Technical Evaluation Report™ - Canada

A Duly Authenticated Report from an Approved Agency

Report No: 2011-02

Issue Date: December 15, 2020

Revision Date: December 2, 2025

Subject to Renewal: January 1, 2027

Starborn® Structural Screws: Fastener Properties and Design Values - Canada

Trade Secret Report Holder:

Starborn® Industries, Inc.
45 Mayfield Ave
Edison, NJ 08837-3820
Phone: 800-596-7747
Email: info@starbornindustries.com
Website: starbornindustries.com

CSI Designations:

DIVISION: 06 00 00 - WOOD, PLASTICS AND COMPOSITES

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

1 Innovative Products Evaluated[1]

1.1 Starborn Structural Screws:

- 1.1.1 Starborn Structural H19 Screws
- 1.1.2 Starborn Structural F19 Screws
- 1.1.3 Starborn Structural H23 Screws
- 1.1.4 Starborn Structural F23 Screws
- 1.1.5 Starborn Structural F23-E Screws
- 1.1.6 Starborn Structural F23-W Screws

2 Product Description and Materials

2.1 *General*

2.1.1 Starborn Structural Screws are alternate dowel-type sell-drilling fasteners designed for use in wood-to-wood connections. The fasteners listed in **Table 1** are evaluated in this report:

Table 1. Starborn Structural Screws Designation and Product Name

Product Name	Unthreaded Shank Diameter[1] in (mm)	Head Type in (mm)	Coating Type (Application)
Structural H19	0.19 (4.8)	5/16 Hex (7.9)	Exterior Use
Structural F19		Flat (T-30)	
Structural H23	0.23 (5.8)	3/8 Hex (9.5)	
Structural F23		T-40 Flat	
Structural F23-E			Exterior / Interior Use (Gray)
Structural F23-W			Interior Use (Gray)

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 *Fastener Material*

2.2.1 Starborn Structural 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 6**.

2.3 *Fastener Coatings*

2.3.1 Starborn F23-W screws are designated for interior, dry use only.

2.3.2 Starborn H19, F19, H23, F23-E, and F23 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 6**. These fasteners are alternatives to hot-dip zinc galvanized fasteners and meet the requirements of NBC Subsection 5.9.1. They feature a proprietary coating system that meets or exceeds the corrosion protection of hot-dipped galvanizing per ASTM A153.

2.3.2.1 Starborn H19, F19, H23, F23-E, and F23 screws were evaluated for use in wood that is chemically treated with waterborne Alkaline Copper Quaternary, Type D (ACQ-D).

2.3.2.2 Starborn H19, F19, H23, F23-E, and F23 screws are approved for use in fire-retardant treated lumber, provided the conditions set forth by the fire-retardant treated lumber manufacturer be met, including appropriate strength reductions.

2.4 *Wood Members*

2.4.1 Solid sawn wood members connected with Starborn Structural Screws shall consist of lumber species or species combinations having a relative density of 0.42 to 0.50.

2.4.2 Structural composite lumber (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. Equivalent specific gravities for structural composite lumber may be used in the design of connections using the relative densities of the sawn lumber shown in **Table 3**, **Table 4**, and **Table 5**.

2.5 *Fastener Specifications*

2.5.1 The fasteners evaluated in this report are specified in **Table 2** and **Figure 1** through **Figure 6**.

Table 2. Fastener Specifications

Product Name	Head Marking	Fastener Length in (mm)	Thread Length in (mm)	Unthreaded Shank Diameter[1] in (mm)	Thread Diameter in (mm)		Nominal Bending Yield,[3] f_{yb} psi (MPa)	Factored Fastener Strength lb (kN)	
					Minor[2]	Major		Tensile	Shear[4]
Structural H19	D19 2.9	2 7/8 (73)	1.4 (36)	0.189 (4.8)	0.169 (4.3)	0.26 (6.6)	196,700 (1,355)	2,305 (10.3)	1,955 (8.7)
	D19 4	4 (102)	2 1/4 (57)						
	D19 6	6 (152)	2 1/2 (64)						
	D19 8	8 (203)							
	D19 10	10 (254)							
Structural F19	D19 2.9	2 7/8	2 (51)	0.189 (4.8)	0.169 (4.3)	0.26 (6.6)	196,880 (1,358)	2,690 (12.0)	1,830 (8.1)
	D19 4	4 1/2							
	D19 6	6							
	D19 8	8							
	D19 10	10							
	D19 12	12							
	D19 14	14							
	D19 16	16							
Structural H23	D23 4	4 (102)	2 3/8 (60)	0.229 (5.8)	0.209 (5.3)	0.307 (7.8)	183,155 (1,262)	3,565 (15.9)	2,680 (11.9)
	D23 5	5 (127)	3 (76)						
Structural F23	D23 2.9	2 7/8 (73)	1.4 (36)	0.229 (5.8)	0.209 (5.3)	0.307 (7.8)	183,155 (1,262)	3,565 (15.9)	2,680 (11.9)
	D23 4	4 (102)	2 3/8 (60)						
	D23 5	5 (127)	3 (76)						
	D23 6	6 (152)	2 3/4 (70)						
	D23 8	8 (203)							
	D23 10	10 (254)							
Structural F23-E	D23 3.4 XFE	3 3/8 (86)	1 1/2 (38)	0.229 (5.8)	0.209 (5.3)	0.307 (7.8)	183,155 (1,262)	3,565 (15.9)	2,680 (11.9)
	D23 5 XFE	5 (127)							
	D23 6.8 XFE	6 3/4 (171)							

