Technical Evaluation Report™

TER 1503-01

FastenMaster® FlatLOK® Fasteners – Limit States Design

OMG®, Inc. DBA FastenMaster®

Product:
FastenMaster® FlatLOK® Fasteners

Issue Date:
August 7, 2015

Revision Date:
June 9, 2023

Subject to Renewal:
July 1, 2024

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COMPANY INFORMATION:	ADDITIONAL LISTEES:

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DIVISION: 06 00 00 - WOOD, PLASTICS AND COMPOSITES

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

1 Product Evaluated[1]

1.1 FastenMaster® FlatLOK® Fasteners

2 Applicable Codes and Standards[2]

2.1 *Codes*

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

2.2 *Standards and Referenced Documents*

2.2.1 *ASME B18.6.1: Wood Screws (Inch Series)*

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

2.2.3 *ASTM A510: Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel*

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

2.2.5 *CSA O86: Engineering Design in Wood*

3 Performance Evaluation

3.1 Testing and related engineering evaluations are defined as intellectual property and/or trade secrets.

3.2 FlatLOK® fasteners were tested and evaluated to determine their structural resistance properties, which are used to develop factored design values using the Limit States Design Method (LSD) in accordance with CSA O86. The following conditions were evaluated:

3.2.1 Withdrawal strength in accordance with ASTM D1761 and in accordance with CSA O86 Clause 12.11.5

3.2.2 Shear strength for use as an alternative to metal straps, ties or fasteners in shear (lateral) loaded applications either parallel or perpendicular to wood grain in accordance with ASTM D1761 and in accordance with CSA O86 Clause 12.11.4

3.2.3 Head pull-through resistance in accordance with ASTM D1761 and in accordance with CSA O86 Clause 12.11.5.3

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

[2] Unless otherwise noted, all references in this TER 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.

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3.3 Use in wet service conditions is outside the scope of this TER.

3.4 Any code compliance issues not specifically addressed in this section are outside the scope of this TER.

3.5 Any engineering evaluation conducted for this TER was performed on the dates provided in this TER and within DrJ's professional scope of work.

3.6 Douglas Consultants Inc. has collaborated with DrJ through the review of this technical evaluation and the conformity to Canadian building codes.

4 Product Description and Materials

4.1 The product evaluated in this TER is shown in Figure 1.

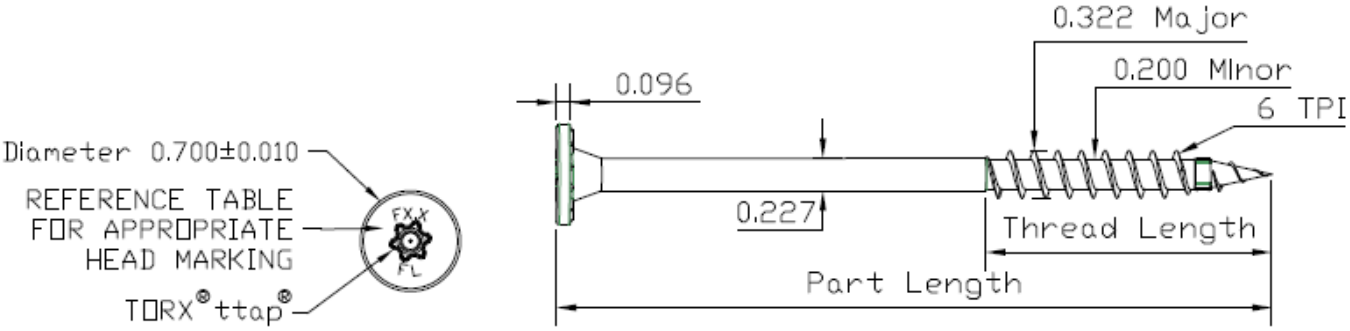

Figure 1. FastenMaster® FlatLOK®

4.2 FlatLOK® fasteners are manufactured using a standard cold-formed process followed by a heat-treating process.

4.3 Fasteners are coated with a proprietary coating that exceeds the protection provided by hot-dipped galvanized coatings conforming to ASTM A153.

