

Technical Evaluation Report™

Report Number 2011-02

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

Starborn® Industries, Inc.

Product:
Starborn® Structural Screws

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DIVISION: 06 00 00 - WOOD, PLASTICS AND COMPOSITES

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

1 Innovative Products Evaluated¹

- 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 Applicable Codes and Standards²

- 2.1 Codes
 - 2.1.1 *NBC—10, 15, 20: National Building Code of Canada*
 - 2.1.2 *O Reg. 332/12: Ontario Building Code (OBC)*³
- 2.2 Standards and Referenced Documents
 - 2.2.1 *AISI S904: Standard Test Methods for Determining the Tensile and Shear Strengths of Screws*
 - 2.2.2 *ASTM A153: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware*
 - 2.2.3 *ASTM D1761: Standard Test Methods for Mechanical Fasteners in Wood*
 - 2.2.4 *ASTM F1575: Standard Test Method for Determining Bending Yield Moment of Nails*
 - 2.2.5 *CSA O86: Engineering Design in Wood*

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.

3 Performance Evaluation

- 3.1 Testing and related engineering evaluations are defined as intellectual property and/or trade secrets.⁴
- 3.2 Engineering evaluations are conducted within DrJ's ANAB accredited ICS code scope, which are also its areas of professional engineering competence.⁵
- 3.3 Starborn® Structural Screws were tested and evaluated to determine their structural resistance properties, which are used to develop reference design values for limit states design (LSD) in accordance with CSA O86. The following conditions were evaluated:
 - 3.3.1 Withdrawal strength in accordance with ASTM D1761 per CSA O86 Clause 12.11.4⁶
 - 3.3.2 Bending yield in accordance with ASTM F1575
 - 3.3.3 Tensile strength in accordance with AISI S904
 - 3.3.4 Shear strength in accordance with AISI S904 per CSA O86 Clause 12.11.3⁷
 - 3.3.5 Head pull-through in accordance with ASTM D1761 per CSA O86 Clause 12.11.4.3⁸
 - 3.3.6 Corrosion resistance of fasteners meeting or exceeding the protection afforded hot dipped galvanized fasteners in accordance with ASTM A153.
- 3.4 Use of fasteners in locations exposed to saltwater or saltwater spray is outside the scope of this report.
- 3.5 Any regulation specific issues not addressed in this section are outside the scope of this report.

⁴ 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-11/chapter-90>.

⁵ 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.

⁶ 2014 CSA O86 Clause 12.11.5

⁷ 2014 CSA O86 Clause 12.11.4

⁸ 2014 CSA O86 Clause 12.11.5.3

4 Product Description and Materials

4.1 General

- 4.1.1 Starborn® Structural screws are alternate dowel-type self-drilling fasteners designed for use in wood-to-wood connections. The fasteners in **Table 1** are evaluated in this report.

Table 1. Starborn® Structural Fastener 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			
Structural F23-W			

SI: 1 in = 25.4 mm

1. Unthreaded shank diameter is measured on uncoated parts. Finished part dimensions are larger due to the thickness of the proprietary coating.

4.2 Fastener Material

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

4.3 Fastener Coatings

- 4.3.1 Starborn® F23-E and F23-W screws are designated for interior, dry use only.
- 4.3.2 Starborn® H19, F19, H23, and F23 screws are designed for exterior use and may be used where fasteners are required to exhibit corrosion resistance when exposed to adverse environmental conditions and/or in preservative treated wood subject to the limitations of Section 9. These fasteners are alternates to hot-dip-zinc-galvanized fasteners 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.
- 4.3.2.1 Starborn® H19, F19, H23, and F23 screws were evaluated for use in wood chemically treated with waterborne Alkaline Copper Quaternary, Type D (ACQ-D).
- 4.3.2.2 Starborn® H19, F19, H23, and F23 screws are approved for use in fire-retardant treated lumber provided the conditions set forth by the fire-retardant treated lumber manufacturer are met, including appropriate strength reductions.

4.4 Wood Members

- 4.4.1 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.
- 4.4.2 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**.