Table 2. Fastener Specifications

Product Name	Head Marking	Fastener Length in (mm)	Thread Length in (mm)	Unthreaded Shank Diameter[1] in (mm)	Thread Diameter in (mm)		Nominal Bending Yield,[3] f_{yb} psi (MPa)	Factored Fastener Strength lb (kN)	
					Minor[2]	Major		Tensile	Shear[4]
Structural F23-W	D23 2.9 XFW	2 7/8 (73)	1.4 (36)	0.229 (5.8)	0.209 (5.3)	0.307 (7.8)	183,155 (1,262)	3,565 (15.9)	2,680 (11.9)
	D23 4.4 XFW	4 3/8 (111)							
	D23 5.9 XFW	5 7/8 (149)							

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

1. The 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.
3. Bending yield strength determined in accordance with ASTM F1575 and based on the minor diameter.
4. Shear strength applicable at both the smooth shank and thread diameter

2.6 The innovative products evaluated in this report are shown in **Figure 1** through **Figure 6**.

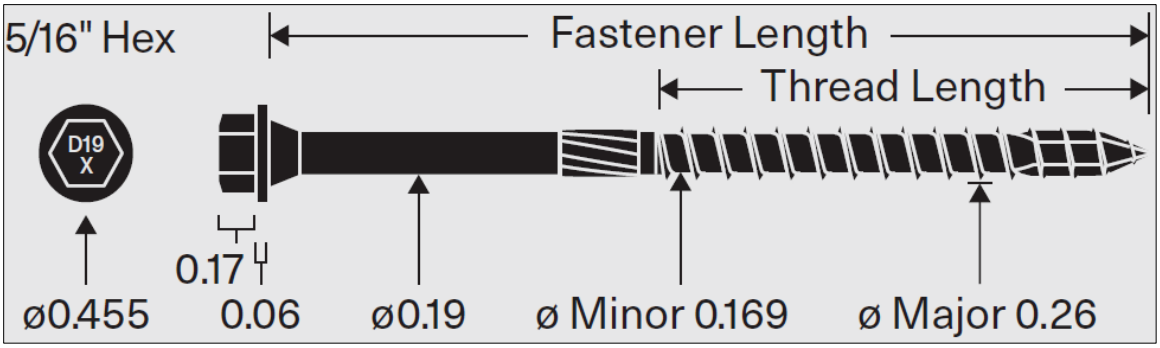

Figure 1. Starborn Structural H19 Screw (Dimensions in Inches)

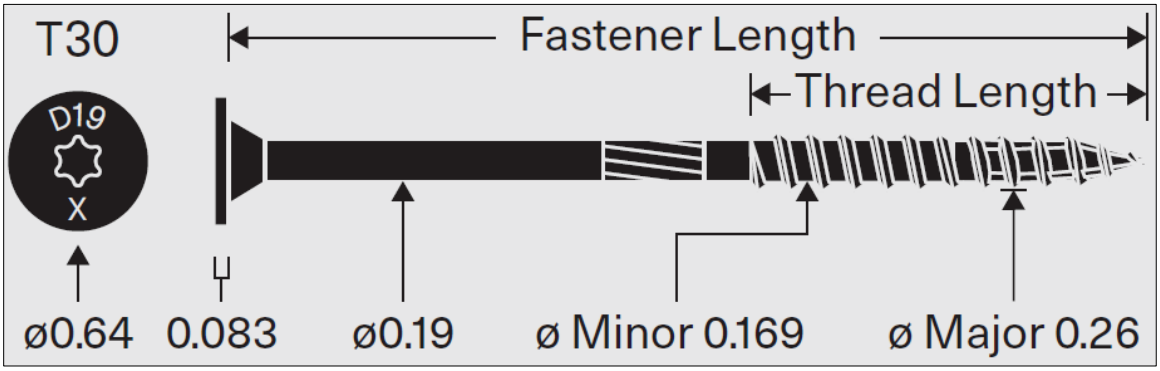

Figure 2. Starborn Structural F19 Screw (Dimensions in Inches)

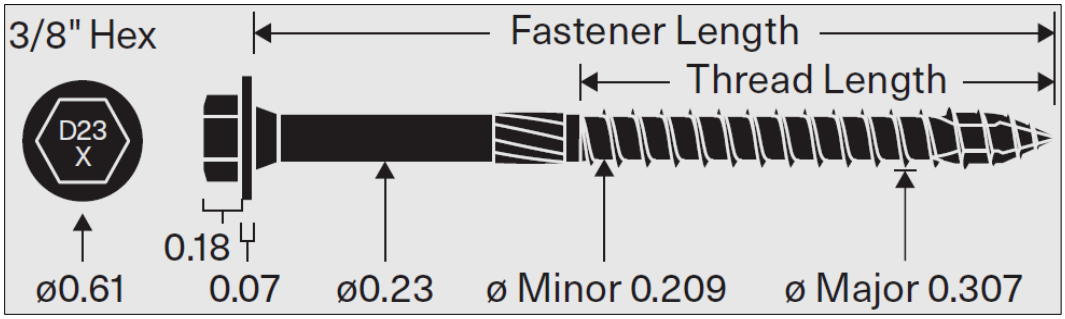

Figure 3. Starborn Structural H23 Screw (Dimensions in Inches)