4.4 Fasteners are approved for use in interior conditions and in chemically treated or untreated lumber where ASTM A153 coatings are approved for use in accordance with NBC Table 5.10.1.1 and Article 9.20.16.1.

4.4.1 The proprietary coating has been tested and found to exceed the protection provided by code approved hot-dipped galvanized coatings meeting ASTM A153, allowing for its use in pressure treated (ACQ) wood.

4.4.2 Fasteners 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.

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4.4.3 The fasteners evaluated in this TER are set forth in Table 1.

Table 1. Fastener Specifications

Fastener Name	Head in (mm)			Fastener Length[1] in (mm)	Shank Diameter[2] in (mm)	Thread Length[1] in (mm)	Thread Diameter in (mm)		Nominal Bending Yield,[3] f_{yb} psi (kPa)	Allowable Fastener Strength, lbf (N)	
	Marking	Diameter	Thickness				Minor	Major		Tensile	Shear
FlatLOK®	F2.8FL	0.70 (17.8)	0.095 (2.41)	2 7/8 (73)	0.227 (5.8)	1.75 (44.5)	0.200 (5.1)	0.322 (8.2)	171,600 (1,183,180)	1940 (8630)	1230 (5470)
	F3.5FL			3/2 (89)		2.00 (50.8)					
	F4.0FL			4 (102)							
	F4.5FL			4 1/2 (114)							
	F5.0FL			5 (127)							
	F6.0FL			6 (152)							
	F6.75FL			6¾ (171)							

SI: 25.4 mm = 1 in, 1 N = 0.225 lb, 1 MPa = 145 psi

1. Fastener length is measured from the underside of the head to the tip. Thread length includes tapered tip (see Figure 1).
2. Shank diameter is based on manufactured thickness. Finished dimensions are larger, due to the proprietary coatings added.
3. Bending yield is determined at shank diameter.

5 Applications

5.1 *General*

5.1.1 FlatLOK® fasteners are used to attach wood framing members in conventional light-frame construction and provide resistance to lateral and withdrawal loads applied parallel and/or perpendicular to the structural framing member. See Section 6 for installation requirements.

5.1.2 FlatLOK® fasteners are installed without lead holes, as prescribed in CSA O86 Clause 12.11.2.1, except when the relative density (G) of the wood is greater than 0.50.

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

5.2 *Design*

5.2.1 Design of FlatLOK® fasteners is governed by the applicable code and the provisions for fasteners in CSA O86 Clause 12.2.

5.2.2 Unless otherwise noted, adjustment of the design stresses for duration of load shall be in accordance with CSA O86 Clause 4.3.2.

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5.3 *FlatLOK® Factored Lateral Design Values – Face Grain Applications*

5.3.1 The factored lateral design values for shear load perpendicular and parallel to grain for FlatLOK® fasteners, as depicted in Figure 2, are specified in Table 2, Table 3, and Table 4.

