



Technical Evaluation Report

TO ASSIST WITH CODE COMPLIANCE

**FastenMaster FlatLOK® Fasteners
Limit States Design**

TER No. 1503-01

**OMG, Inc
d/b/a FastenMaster**

**Issue Date: August 7, 2015
Subject to Renewal: July 1, 2016**

153 Bowles Road
Agawam, Massachusetts 01001
413-789-0252
fastenmaster.com

DIVISION: 06 00 00 – WOOD, PLASTICS, AND COMPOSITES

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

1. Product Evaluated:

- 1.1. FastenMaster FlatLOK® Fasteners
- 1.2. For the most recent version of this report, visit drjengineering.org. For more detailed state professional engineering and code compliance legal requirements and references, visit drjengineering.org/statelaw. DrJ is fully compliant with all state professional engineering and code compliance laws.

2. Applicable Codes and Standards:¹

- 2.1. *2010 National Building Code of Canada (NBC)*
- 2.2. *CAN/CSA-086 – Engineering Design In Wood*
- 2.3. *ASME B18.6.1 – Wood Screws (Inch Series)*
- 2.4. *ASTM A510 – Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel*
- 2.5. *ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware*
- 2.6. *ASTM D1761 – Standard Test Methods for Mechanical Fasteners in Wood*

¹ Unless otherwise noted, all references in this TER are from the 2010 version of the NBC and the standards referenced therein, including, but not limited to, CSA 086-09.

DrJ is a Professional Engineering Approved Source

 **Learn more about DrJ's Accreditation**

- DrJ is an ISO/IEC 17065 accredited product certification body through ANSI Accreditation Services.
- DrJ provides certified evaluations that are signed and sealed by a P.E.
- DrJ's work is backed up by professional liability insurance.
- DrJ is fully compliant with IBC Section 1703.



ANSI Accredited Program
PRODUCT CERTIFICATION
#1131

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3. Performance Evaluation:

- 3.1. 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 in accordance with CAN/CSA-O86. The following conditions were evaluated:
- 3.1.1. Withdrawal strength in accordance with *ASTM D1761* and in accordance with *CSA O86* Clause 10.11.5.
 - 3.1.2. 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 10.11.4.
 - 3.1.3. Head pull-through in accordance with *ASTM D1761* and in accordance with *CSA O86* Clause 10.11.5.3.
- 3.2. Use in wet service conditions is outside the scope of this evaluation.
- 3.3. Any code compliance issues not specifically addressed in this section are outside the scope of this evaluation.

4. Product Description and Materials:

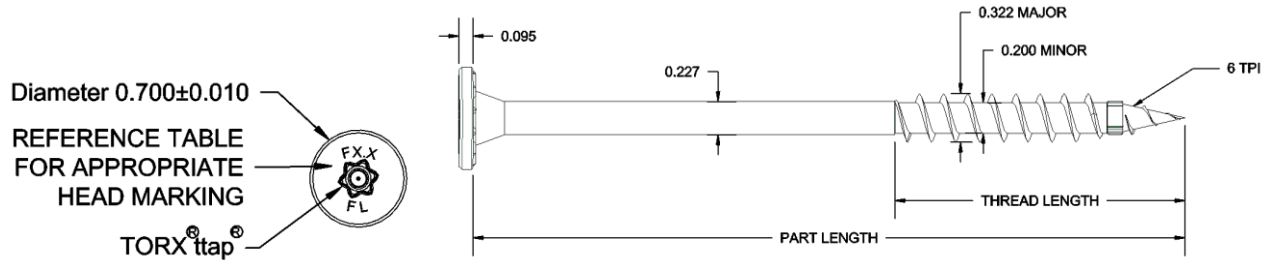


Figure 1: FastenMaster FlatLOK®

- 4.1. FlatLOK® fasteners are manufactured using a standard cold-formed process followed by a heat-treating process.
- 4.2. Fasteners are coated with a proprietary coating that exceeds the protection provided by hot-dipped galvanized coatings conforming to *ASTM A153*.
- 4.3. 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.(1) and Section 9.2.16.1.
 - 4.3.1. 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.
 - 4.3.2. 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.
- 4.4. The fasteners evaluated in this report are set forth in [Table 1](#).