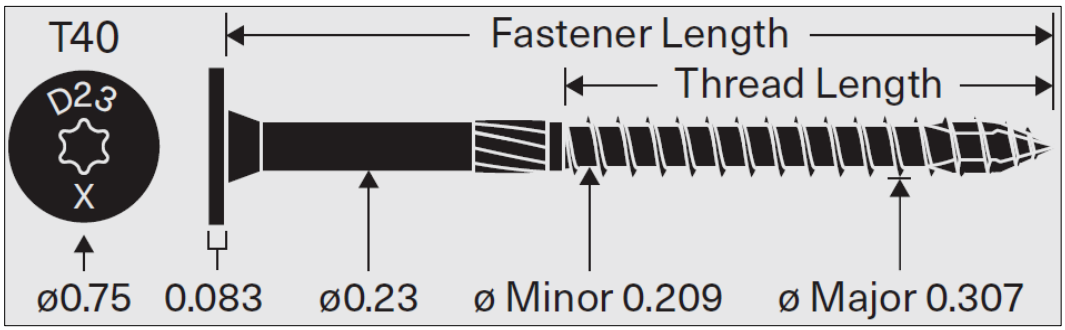

Figure 4. Starborn Structural F23 Screw (Dimensions in Inches)

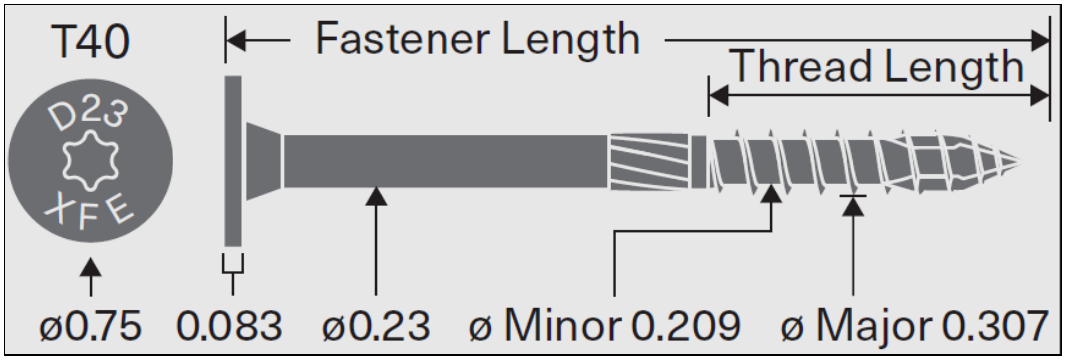

Figure 5. Starborn Structural F23-E Screw (Dimensions in Inches)

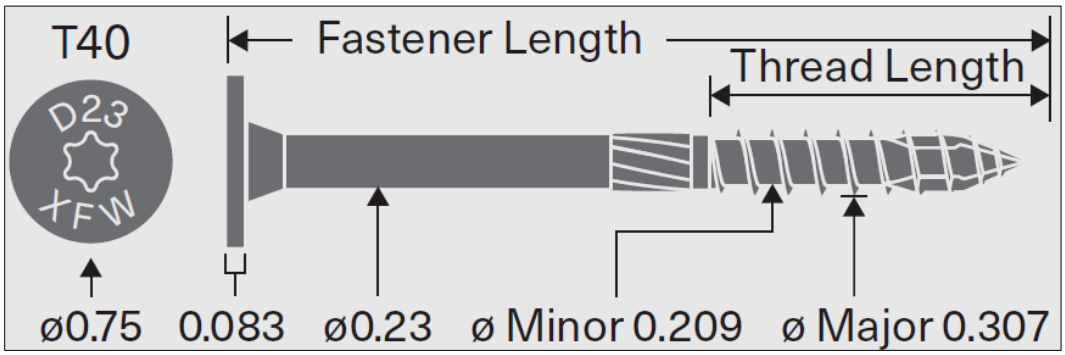

Figure 6. Starborn Structural F23-W Screw (Dimensions in Inches)

2.7 As needed, review material properties for design in **Section 4** and the regulatory evaluation in **Section 5**.

3 Applicable Codes and Standards[2]

3.1 *Codes*

3.1.1 *NBC—10, 15, 20: National Building Code of Canada*

3.1.2 *O Reg. 163/24: Ontario Building Code (OBC)[3]*

3.2 *Standards and Referenced Documents*

3.2.1 *AISI S904: Standard Test Methods for Determining the Tensile and Shear Strengths of Screws*

3.2.2 *ASTM A153: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware*

3.2.3 *ASTM D1761: Standard Test Methods for Mechanical Fasteners in Wood*

3.2.4 *ASTM F1575: Standard Test Method for Determining Bending Yield Moment of Nails, Spikes, and Dowel-type Threaded Fasteners*

3.2.5 *CSA O86: Engineering Design in Wood*

4 Tabulated Properties Generated from Nationally Recognized Standards

4.1 *General*

4.1.1 Starborn Structural Screws are self-tapping fasteners for wood-to-wood connections in conventional light frame construction. They provide resistance against withdrawal, head pull-through, axial, and shear loads. See **Section 6** for installation requirements.

4.1.2 Starborn Structural Screws can be used in applications including structural and general timber construction work. Typical uses include deck ledger attachment, interior framing, staircase, and multi-ply beam construction, as well as on rafter insulation and façade attachment.

4.1.3 Starborn Structural Screws are installed without lead holes, as prescribed in CSA O86 Article 12.11.2.1.

4.1.4 Where the application exceeds the limitations set forth herein, design shall be permitted in accordance with accepted engineering procedures, experience, and technical judgment.

4.1.5 *Design:*

4.1.5.1 Design of Starborn Structural Screws is governed by the applicable code and the provisions for wood screws in CSA O86.

4.1.5.2 Unless otherwise noted, modification factors shall be applied in accordance with the applicable code.

4.1.5.3 The design values in **Table 3**, **Table 4**, and **Table 5** are for the standard load duration in a dry service condition. Tabulated values shall be factored by all the appropriate factors per CSA O86.