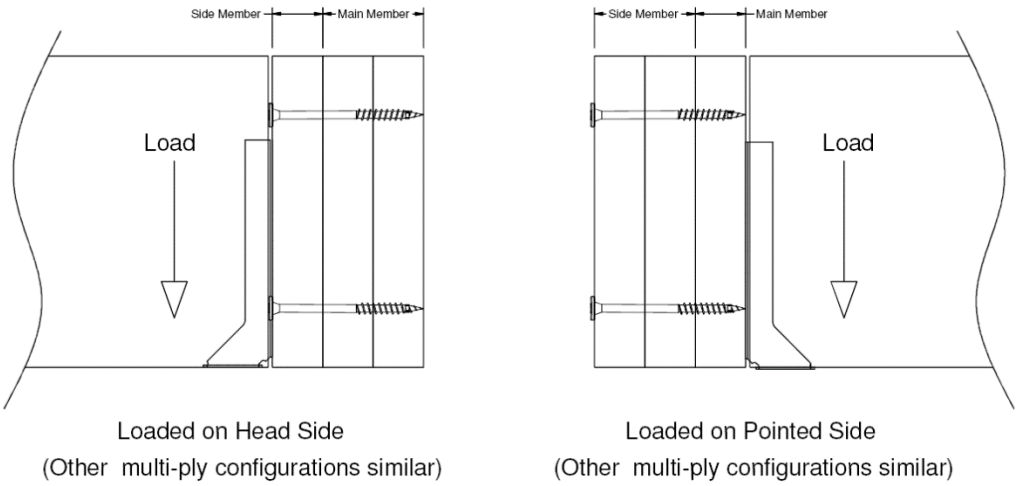

Figure 2. Loading Diagram for Shear Perpendicular to Grain

Table 2. FlatLOK® Factored Lateral Design Values – Dimensional Lumber[1,2,3]

FlatLOK® Fastener	Fastener Length in (mm)	Side Member Thickness in (mm)	Min. Penetration into Main Member in (mm)	Factored Lateral Design Values by Species (Specific Gravity), lbf (N)			
				N (0.35)	SPF (0.42)	H.Fir (0.46)	D.Fir (0.49)
FL278	2 7/8 (73)	1 1/2 (38)	1 3/8 (35)	250 (1110)	300 (1335)	330 (1460)	350 (1555)
FL312	3 1/2 (89)	1 1/2 (38)	2 (51)	305 (1355)	365 (1625)	400 (1780)	425 (1895)
FL004	4 (102)	1 1/2 (38)	2½ (64)	345 (1545)	415 (1855)	455 (2030)	485 (2145)
FL412	4 1/2 (114)	1 1/2 (38)	3 (76)	370 (1640)	425 (1895)	460 (2040)	485 (2145)
		3 (76)	1 1/2 (38)	390 (1740)	470 (2085)	515 (2285)	545 (2435)
FL005	5 (127)	1 1/2 (38)	3 (76)	370 (1640)	425 (1895)	460 (2040)	485 (2145)
FL006	6 (152)	1 1/2 (38)	3 (76)	370 (1640)	425 (1895)	460 (2040)	485 (2145)
		4 1/2 (114)	1 1/2 (38)	475 (2115)	540 (2405)	575 (2560)	600 (2670)
FL634	6¾ (171)	1 1/2 (38)	3 (76)	370 (1640)	425 (1895)	460 (2040)	485 (2145)

SI: 25.4 mm = 1 in, 1 N = 0.225 lb

1. Factored lateral design values apply to two-member single-shear connections where both members are of the same specific gravity, and the fastener is oriented perpendicular to grain. Where the members are of different specific gravities, use the lower of the two.
2. Values shall be adjusted by all applicable adjustment factors per CSA O86 Clause 4.3.2.
3. All values are calculated using fastener bending yield and diameter at the shank.

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Table 3. FlatLOK® Factored Lateral Design Values – Engineered Lumber in Face Grain Applications[1,2,3]

FlatLOK® Fastener	Fastener Length in (mm)	Side Member Thickness in (mm)	Min. Penetration into Main Member in (mm)	Factored Lateral Design Values by Species (Specific Gravity) & Load Orientation, lbf (N)	
				LVL (0.50)	LSL (0.50)
FL278	2 7/8 (73)	1 1/4 (32)	1 5/8 (32)	355 (1585)	355 (1585)
FL312	3 1/2 (89)	1 3/4 (44.5)	1 3/4 (44.5)	435 (1930)	435 (1930)
FL005	5 (127)	1 3/4 (44.5)	3 1/4 (83)	520 (2320)	520 (2320)
		3 1/2 (89)	1 1/2 (38)	610 (2710)	610 (2710)
FL634	6 3/4 (171)	1 3/4 (44.5)	5 (127)	520 (2320)	520 (2320)
		5 (127)	1 3/4 (44.5)	610 (2710)	610 (2710)
FL634	6 3/4 (171)	3 1/2 (89)	3 1/4 (83)	610 (2710)	610 (2710)