Fastener	Head Marking	Fastener Length ¹ in. (mm)	Thread Length ¹ in. (mm)	Head Diameter in. (mm)	Head Thickness in. (mm)	Shank Diameter ² in. (mm)	Minor Thread (Root) Diameter	Major Thread (Root) Diameter	Bending Yield ³ (f_{yb}), psi (kPa)	Allowable Fastener Strength	
										Tensile lbf (n)	Shear lbf (n)
FlatLOK®	F2.8FL	2 ⁷ / ₈ " (73)	1.75" (44.5)	0.70" (17.8)	0.95" (24.1)	0.227" (5.8)	0.200" (5.1)	0.322" (8.2)	171,600 (1,183,180)	1940 (436)	1230 (276)
	F3.5FL	3 ¹ / ₂ " (89)	2.00" (50.8)								
	F4.0FL	4" (102)	2.00" (50.8)								
	F4.5FL	4 ¹ / ₂ " (114)	2.00" (50.8)								
	F5.0FL	5" (127)	2.00" (50.8)								
	F6.0FL	6" (152)	2.00" (50.8)								
F6.75FL	6 ³ / ₄ " (171)	2.00" (50.8)									

For SI: 1" = 25.4 mm, 1 lbf = 4.4482 N, 1 psi = 6.895 kPa or 0.00689 Mpa, 1 lbf = 0.224809 newtons.

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 based on manufactured thickness. Finished dimensions are larger, due to the proprietary coatings added.

3. Bending yield determined at shank diameter.

Table 1: Fastener Dimensions & Strength Details

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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 CAN/CSA-O86 Clause 10.11.2.1, except when the relative density (G) of the wood is greater than 0.50.

5.1.3. Design

5.1.3.1. Design of FlatLOK[®] fasteners is governed by the applicable code and the provisions for fasteners in CAN/CSA-O86 Clause 10.2.

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

5.2. FlatLOK[®] Factored Lateral Design Values – Face Grain Applications

5.2.1. The factored lateral design values for shear load perpendicular and parallel to grain for FlatLOK[®] fasteners are specified in [Table 2-4](#), as depicted in [Figure 2](#).