4.2 *Starborn Structural Screws Factored Lateral Design Values (N_r)*

4.2.1 The factored lateral design values for shear load perpendicular-to-grain and parallel-to-grain for Starborn Structural Screws are specified in **Table 3**.

Table 3. Starborn Structural Screws Factored Lateral Design Values (N_r)

Product Name	Fastener Length, in (mm)	Thread Length, in (mm)	Minimum Side Member Thickness, in (mm)	Main Member Penetration, in (mm)	Factored Lateral Design Values,[1,2] lb (N)					
					Species[3,4] (Relative Density)					
					HF/SPF (0.42)		DF-L (0.49)		SCL (0.50)	
					$N_r\perp$	$N_r\parallel$	$N_r\perp$	$N_r\parallel$	$N_r\perp$	$N_r\parallel$
Structural H19	2 7/8 (73)	1.4 (36)	1 1/2 (38)	1 3/8 (35)	645 (2,870)	810 (3,605)	810 (3,605)	950 (4,230)	810 (3,605)	950 (4,230)
	4 (102)	2 1/4 (57)		2 1/2 (64)	700 (3,115)	585 (2,605)	940 (4,185)	895 (3,985)	940 (4,185)	895 (3,985)
	6 (152)	2 1/2 (64)		4 1/2 (114)						
	8 (203)			6 1/2 (165)						
	10 (254)			8 1/2 (216)						
Structural F19	2 7/8 (73)	2 (51)	1 1/2 (38)	1 3/8 (35)	625 (2,780)	680 (3,025)	820 (3,650)	725 (3,225)	820 (3,650)	725 (3,225)
	4 1/2 (114)			2 1/2 (64)						
	6 (152)			4 1/2 (114)	680 (3,025)	755 (3,360)	920 (4,090)	800 (3,560)	920 (4,090)	800 (3,560)
	8 (203)			6 1/2 (165)	735 (3,270)	660 (2,935)	920 (4,090)	810 (3,600)	920 (4,090)	810 (3,600)
	10 (254)			8 1/2 (216)	800 (3,560)	700 (3,115)	1,000 (4,450)	790 (3,515)	1,000 (4,450)	790 (3,515)
	12 (305)			10 1/2 (266.7)						
	14 (356)			12 1/2 (317.5)						
	16 (406)			14 1/2 (368)						
Structural H23	4 (102)	2 3/8 (60)	1 1/2 (38)	2 1/2 (64)	930 (4,140)	905 (4,025)	1,245 (5,535)	1,120 (4,975)	1,245 (5,535)	1,120 (4,975)
	5 (127)	3 (76)		3 1/2 (89)						
Structural F23	2 7/8 (73)	1.4 (36)	1 1/2 (38)	1 3/8 (35)	790 (3,515)	895 (3,985)	875 (3,895)	1,165 (5,185)	875 (3,895)	1,165 (5,185)
	4 (102)	2 3/8 (60)	1 1/2 (38)	2 1/2 (64)	930 (4,140)	905 (4,025)	1,245 (5,535)	1,120 (4,975)	1,245 (5,535)	1,120 (4,975)
	5 (127)	3 (76)		3 1/2 (89)						
	6 (152)	2 3/4 (70)		4 1/2 (114)						
	8 (203)			6 1/2 (165)						
	10 (254)			8 1/2 (216)						
Structural F23-W	2 7/8 (73)	1.4 (36)	1 1/2 (38)	1 3/8 (35)	790 (3,315)	895 (3,985)	875 (3,895)	1,165 (5,185)	875 (3,895)	1,165 (5,185)
	4 3/8 (111)	1.4 (36)		2 7/8 (73)	930 (4,140)	905 (4,025)	1,245 (5,535)	1,120 (4,975)	1,245 (5,535)	1,120 (4,975)
	5 7/8 (149)			4 1/2 (114)						

Table 3. Starborn Structural Screws Factored Lateral Design Values (N_r)

Product Name	Fastener Length, in (mm)	Thread Length, in (mm)	Minimum Side Member Thickness, in (mm)	Main Member Penetration, in (mm)	Factored Lateral Design Values,[1,2] lb (N)					
					Species[3,4] (Relative Density)					
					HF/SPF (0.42)		DF-L (0.49)		SCL (0.50)	
					$N_r\perp$	$N_r\parallel$	$N_r\perp$	$N_r\parallel$	$N_r\perp$	$N_r\parallel$
Structural F23-E	3 3/8 (86)	1 1/2 (38)	1 3/4 (44)	1 5/8 (41)	465 (2,070)	465 (2,070)	545 (2,415)	545 (2,415)	875 (3,895)	1,165 (5,185)
	5 (127)			3 1/4 (83)					1,245 (5,535)	1,120 (4,975)
	6 3/4 (171)			5 (127)						
	6 3/4 (171)		31/2 (89)	3 1/4 (83)						

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

1. $N_r\perp$ = lateral design value for perpendicular-to-grain loading, $N_r\parallel$ = lateral design value for parallel-to-grain loading
2. Tabulated values are for a standard load duration. Values shall be factored by all applicable modification factors per CSA O86.
3. HF = Hemlock-Fir, SPF = Spruce-Pine-Fir, DF-L = Douglas Fir, Larch, SCL = Structural Composite Lumber
4. Reference lateral design values apply to two-member single shear connections where both members are of the same relative density, and the fastener is oriented perpendicular-to-grain (side grain). Where the members are of different relative densities, use the lower of the two.

4.3 *Starborn Structural Screws Factored Withdrawal Design Values (P_{rw})*

4.3.1 The design provisions for withdrawal noted in CSA O86 Subsection 12.11.4 apply to Starborn Structural Screws, unless otherwise noted in this report. Factored withdrawal design values for Starborn Structural Screws in select lumber species are specified in **Table 4**.