4.5 Fastener Specifications

4.5.1 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, f_{yb} psi (MPa)	Factored Fastener Strength lb (kN)	
					Minor ²	Major		Tensile	Shear
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	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)						

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, f_{yb} psi (MPa)	Factored Fastener Strength lb (kN)	
					Minor ²	Major		Tensile	Shear
	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)							
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

- The 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.

4.6 The innovative products evaluated in this report are shown in **Figure 1, Figure 2, Figure 3, Figure 4, Figure 5 and Figure 6.**

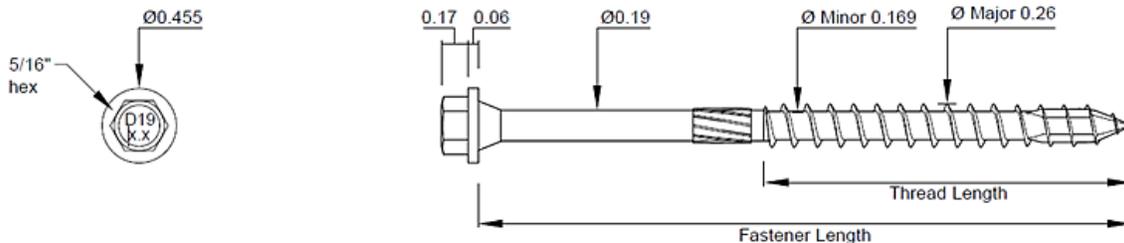


Figure 1. Starborn® Structural H19 Screw (Dimensions in Inches)

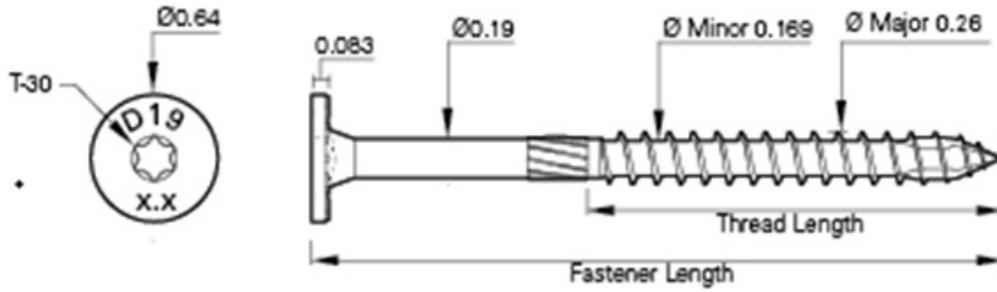


Figure 2. Starborn® Structural F19 Screw (Dimensions in Inches)

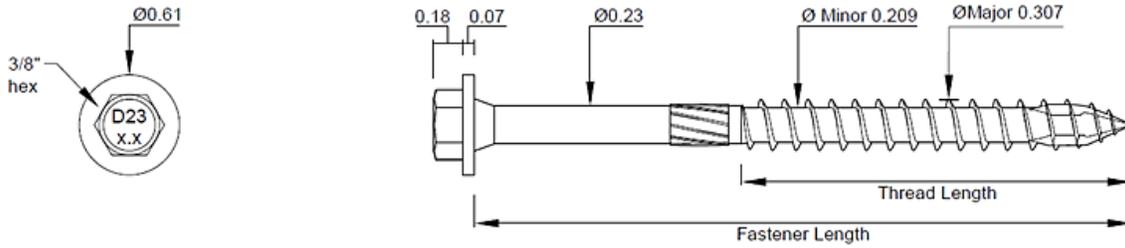


Figure 3. Starborn® Structural H23 Screw (Dimensions in Inches)