SI: 25.4 mm = 1 in, 1 N = 0.225 lb

1. Factored lateral design values apply to two-member single-shear connections where both members are of the same specific gravity, and the fastener is oriented perpendicular to grain. Where the members are of different specific gravities, use the lower of the two.
2. Values shall be adjusted by all applicable adjustment factors per CSA O86 Clause 4.3.2.
3. All values are calculated using fastener bending yield and diameter at the shank.

5.4 *FlatLOK® Factored Lateral Design Values – Edge Grain Applications*

Table 4. FlatLOK® Factored Design Loads – Edge Grain Applications[1,2]

FlatLOK® Fastener	Fastener Length in (mm)	Side Member Thickness in (mm)	Min. Penetration into Main Member in (mm)	Factored Lateral Design Values by Species (Specific Gravity) & Load Orientation, lbf (N)				
				N (0.35)	SPF (0.42)	H.Fir (0.46)	D.Fir (0.49)	LSL[3] (0.50)
FL006	6 (152)	3½ (89)	2½ (63.5)	130 (580)	175 (790)	205 (910)	225 (1000)	230 (1030)

SI: 25.4 mm = 1 in, 1 N = 0.225 lb

1. Reference lateral design values apply to two-member single-shear connections where both members are of the same specific gravity, and the fastener is oriented perpendicular to grain. Where the members are of different specific gravities, use the lower of the two.
2. Values shall be adjusted by all applicable adjustment factors per CSA O86 Clause 4.3.2.
3. Minimum thickness 1¼"

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5.5 *FlatLOK® Factored Withdrawal Load*

5.5.1 The design provisions for withdrawal in CSA O86 Clause 12.11.5 apply to FlatLOK® fasteners, unless otherwise noted in this TER. Factored withdrawal design values for FlatLOK® fasteners in select lumber species are specified in Table 5 and Table 6.

Table 5. FlatLOK® Factored Withdrawal Design Values in Face Grain Applications[1,2]

Thread Penetration into Main Member in (mm)	Factored Withdrawal Design Values by Species (Specific Gravity) lb (N)					
	N (0.35)	SPF (0.42)	HF (0.46)	DF (0.49)	LSL (0.5)	LVL (0.5)
1 (25)	65 (290)	110 (475)	140 (610)	165 (725)	170 (765)	170 (765)
1¼ (31.7)	120 (540)	175 (770)	210 (920)	235 (1,045)	245 (1,090)	245 (1,090)
1½ (38)	180 (795)	240 (1,060)	280 (1,235)	310 (1,370)	320 (1,420)	320 (1,420)
1¾ (44.5)	235 (1,045)	305 (1,355)	350 (1,545)	380 (1,695)	395 (1,750)	395 (1,750)
2 (50.8)	290 (1,300)	370 (1,650)	420 (1,860)	455 (2,020)	465 (2,075)	465 (2,075)

SI: 25.4 mm = 1 in, 1 N = 0.225 lb

1. Values shall be adjusted by all applicable adjustment factors per CSA O86 Clause 12.2 and 12.11.5 for wood screws.
2. Fastener penetration is that portion of the threaded length embedded in the main member, including the tip.

Table 6. FlatLOK® Factored Withdrawal Design Values in Edge Grain Applications[1,2]

Thread Penetration into Main Member in (mm)	Factored Withdrawal Design Values by Species (Specific Gravity), lb (N)					
	N (0.35)	SPF (0.42)	HF (0.46)	DF (0.49)	LSL (0.5)	LVL (0.5)
1 (25.4)	110 (485)	145 (645)	165 (745)	185 (820)	190 (850)	190 (850)
1¼ (31.6)	185 (830)	225 (1,000)	245 (1,100)	265 (1,175)	270 (1,200)	270 (1,200)
1½ (38.1)	265 (1,170)	305 (1,350)	325 (1,455)	345 (1,530)	350 (1,555)	350 (1,555)
1¾ (44.5)	340 (1,510)	380 (1,700)	405 (1,805)	425 (1,885)	430 (1,910)	430 (1,910)
2 (50.8)	415 (1,855)	460 (2,055)	485 (2,160)	505 (2,240)	510 (2,265)	510 (2,265)