Table 4. Starborn Structural Screws Factored Withdrawal Design Values (P^{rw}) in Side Grain Applications

Product Name	Thread Penetration[2] into Member, in (mm)	Fastener Length in (mm)	Thread Length in (mm)	Factored Withdrawal Values,[1] lb (N)		
				Species (Relative Density)		
				HF/SPF (0.42)	DF-L (0.49)	SCL (0.50)
Structural H19	1 (25.4)	2 7/8 (73)	1.4 (36)	550 (2,450)	735 (3,270)	735 (3,270)
		4 (102)	2 1/4 (57)			
		6 (152)	2 1/2 (64)			
		8 (203)				
		10 (254)				
Structural F19	1 (25.4)	2 7/8 (73)	2 (51)			
		4 1/2 (114)				
		6 (152)				
		8 (203)				
		10 (254)				
		12 (305)				
		14 (356)				
		16 (406)				

Table 4. Starborn Structural Screws Factored Withdrawal Design Values (P_{rw}) in Side Grain Applications

Product Name	Thread Penetration[2] into Member, in (mm)	Fastener Length in (mm)	Thread Length in (mm)	Factored Withdrawal Values,[1] lb (N)		
				Species (Relative Density)		
				HF/SPF (0.42)	DF-L (0.49)	SCL (0.50)
Structural H23	1 (25.4)	4 (102)	2 3/8 (60)	605 (2,690)	775 (3,450)	775 (3,450)
		5 (127)	3 (76)			
Structural F23	1 (25.4)	2 7/8 (73)	1.4 (36)	605 (2,690)	775 (3,450)	775 (3,450)
		4 (102)	2 3/8 (60)			
		5 (127)	3 (76)			
		6 (152)	2 3/4 (70)			
		8 (203)				
		10 (254)				
Structural F23-E	1 (25.4)	3 3/8 (86)	1 1/2 (38)	605 (2,690)	775 (3,450)	775 (3,450)
		5 (127)				
		6 3/4 (171)				
Structural F23-W	1 (25.4)	2 7/8 (73)	1.4 (36)			
		4 3/8 (111)				
		5 7/8 (149)				
Structural H19	2 (51)	4 (102)	2 1/4 (57)	1,295 (5,765)	1,705 (7,585)	1,705 (7,585)
		6 (152)	2 1/2 (64)			
		8 (203)				
		10 (254)				
Structural F19	2 (51)	2 7/8 (73)	2 (51)			
		4 1/2 (114)				
		6 (152)				
		8 (203)				
		10 (254)				
		12 (305)				
		14 (356)				
Structural H23	2 (51)	4 (102)	2 3/8 (60)	1,640 (7,300)	1,920 (8,545)	1,920 (8,545)
		5 (127)	3 (76)			

Table 4. Starborn Structural Screws Factored Withdrawal Design Values (P_{rw}) in Side Grain Applications

Product Name	Thread Penetration[2] into Member, in (mm)	Fastener Length in (mm)	Thread Length in (mm)	Factored Withdrawal Values,[1] lb (N)		
				Species (Relative Density)		
				HF/SPF (0.42)	DF-L (0.49)	SCL (0.50)
Structural F23	2 (51)	4 (102)	2 3/8 (60)	1,640 (7,300)	1,920 (8,545)	1,920 (8,545)
		5 (127)	3 (76)			
		6 (152)	2 3/4 (70)			
		8 (203)				
		10 (254)				

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

1. Tabulated values are for a standard load duration. Values shall be factored by all applicable modification factors per CSA O86 for wood screws.
2. Fastener penetration is the threaded length embedded in the main member, including the tip.

4.4 *Starborn Structural Screws Factored Head Pull-Through Design Values (P_{pt})*

4.4.1 The factored design value for head pull-through for Starborn Structural Screws are specified in **Table 5**.

Table 5. Starborn Structural Screws Factored Head Pull-Through Design Values (P_{pt})

Product Name	Fastener Length in (mm)	Thread Length in (mm)	Factored Head Pull-Through Values,[1,2] lb (N) (Specific Gravity)		
			HF/SPF (0.42)	DF/SP (0.50)	SCL (0.50)
Structural H19	2 7/8 (73)	1.4 (36)	875 (3,895)	1,298 (5,765)	1,298 (5,765)
	4 (102)	2 1/4 (57)			
	6 (152)	2 1/2 (64)			
	8 (203)				
	10 (254)				
Structural F19	2 7/8 (73)	2 (51)	1,845 (8,205)	2,105 (9,365)	2,105 (9,365)
	4 1/2 (114)				
	6 (152)				
	8 (203)				
	10 (254)				
	12 (305)				
	14 (356)				
	2 7/8 (73)				
Structural H23	4 (102)	2 3/8 (60)	1,670 (7,430)	2,320 (10,325)	2,320 (10,325)
	5 (127)	3 (76)			

Table 5. Starborn Structural Screws Factored Head Pull-Through Design Values (P_{pt})

Product Name	Fastener Length in (mm)	Thread Length in (mm)	Factored Head Pull-Through Values,[1,2] lb (N) (Specific Gravity)		
			HF/SPF (0.42)	DF/SP (0.50)	SCL (0.50)
Structural F23	2 7/8 (73)	1.4 (36)	2,095 (9,325)	2,610 (11,615)	2,610 (11,615)
	4 (102)	2 3/8 (60)			
	5 (127)	3 (76)			
	6 (152)	2 3/4 (70)			
	8 (203)				
	10 (254)				
Structural F23-E	3 3/8 (86)	1 1/2 (38)			
	5 (127)				
	6 3/4 (171)				
Structural F23-W	2 7/8 (73)	1.4 (36)			
	4 3/8 (111)				
	5 7/8 (149)				

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

1. Values based on 1 1/2" thickness of wood member.
2. Tabulated values are for a standard load duration. Values shall be factored by all applicable modification factors per CSA O86 for wood screws.