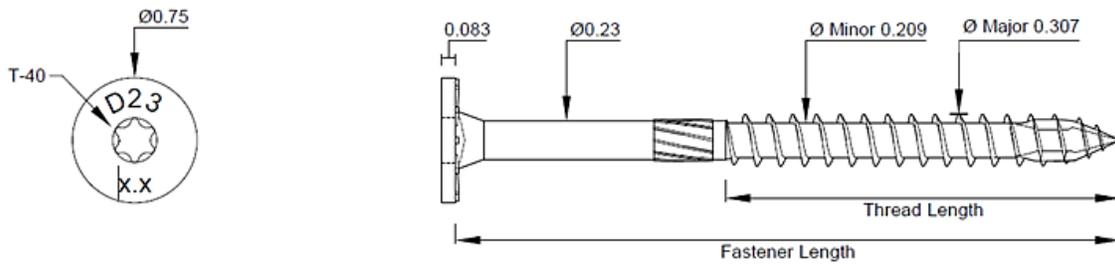


Figure 4. Starborn® Structural F23 Screw (Dimensions in Inches)

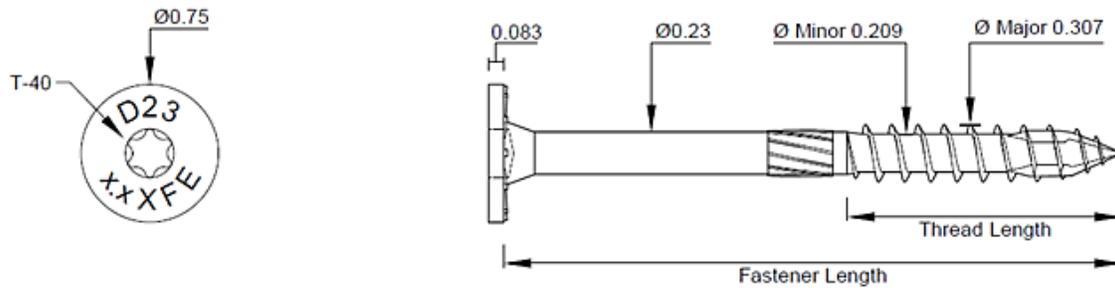


Figure 5. Starborn® Structural F23-E Screw (Dimensions in Inches)

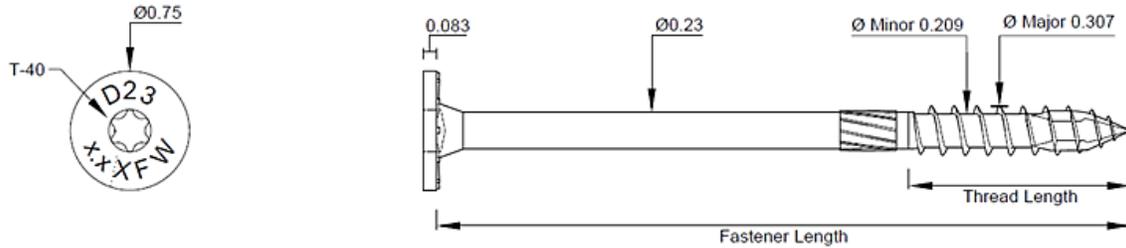


Figure 6. Starborn® Structural F23-W Screw (Dimensions in Inches)

5 Applications

5.1 General

- 5.1.1 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.
- 5.1.2 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.
- 5.1.3 Starborn® Structural Screws are installed without lead holes, as prescribed in CSA O86 Article 12.11.2.1.
- 5.1.4 Where the application exceeds the limitations set forth herein, design shall be permitted in accordance with accepted engineering procedures, experience, and technical judgment.

5.1.5 Design

- 5.1.5.1 Design of Starborn® Structural Screws is governed by the applicable code and the provisions for wood screws in CSA O86.
- 5.1.5.2 Unless otherwise noted, modification factors shall be applied in accordance with the applicable code.
- 5.1.5.3 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.