SI: 25.4 mm = 1 in, 1 N = 0.225 lb

1. Values shall be adjusted by all applicable adjustment factors per CSA O86 Clause 12.2 and 12.11.5 for wood screws.
2. Fastener penetration is that portion of the threaded length embedded in the main member, including the tip.

5.5.2 *Head pull-through resistance in accordance with CSA O86 Section 12.11.5.3*

5.5.2.1 The factored design values for head pull-through resistance for FlatLOK® fasteners are specified in Table 7.

Table 7. FlatLOK® Factored Head Pull-Through Resistance[1]

Side Member Thickness Minimum in (mm)	Factored Head Pull-Through Resistance (for each fastener in a connection) Dimensional Lumber, LSL, or LVL lb (N)
1.5 (38.1)	255 (1145)

SI: 25.4 mm = 1 in, 1 N = 0.225 lb

1. Values for each fastener in a connection per CSA O86 Clause 12.11.5.3

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5.5.3 *Edge and End Distances:*

5.5.3.1 Fastener edge and end distances shall be as specified in Figure 3 and Table 8.

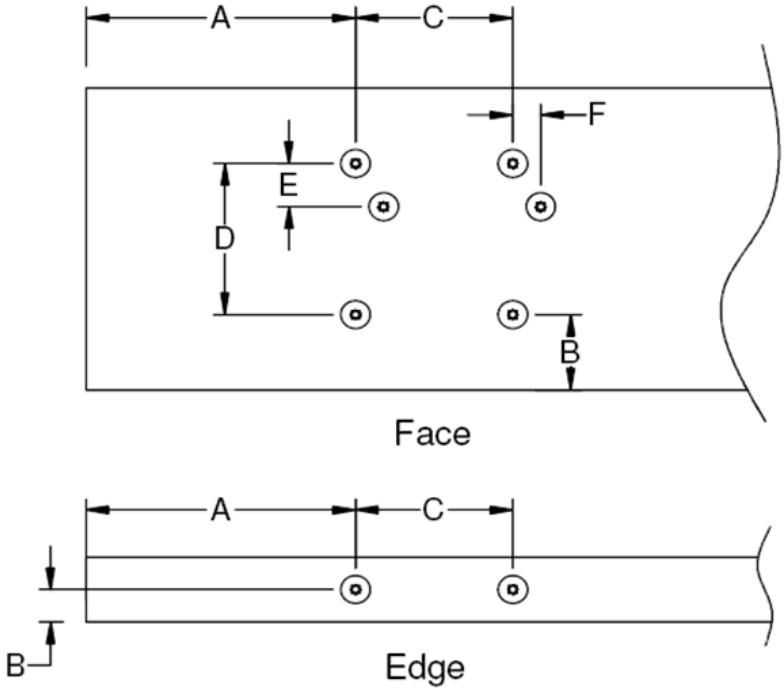

Figure 3. FlatLOK® Edge and End Distance Requirements

Table 8. FlatLOK® Edge and End Distance Requirements

Letter	Installed Condition	Minimum Distance or Spacing,[1] in (mm)	
		Face	Edge
A	Min. End Distance	6 (152)	6 (152)
B	Min. Edge Distance	1 3/4 (44.5)	3/4 (19.1)
C	Min. Spacing Between Fasteners in a Row	3 1/2 (88.9)	3 1/2 (88.9)
D	Min. Spacing Between Non-Staggered Rows	3 1/2 (88.9)	NA
E	Min. Spacing Between Staggered Rows	5/8 (15.9)	NA
F	Min. Stagger Between Fasteners in Adjacent Rows	5/8 (15.9)	NA

SI: 25.4 mm = 1 in

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 the more restrictive. These values have been determined by testing and may not correlate with CSA O86 Clause 12.9.2.1.