4.5 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.

5 Regulatory Evaluation and Accepted Engineering Practice

5.1 Starborn Structural Screws comply with the following adopted codes and/or accepted engineering practice for the following reasons:

5.1.1 Withdrawal strength in accordance with ASTM D1761 per CSA O86 Clause 12.11.4

5.1.2 Bending yield in accordance with ASTM F1575

5.1.3 Tensile strength in accordance with AISI S904

5.1.4 Shear strength in accordance with AISI S904 per CSA O86 Clause 12.11.4

5.1.5 Head pull-through in accordance with ASTM D1761 per CSA O86 Clause 12.11.4.3

5.1.6 Corrosion resistance of fasteners meeting or exceeding the protection afforded hot dipped galvanized fasteners in accordance with ASTM A153.

5.2 Any building code, regulation and/or accepted engineering evaluations (i.e., research reports, duly authenticated reports, etc.) that are conducted for this report were performed by DrJ, which is an ISO/IEC 17065 accredited certification body and a professional engineering company operated by RDP or approved sources. DrJ is qualified[4] to practice product and regulatory compliance services within its scope of accreditation and engineering expertise,[5] respectively.

5.3 Testing and related engineering evaluations are defined as intellectual property and/or trade secrets.[6]

5.4 Engineering evaluations are conducted with DrJ's ANAB accredited ICS code scope of expertise that is also its areas of professional engineering competence.[7]

5.5 Any code specific issues not addressed in this section are outside the scope of this report.

6 Installation

6.1 Installation shall comply with the approved construction documents, the manufacturer installation instructions, this report, and the applicable building code.

6.2 In the event of a conflict between the manufacturer installation instructions and this report, contact the manufacturer for counsel on the proper installation method.

6.3 *Installation Procedure*

6.3.1 Starborn Structural Screws shall be installed using a high-torque low speed drill in accordance with the manufacturer installation instructions, applicable code, the approved construction documents, this report, CSA O86, and standard framing practice as applied to wood fasteners.

6.3.2 The fasteners must be installed using a $^{5}/_{16}$" hex, $^{3}/_{8}$" hex, or Torx® driver bit. Pre-drilling of pilot holes is not required but may be used where lumber is prone to splitting.

6.3.3 All fastener spacing, edge distance, and end distance shall be per **Table 6** and **Table 7**.

Table 6. Placement of Starborn Structural H19 and F19 in Side Grain

Symbol in Figure 7	Dimension	Minimum Spacing[1,2] (mm)	
		Species (Relative Density)	
		HF/SPF	DF-L
S_P	Spacing parallel to grain	106	132
S_Q	Spacing perpendicular to grain	53	66
a	End distance parallel to grain	79	99
e	Edge distance perpendicular to grain	26	33

SI: 1 in = 25.4 mm

1. Table values are based on the major thread diameter from **Table 2** in accordance with CSA O86 Table 12.25.
2. Spacing, edge distances, and end distances of fasteners shall be sufficient to prevent splitting of the wood or as shown in this table, whichever is more restrictive.
3. See **Figure 7** for fastener placements.

Table 7. Placement of Starborn Structural H23, F23, F23-E, and F23-W in Side Grain

Symbol in Figure 7	Dimension	Minimum Spacing[1,2] (mm)	
		Species (Relative Density)	
		HF/SPF	DF-L
S_P	Spacing parallel to grain	125	156
S_Q	Edge distance perpendicular to grain	62	78
a	Spacing parallel to grain	94	117
e	End distance parallel to grain	31	39

SI: 1 in = 25.4 mm

1. Table values are based on the major thread diameter from **Table 2** in accordance with CSA O86 Table 12.25.
2. Spacing, edge distances, and end distances of fasteners shall be sufficient to prevent splitting of the wood or as shown in this table, whichever is more restrictive.
3. See **Figure 7** for fastener placements.