5.2 Starborn® Structural Screw Factored Lateral Design Values (N_r)

- 5.2.1 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 Screw 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)						

Table 3. Starborn® Structural Screw 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⊥}	N _{r∥}	N _{r⊥}	N _{r∥}	N _{r⊥}	N _{r∥}
	10 (254)			8½ (216)						
Structural F19	2⅞ (73)	2 (51)	1½ (38)	1⅜ (35)	625 (2,780)	680 (3,025)	820 (3,650)	725 (3,225)	820 (3,650)	725 (3,225)
	4½ (114)			2½ (64)	625 (2,780)	680 (3,025)	820 (3,650)	725 (3,225)	820 (3,650)	725 (3,225)
	6 (152)			4½ (114)	680 (3,025)	755 (3,360)	920 (4,090)	800 (3,560)	920 (4,090)	800 (3,560)
	8 (203)			6½ (165)	735 (3,270)	660 (2,935)	920 (4,090)	810 (3,600)	920 (4,090)	810 (3,600)
	10 (254)			8½ (216)	800 (3,560)	700 (3,115)	1000 (4,450)	790 (3,515)	1000 (4,450)	790 (3,515)
	12 (305)			10½ (266.7)						
	14 (356)			12½ (317.5)						
	16 (406)			14½ (368)						
Structural H23	4 (102)	2⅜ (60)	1½ (38)	2½ (64)	930 (4,140)	905 (4,025)	1245 (5,535)	1,120 (4,975)	1245 (5,535)	1,120 (4,975)
	5 (127)	3 (76)		3½ (89)						
Structural F23	2⅞ (73)	1.4 (36)	1½ (38)	1⅜ (35)	790 (3,515)	895 (3,985)	875 (3,895)	1,165 (5,185)	875 (3,895)	1,165 (5,185)
Structural F23	4 (102)	2⅜ (60)	1½ (38)	2½ (64)	930 (4,140)	905 (4,025)	1245 (5,535)	1,120 (4,975)	1245 (5,535)	1,120 (4,975)
	5 (127)	3 (76)		3½ (89)						
	6 (152)	2¾ (70)		4½ (114)						
	8 (203)			6½ (165)						
	10 (254)			8½ (216)						
Structural F23-W	2⅞ (73)	1.4 (36)	1½ (38)	1⅜ (35)	790 (3,315)	895 (3,985)	875 (3,895)	1,165 (5,185)	875 (3,895)	1,165 (5,185)
	4⅜ (111)	1.4 (36)		2⅞ (73)	930 (4,140)	905 (4,025)	1,245 (5,535)	1,120 (4,975)	1,245 (5,535)	1,120 (4,975)

Table 3. Starborn® Structural Screw 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⊥}	N _{r∥}	N _{r⊥}	N _{r∥}	N _{r⊥}	N _{r∥}
	5/8 (149)			4 1/2 (114)						
Structural F23-E	3 3/8 (86)	1 1/2 (38)	1 3/4 (44)	1 5/8 (41)	465 (2070)	465 (2070)	545 (2415)	545 (2415)	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)		3 1/2 (89)	3 1/4 (83)						

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

- N_{r⊥} = lateral design value for perpendicular-to-grain loading, N_{r∥} = lateral design value for parallel-to-grain loading
- Tabulated values are for a standard load duration. Values shall be factored by all applicable modification factors per CSA O86.
- HF = Hemlock-Fir, SPF = Spruce-Pine-Fir, DF-L = Douglas Fir, Larch, SCL = Structural Composite Lumber
- 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.

5.3 *Starborn® Structural Screw Factored Withdrawal Design Values (P_{rw})*

5.3.1 The design provisions for withdrawal noted in CSA O86 Subsection 12.11.4⁹ 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 Screw 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)				
2 ⁷ / ₈ (73)		2				
4 ¹ / ₂ (114)						
6 (152)						
8 (203)						
10 (254)						
12 (305)						
14 (356)						
16 (406)						
Structural H23	4 (102)	2 ³ / ₈ (60)	605 (2,690)	775 (3,450)	775 (3,450)	
	5 (127)	3 (76)				
Structural F23	2 ⁷ / ₈ (73)	1.4 (36)	605 (2,690)	775 (3,450)	775 (3,450)	

⁹ 2014 CSA O86 Clause 12.11.5

Table 4. Starborn® Structural Screw 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)
		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)				
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 ⁷ / ₈ (73)	2			
		4 ¹ / ₂ (114)				
		6 (152)				
		8 (203)				