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

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6 Installation

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

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

6.3 FlatLOK® fasteners shall be installed in accordance with the applicable code, the approved construction documents, this TER, the manufacturer installation instructions, CSA O86, and standard framing practice as applied to wood fasteners.

6.4 Use a ½" low RPM/high-torque drill to drive the fastener head flush with the surface of the framing member using the driver bit included with the fasteners.

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, shear, and head pull-through testing in accordance with ASTM D1761

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 providers of the codes and standards are legally responsible for their 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 Where the accuracy of the provisions provided herein is reliant upon the published properties of materials, DrJ relies upon the grade mark, grade stamp, mill certificate, and/or test data provided by material suppliers to be minimum properties. DrJ analysis relies upon these properties to be accurate.

8 Findings

8.1 When used and installed in accordance with this TER, the provisions of the applicable building codes defined in Section 2 and the manufacturer installation instructions, the product listed in Section 1.1 shall be approved for:

8.1.1 Use as an alternative to those fasteners prescribed by the applicable code

8.2 This product has been evaluated in the context of the codes listed in Section 2 and is compliant with all known provincial, territorial, and local building codes. Where there are known variations in provincial, territorial, or local codes applicable to this TER, they are listed here.

8.2.1 No known variations

8.3 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...

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8.4 Valid evaluations are obtained from independent professional organizations, which include but are not limited to ISO/IEC 17065 accredited evaluation services and professional engineers.[3]

8.5 ISO/IEC 17065 accreditation bodies, including but not limited to SCC and ANAB, confirm that product certification bodies have the expertise to provide evaluation services within their scope of accreditation. All SCC and ANAB product certification bodies meet NBC requirements to offer evaluation services for alternative solutions.[4]

8.5.1 DrJ is an ISO/IEC 17065 ANAB-Accredited Product Certification Body – Accreditation #1131, and employs professional engineers.[5]

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

8.6.1 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*."

8.6.2 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*."[6]

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

9 Conditions of Use

9.1 The FlatLOK® fasteners covered in this TER shall be installed in accordance with this TER and the manufacturer installation instructions.

9.2 For conditions not covered in this TER, connections shall be designed in accordance with generally accepted engineering practice.

9.3 Where required by the authority having jurisdiction (AHJ) in which the project is to be constructed:

9.3.1 This TER and the installation instructions shall be submitted at the time of permit application.

9.3.2 Any calculations required to show compliance with this TER, incorporated as part of the construction documents that are to be examined for conformance to the requirements of the pertinent laws shall conform with accepted engineering practice, and be approved when requirements of the pertinent laws are met.

9.4 Any generally accepted engineering calculations needed to show compliance with this TER shall be submitted to the AHJ for review and approval.

9.5 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 (i.e., owner).

9.6 At a minimum, this product shall be installed per Section 6 of this TER.

9.7 This product has an internal quality control program and a third-party quality assurance program in accordance with ISO/IEC 17065 certification procedures.

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[3] NBC Division C Article 2.2.1.2

[4] 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.

[5] 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*".

[6] 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.*"

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9.8 The actual design, suitability, and use of this TER, for any particular building, is the responsibility of the owner or the owner's authorized agent.

9.9 This TER 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.

9.10 The implementation of this TER for this product is dependent on the design, quality control, third-party quality assurance, proper implementation of installation instructions, inspections, and any other code or regulatory requirements that may apply.

10 Identification

10.1 The product listed in Section 1.1 is identified by a label on the board or packaging material bearing the manufacturer name, product name, TER number, and other information to confirm code compliance.

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

11 Review Schedule

11.1 This TER is subject to periodic review and revision. For the most recent version, visit drjcertification.org.

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

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