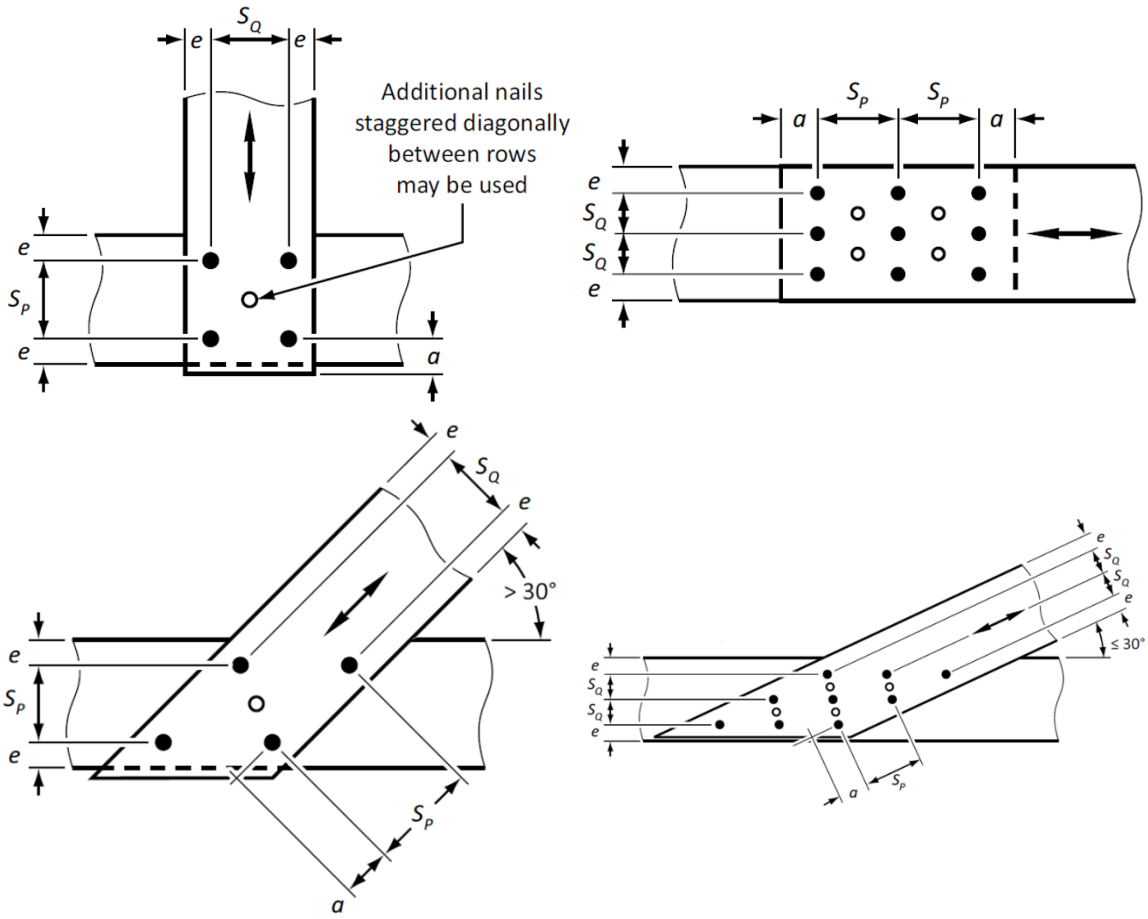

Figure 7. Example Diagrams Illustrating Fastener Spacings[8]

6.3.4 Minimum penetration is 1" (25.4 mm) unless otherwise stated in this report. Install fasteners with head flush to the surface of the wood member.

7 Substantiating Data

7.1 Testing has been performed under the supervision of a professional engineer and/or under the requirements of ISO/IEC 17025 as follows:

7.1.1 Withdrawal in accordance with ASTM D1761

7.1.2 Lateral strength in accordance with ASTM D1761

7.1.3 Head pull-through in accordance with ASTM D1761

7.1.4 Bending yield in accordance with ASTM F1575

7.1.5 Tensile strength in accordance with AISI S904

7.1.6 Shear strength in accordance with AISI S904

7.2 Information contained herein is the result of testing and/or data analysis by sources that conform to the evaluation requirements of NBC Volume 1 Relationship of the NBC to Standards Development and Conformity Assessment and/or professional engineering regulations. DrJ relies upon accurate data to perform its ISO/IEC 17065 evaluations.

7.3 Where appropriate, DrJ's analysis is based on provisions that have been codified into law through provincial, territorial, or local adoption of codes and standards. The developers of these codes and standards are responsible for the reliability of published content. DrJ analysis may use code-adopted provisions as a control sample. A control sample versus a test sample establishes a product as being equivalent to that prescribed in this code in quality, strength, effectiveness, fire resistance, durability and safety.

7.4 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, listings, certified reports, duly authenticated reports from approved agencies, and research reports prepared by approved agencies and/or approved sources provided by the suppliers of products, materials, designs, assemblies and/or methods of construction. These are presumed to be minimum properties and relied upon to be accurate. The reliability of DrJ's engineering practice, as contained in this report, may be dependent upon published design properties by others.

7.5 *Testing and Engineering Analysis*

7.5.1 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.

7.6 Where additional condition of use and/or code compliance information is required, please search for Starborn Structural Screws on the DrJ Certification website.

8 Findings

8.1 As outlined in **Section 4**, Starborn Structural Screws have performance characteristics that were tested and/or meet applicable regulations. In addition, they are suitable for use pursuant to its specified purpose.

8.2 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:

8.2.1 To meet the requirements of the NBC Article 4.3.1.1.

8.2.2 Are an alternative to wood screws specified in NBC Article 9.23.3.3.

8.3 Any application specific issues not addressed herein can be engineered by an RDP. Assistance with engineering is available from Starborn Industries, Inc.

8.4 These innovative products have been evaluated in the context of the codes listed in **Section 3** and are compliant with all known provincial, territorial, and local building codes. Where there are known variations in provincial, territorial, or local codes applicable to this report, they are listed here:

8.4.1 No known variations

8.5 NBC Volume 1 Relationship of the NBC to Standards Development and Conformity Assessment:

> **Certification**
>
> Certification is the confirmation by an independent organization that a product, service, or system meets a requirement…Certification bodies publish lists of certified products and companies…Several organizations, including the Canadian Construction Materials Centre (CCMC), offer such evaluation services.
>
> **Evaluation**
>
> An evaluation is a written opinion by an independent professional organization that a product will perform its intended function. An evaluation is very often done to determine the ability of an innovative product, for which no standards exist, to satisfy the intent of the Code requirement...