Table 4. Starborn® Structural Screw 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)
		10 (254)				
		12 (305)				
		14 (356)				
Structural H23		4 (102)	2 ³ / ₈ (60)	1,640 (7,300)	1,920 (8,545)	1,920 (8,545)
		5 (127)	3 (76)			
Structural F23		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

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

5.4 *Starborn® Structural Screw Factored Head Pull-Through Design Values (P_{pt})*

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

Table 5. Starborn® Structural Screw 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	1845 (8205)	2105 (9365)	2105 (9365)
	4 ¹ / ₂ (114)				
	6 (152)				
	8 (203)				
	10 (254)				
	12 (305)				
	14 (356)				
	2 ⁷ / ₈ (73)				
	Structural H23				
5 (127)		3 (76)			
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)			

Table 5. Starborn® Structural Screw 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)
	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

- Values based on 1¹/₂" thickness of wood member.
- Tabulated values are for a standard load duration. Values shall be factored by all applicable modification factors per CSA O86 for wood screws.

5.5 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.

6 Installation

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

6.2 In the event of a conflict between the manufacturer installation instructions this report and the applicable building code, the more restrictive shall govern.

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	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

- Table values are based on the major thread diameter from **Table 2** in accordance with CSA O86 Table 12.25.
- 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.

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

Symbol	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

- Table values are based on the major thread diameter from **Table 2** in accordance with CSA O86 Table 12.25.
- 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.

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: 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 delineated in Section 3, Starborn® Structural Screws have performance characteristics that were tested and/or meet pertinent standards and is suitable for use pursuant to its specified purpose.
- 8.2 When used and installed in accordance with this report and the manufacturer installation instructions, Starborn® Structural Screws shall be approved for the following applications:
 - 8.2.1 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 2 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,¹⁰ including but not limited to, Standards Council of Canada (SCC)¹¹ and ANSI National Accreditation Board (ANAB),¹² 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.¹³
- 8.6.1 DrJ is an ISO/IEC 17065 ANAB-Accredited Product Certification Body – Accreditation #1131¹⁴ and employs professional engineers.¹⁵
- 8.7 Through ANAB accreditation and the IAF Multilateral Agreements, this report can be used to obtain innovative products 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.”¹⁶
- 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.”¹⁷
- 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 3.
- 9.2 As defined in Section 3, 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 fasteners in locations exposed to saltwater or saltwater spray is outside the scope of this report.

¹⁰ <https://anabpd.ansi.org/Accreditation/product-certification/DirectoryListingAccredited?menuID=1&prgID=1>

¹¹ https://iaf.nu/en/member-details/?member_id=91

¹² https://iaf.nu/en/member-details/?member_id=14

¹³ 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.

¹⁴ <https://anabpd.ansi.org/Accreditation/product-certification/AllDirectoryDetails?&prgID=1&OrgId=2125&statusID=4>

¹⁵ 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”.

¹⁶ <https://iaf.nu/en/about-iaf-mla/#:~:text=required%20to%20recognise>

¹⁷ 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.”

- 9.5 Where 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, are dependent on 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 designer (e.g., owner).
- 9.7 The actual design, suitability, and use of this report, for any particular building, is the responsibility of the owner or the owner's authorized agent.

10 Identification

- 10.1 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, report number, and other information to confirm code compliance.
- 10.2 Additional technical information can be found at www.starbornindustries.com.

11 Review Schedule

- 11.1 This report is subject to periodic review and revision. For the most recent version, visit drjcertification.org.
- 11.2 For information on the status of this report, contact [DrJ Certification](#).

12 Legislation that Authorizes New Product Approval in International Markets is Found in Appendix A

- 12.1 Starborn® Structural Screws has been tested by an ISO/IEC 17025 accredited laboratory and/or evaluated to be in conformance with accepted engineering practice to ensure durable, livable and safe construction.
- 12.2 This report is published by an ISO/IEC 17065 accredited certification body with the expertise to evaluate products, materials, designs, services, assemblies, and/or methods of construction.
- 12.3 This report meets the legislative intent and definition of a duly authenticated report, which shall be accepted by the AHJ, unless there are specific reasons why the alternative shall not be approved as provided for in writing.

