20approved AND

<https://up.codes/viewer/colorado/ibc-2021/chapter/1/scope-and-administration#105.3.1>:~:text=If%20the%20application%20or%20the%20construction%20documents%20do%20not%20conform%20to%20the%20requirements%20of%20pertinent%20laws%2C%20the%20building%20official%20shall%20reject%20such%20application%20in%20writing%2C%20stating%20the%20reasons%20therefore

<https://up.codes/viewer/colorado/ibc-2021/chapter/17/special-inspections-and-tests#1707.1>:~:text=the%20building%20official%20shall%20accept%20duly%20authenticated%20reports%20from%20approved%20agencies%20in%20respect%20to%20the%20quality%20and%20manner%20of%20use%20of%20new%20materials%20or%20assemblies%20as%20provided%20for%20in%20Section%20104.11

<https://iaf.nu/en/about-iaf-mia/#>:~:text=it%20is%20required%20to%20recognise%20certificates%20and%20validation%20and%20verification%20statements%20issued%20by%20conformity%20assessment%20bodies%20accredited%20by%20all%20other%20signatories%20of%20the%20IAF%20MLA%2C%20with%20the%20appropriate%20scope

True for all ANAB accredited product evaluation agencies and all International Trade Agreements.

<https://www.justice.gov/crt/deprivation-rights-under-color-law> AND <https://www.justice.gov/atr/mission>

Unless otherwise noted, all references in this Listing are from the 2021 version of the codes and the standards referenced therein. This material, product, design, service, and/or method of construction also complies with the 2000-2021 versions of the referenced codes and the standards referenced therein.

See [Adoptions by Publisher](#) for the latest adoption of a non-amended or amended model code by the local jurisdiction. <https://up.codes/codes/general>

See [Adoptions by Publisher](#) for the latest adoption of a non-amended or amended model code by state. <https://up.codes/codes/general>

<https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3282/subpart-A/section-3282.14>

<https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3280>

<https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3280#p-3280.2> (Listed%20or%20certified); <https://up.codes/viewer/colorado/ibc-2021/chapter/2/definitions#listed> AND <https://up.codes/viewer/colorado/ibc-2021/chapter/2/definitions#labeled>

2015 IRC Section R507.2

2015 IRC Section R507.2.1

2015 IRC Section R507.2

2015 IRC Section R507.2.1

2015 IRC Section R507.2.1

2015 IRC Section R507.2

2015 IRC Section 507.2

2015 IRC Section R507.2

2015 IRC Table R507.2

2015 IRC Table R507.2



[2015 IRC Section R507.2](#)

[2015 IRC Section R507.2.1](#)

[2015 IRC Section R507.2.1](#)

[2015 IRC Section R507.2](#)

[2015 IRC Section 507.2](#)

[2015 IRC Section 507.2](#)

[2015 IRC Table R507.2](#)

[2015 IRC Section R507.2](#)

[2015 IRC Section R507.2.1](#)

[2015 IRC Section R507.2](#)

[2015 IRC Section 507.2](#)

[2015 IRC Section R507.2](#)

<https://up.codes/viewer/colorado/ibc-2021/chapter/17/special-inspections-and-tests#1703.4>

<https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3280#:~:text=All%20construction%20methods%20shall%20be%20in%20conformance%20with%20accepted%20engineering%20practices%20to%20insure%20durable%2C%20livable%2C%20and%20safe%20housing%20and%20shall%20demonstrate%20acceptable%20workmanship%20reflecting%20journeyman%20quality%20of%20work%20of%20the%20various%20trades>

<https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3280#:~:text=The%20strength%20and%20rigidity%20of%20the%20component%20parts%20and/or%20the%20integrated%20structure%20shall%20be%20determined%20by%20engineering%20analysis%20or%20by%20suitable%20load%20tests%20to%20simulate%20the%20actual%20loads%20and%20conditions%20of%20application%20that%20occur>

The term “*band joist*” is used throughout this report. Other regionally used terms that are synonymous with band joist include rim board, band board, header board, and header joist.

[2015 IRC Section 507.2](#)

Qualification is performed by a legislatively defined Accreditation Body. ANSI National Accreditation Board (ANAB) is the largest independent accreditation body in North America and provides services in more than 75 countries. DrJ is an ANAB accredited product certification body.

See Code of Federal Regulations (CFR) Title 24 Subtitle B Chapter XX Part 3280 for definition.

[2015 IRC Section 507.2](#)

[2018 IFC Section 104.9](#)

Approved is an adjective that modifies the noun after it. For example, Approved Agency means that the Agency is accepted officially as being suitable in a particular situation. This example conforms to IBC/IRC/IFC [Section 201.4](#) where the building code authorizes sentences to have an ordinarily accepted meaning such as the context implies.

<https://up.codes/viewer/wyoming/ibc-2021/chapter/17/special-inspections-and-tests#1707.1>

Multilateral approval is true for all ANAB accredited product evaluation agencies and all International Trade Agreements.

[2015 IRC Section R507.1](#)

[2015 IRC Section R507.2.1](#)

[2015 IRC Section R507.2.1](#)

[2015 IRC Section R507.2.2](#)

[2015 IRC Section R507.2.3](#)

[2015 IRC Table R507.2.1](#)