8.6 ISO/IEC 17065 accredited third-party certification bodies,[9] including but not limited to, Standards Council of Canada (SCC)[10] and ANSI National Accreditation Board (ANAB),[11] confirm that product certification bodies have the expertise to provide technical evaluation services within their scope of accreditation. All SCC and ANAB product certification bodies meet NBC requirements to offer evaluation services for alternative solutions.[12]

8.6.1 DrJ is an ISO/IEC 17065 ANAB-Accredited Product Certification Body – Accreditation #1131[13] and employs professional engineers.[14]

8.7 Through ANAB accreditation and the IAF Multilateral Agreements, this report can be used to obtain product approval in any jurisdiction or country that has IAF MLA Members & Signatories to meet the Purpose of the MLA – "*certified once, accepted everywhere*." IAF specifically says, "*Once an accreditation body is a signatory of the IAF MLA, it is required to recognise certificates and validation and verification statements issued by conformity assessment bodies accredited by all other signatories of the IAF MLA, with the appropriate scope*."[15]

8.8 Product certification organizations, accredited by the SCC and ANAB, are defined as equivalent evaluation services:

8.8.1 Canada-United States-Mexico Agreement (CUSMA), Article 11.6 Conformity Assessment confirms mutual recognition by stating, "*...each Party shall accord to conformity assessment bodies located in the territory of another Party treatment no less favorable than that it accords to conformity assessment bodies located in its own territory or in the territory of the other Party*."

8.8.2 The SCC National Conformity Assessment Principles states, "*SCC is a member of a number of international organizations developing voluntary conformity assessment agreements that help ensure the international acceptance of Canadian conformity assessment results. Signatories to these agreements (like SCC) recognize each other's accreditations as being equivalent to their own*."[16]

8.9 Building official approval of a licensed professional engineer is performed by verifying the professional engineer and/or their business entity are listed by the engineering regulators of the relevant jurisdiction.

9 Conditions of Use

9.1 Material properties shall not fall outside the boundaries defined in **Section 4**.

9.2 As defined in **Section 4**, 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.

9.3 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 CSA O86.

9.4 Use of Starborn Structural Screws in locations exposed to saltwater or saltwater spray is outside the scope of this report.

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

9.5.1 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.

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

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

9.5.4 At a minimum, these innovative products shall be installed per **Section 6** of this report.

9.5.5 This report shall be reviewed for code compliance by the AHJ in concert with the duties and powers granted to the building official by the provincial regulations governing such duties and powers.

9.5.6 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, inspections, and any other regulatory requirements that may apply.

9.6 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 (i.e., owner).

9.7 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.

10 Identification

10.1 Starborn Structural Screws (Starborn Structural H19 Screws, Starborn Structural F19 Screws, Starborn Structural H23 Screws, Starborn Structural F23 Screws, Starborn Structural F23-E Screws, and Starborn Structural F23-W Screws), as 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.

10.2 Additional technical information can be found at starbornindustries.com.

11 Review Schedule

11.1 This report is subject to periodic review and revision. For the latest version, visit www.drjcertification.org.

11.2 For information on the status of this report, please contact DrJ Certification.

Notes

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

2 Unless otherwise noted, all references in this report are from the 2020 version of the NBC. This alternative solution is also approved for use with the 2010 and 2015 NBC and the standards referenced therein.

3 References in this report to the National Building Code of Canada (NBC) apply to the Ontario Building Code (OBC), unless noted otherwise.

4 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.

5 https://anabpd.ansi.org/Accreditation/product-certification/AllDirectoryDetails?prgID=1&orgID=2125&statusID=4#:~:text=Bill%20Payment%20Date-,Accredited%20Scopes,-13%20ENVIRONMENT.%20HEALTH

6 18 U.S. Code § 1831 - Economic espionage - Whoever, intending or knowing that the offense will benefit any foreign government, foreign instrumentality, or foreign agent, knowingly steals, or without authorization appropriates, takes, carries away, or conceals, or by fraud, artifice, or deception obtains a trade secret shall be fined not more than $5,000,000 or imprisoned not more than 15 years, or both. Any organization that commits any offense described shall be fined not more than the greater of $10,000,000 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. https://www.law.cornell.edu/uscode/text/18/part-I/chapter-90.

7 ANAB is part of the USMCA and IAF MLA, where the purpose of these agreements are to ensure mutual recognition of accredited certification and validation/verification statements between agreement signatories, and subsequent acceptance of ANAB accredited certification and validation/verification statements by professional engineers based upon having one universal approval process for the timely approval of innovative materials, products, designs, services, assemblies and/or methods of construction.

8 Graphics in **Figure 7** are as shown in CSA O86-19, Figure 12.16.

9 https://anabpd.ansi.org/Accreditation/product-certification/DirectoryListingAccredited?menuID=1&prgID=1

10 https://iaf.nu/en/member-details/?member_id=91

11 https://iaf.nu/en/member-details/?member_id=14

12 NBC Division A Clause A-1.2.1.1.(1)(b) provides information on code compliance via alternative solutions and defines alternative solutions as *"...achiev[ing] at least the minimum level of performance required by Division B."* NBC Division C Section 2.3 includes additional guidance for documentation of alternative solutions.

13 https://anabpd.ansi.org/Accreditation/product-certification/AllDirectoryDetails?&prgID=1&OrgId=2125&statusID=4

14 Through ANAB accreditation and the IAF MLA, DrJ certification can be used to obtain material, product, design, or method of construction approval in any jurisdiction or country that has IAF MLA Members & Signatories to meet the Purpose of the MLA – "*certified once, accepted everywhere*".

15 https://iaf.nu/en/about-iaf-mla/#:~:text=required%20to%20recognise

16 The National Conformity Assessment Principles states, "*Product regulations and standards may vary from country to country. If these are set arbitrarily, they could be deemed as protectionist. The World Trade Organization (WTO) Agreement on Technical Barriers to Trade (TBT Agreement) is intended to ensure that technical regulations, standards and conformity assessment procedures of member countries do not create unnecessary obstacles to trade. Under the TBT Agreement, members of the WTO agree to use international standards, including conformity assessment standards and guides, as a basis for their technical requirements.*"