Appendix A

1 Legislation that Authorizes New Product Approval in Canada

- 1.1 The Competition Act is a Canadian federal law governing competition law in Canada. The Act contains both criminal and civil provisions aimed at preventing anti-competitive practices in the marketplace. The Act is enforced and administered by the Competition Bureau, whose regulations encourage the approval of NBC referenced and alternative products, materials, designs, services, assemblies and/or methods of construction that:
 - 1.1.1 Advance Innovation,
 - 1.1.2 Promote competition so all businesses have the opportunity to compete on price and quality in an open market on a level playing field unhampered by anticompetitive constraints, and
 - 1.1.3 Benefit consumers through lower prices, better quality, and greater choice.
- 1.2 **Approved by International Jurisdictions:** The USMCA and GATT agreements provide for approval of innovative materials, products, designs, services, assemblies and/or methods of construction through the Technical Barriers to Trade (TBT) agreements and the International Accreditation Forum (IAF) Multilateral Recognition Arrangement (MLA), where these agreements proclaim the desire of both countries to have their markets open to innovation.
- 1.3 These agreements:
 - 1.3.1 Permit participation of conformity assessment bodies located in the territories of other Members (defined as GATT Countries) under conditions no less favourable than those accorded to bodies located within their territory or the territory of any other country,
 - 1.3.2 State that conformity assessment procedures (i.e., ISO/IEC 17020, 17025, 17065, etc.) are prepared, adopted, and applied so as to grant access for suppliers of like products originating in the territories of other Members under conditions no less favourable than those accorded to suppliers of like products of national origin or originating in any other country, in a comparable situation.
 - 1.3.3 State that conformity assessment procedures are not prepared, adopted, or applied with a view to or with the effect of creating unnecessary obstacles to international trade. This means that conformity assessment procedures shall not be more strict or be applied more strictly than is necessary to give the importing Member adequate confidence that products conform to the applicable technical regulations or standards.
- 1.4 To this end, Canada operates an accreditation system as follows:



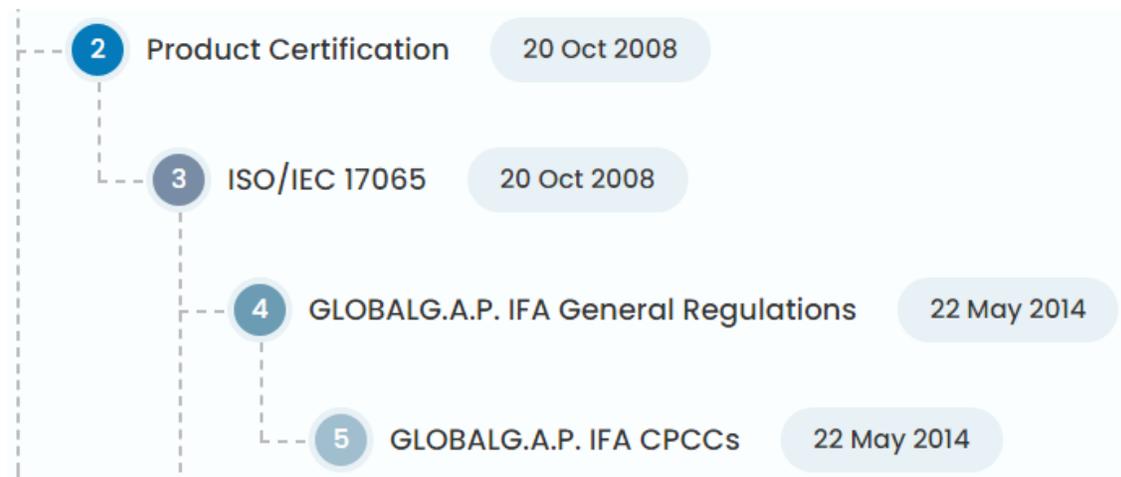
1.5 This includes ISO/IEC 17065 product certification as follows:



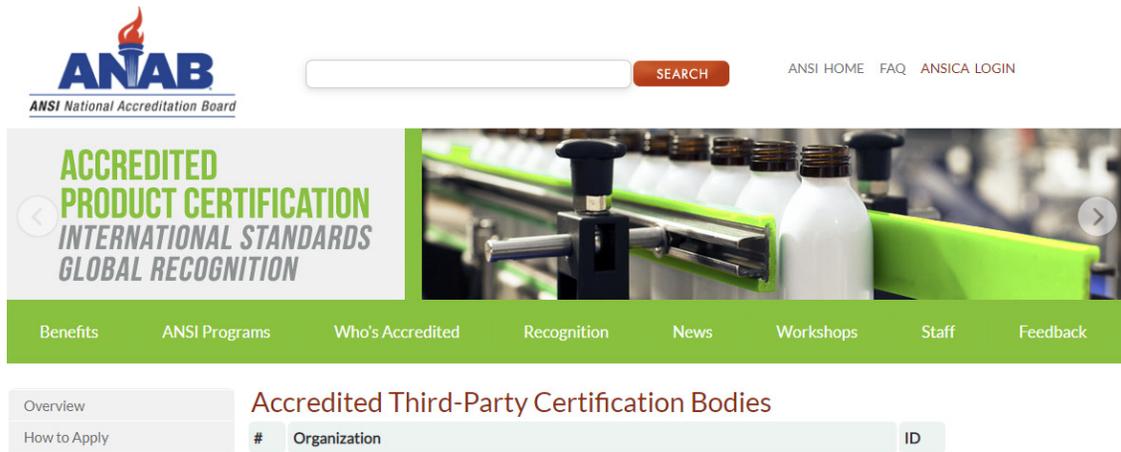
1.6 Similarly, the United States operates multiple accreditation process with ANAB being the most prominent ISO/IEC 17065 product certification organization as follows:

A screenshot of the ANAB accreditation body information page. It features the ANAB logo (ANSI National Accreditation Board) on the left. On the right, it lists 'Accreditation Body' and 'IAF MLA Signatory'. The main heading is 'ANAB (ANSI National Accreditation Board)'. Below this, it states 'Code of Conduct Adopted: 01 Feb 2005', the website 'http://www.anab.org', and 'United States of America'. At the bottom, there are logos for IAAC and APAC.

1.7 This includes ISO/IEC 17065 product certification as follows:



- 1.8 The list of ANAB accredited ISO/IEC 17065 product certification organizations can be found at the following link: <https://anabpd.ansi.org/Accreditation/product-certification/DirectoryListingAccredited?menuID=1&prgID=1>



- 1.9 Approval is granted via International Agreement, where the purpose of the IAF MLA is to ensure mutual recognition of accredited certification and validation/verification statements between signatories. Subsequent acceptance of accredited certification and validation/verification statements is required so that one accreditation can be used for the timely approval of innovative materials, products, designs, services, assemblies and/or methods of construction. Accreditations granted by IAF MLA signatories are recognised worldwide based on their equivalent accreditation programs, therefore reducing costs and adding value to businesses and consumers.
- 1.10 Consequently, these agreements permit product approval of innovative Australian and New Zealand products into US markets and vice-versa.
- 1.11 Finally, a question that often arises is, why do these agreements exist? In addition, another question is why is the ISO/IEC 17065 accredited third-party certification process so important?
- 1.11.1 The answer is because all countries desire to protect the intellectual property and trade secrets of their country's businesses.
 - 1.11.2 In the US this protection is provided by 18 U.S. Code § 1831 Under Economic Espionage, where it states "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."
 - 1.11.3 Any organization that commits any offense described shall be fined not more than the greater of \$10,000,000 or three (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.¹⁸
 - 1.11.4 Protection of intellectual property and trade secrets reinforces the value of the IAF MLA, the GATT/TBT and the ISO/IEC 17065 product approval process.
 - 1.11.5 The goal is to protect everyone's best interests while also facilitating economic freedom and opportunity by promoting free and fair competition in the marketplace.

¹⁸ <https://www.law.cornell.edu/uscode/text/18/part-II/chapter-90>