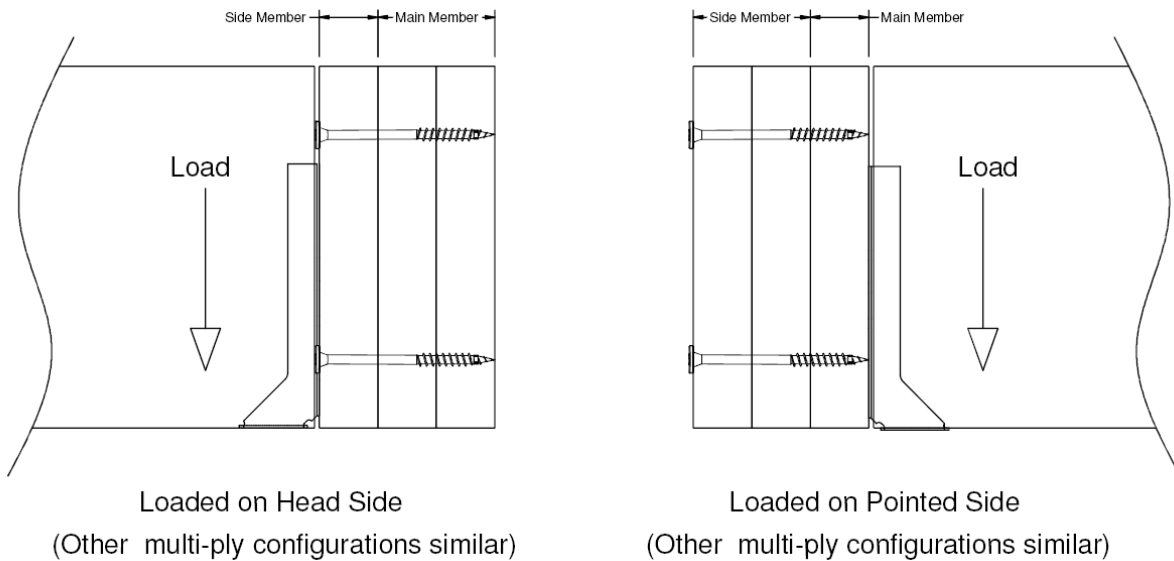


Figure 2: Loading Diagram for Shear Perpendicular to Grain

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Dimensional Lumber							
Product	Overall Fastener Length in. (mm)	Side Member Thickness in. (mm)	Minimum 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)
FL278	27/8" (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)	2 1/2" (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	6 3/4" (171)	1 1/2" (38)	3" (76)	370 (1640)	425 (1895)	460 (2040)	485 (2145)

For SI: 1" = 25.4 mm, 1 lb. = 4.4482 N

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 CAN/CSA-O86, 4.3.2.
3. All values calculated using fastener bending yield and diameter at the shank.

Table 2: FlatLOK® Factored Lateral Design Values Using Dimensional Lumber

Engineered Lumber					
Product	Overall Fastener Length in. (mm)	Side Member Thickness in. (mm)	Minimum 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	27/8" (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)

For SI: 1" = 25.4 mm, 1 lb. = 4.4482 N

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 CAN/CSA-O86, 4.3.2.

Table 3: FlatLOK® Factored Lateral Design Values Using Engineered Lumber in Face Grain Applications

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5.3. FlatLOK® Factored Lateral Design Values – Edge Grain Applications

Dimensional & Engineered Lumber								
Product	Overall Fastener Length in. (mm)	Side Member Thickness in. (mm)	Minimum Penetration Into Main Member in. (mm)	Factored Lateral Design Values by Species (Specific Gravity) Parallel to Grain Loading Lb (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)

For SI: 1" = 25.4 mm, 1 lb. = 4.4482 N
 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 CAN/CSA-O86, 4.3.2.
 3. Minimum thickness 1¼".

Table 4: FlatLOK® Factored Lateral Design Values in Edge Grain Applications

5.4. FlatLOK® Factored Withdrawal Load

5.4.1. The design provisions for withdrawal in CAN/CSA-O86 Section 10.11.5 apply to FlatLOK® fasteners, unless otherwise noted in this report. Factored withdrawal design values for FlatLOK® fasteners in select lumber species are specified in [Table 5](#) and [Table 6](#).

Face Grain Applications						
Thread Penetration Into Main Member in. (mm)	Reference 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)	125 (555)	205 (910)	260 (1165)	310 (1385)	330 (1465)	330 (1465)
1¼" (31.7)	235 (1,040)	330 (1475)	395 (1765)	4501 (2005)	470 (2090)	470 (2090)
1½" (38)	340 (1,520)	460 (2035)	530 (2365)	590 (2630)	612 (2720)	612 (2720)
1¾" (44.5)	450 (2,005)	585 (2600)	665 (2965)	730 (3250)	755 (3350)	755 (3350)
2" (50.8)	560 (2,485)	710 (3160)	800 (3565)	895 (3875)	895 (3980)	894 (3980)

For SI: 1" = 25.4 mm, 1 lb. = 4.4482 N
 1. Values shall be adjusted by all applicable adjustment factors per CAN/CSA-O86 Section 10.2 and 10.11.5 for wood screws.
 2. Fastener penetration is that threaded length embedded in the main member, including the tip.

Table 5: FlatLOK® Factored Withdrawal Design Values in Face Grain Applications

Edge Grain Applications						
Thread Penetration Into Main Member in. (mm)	Reference Withdrawal Design Values by Species (Specific Gravity) Lbf (N)					
	N (0.35)	SPF (0.42)	HF (0.46)	DF (0.49)	LSL (0.5)	LVL (0.5)
1" (25.4)	210 (930)	280 (1240)	320 (1425)	355 (1575)	365 (1625)	365 (1625)
1¼" (31.6)	355 (1585)	430 (1910)	475 (2105)	505 (2255)	520 (2305)	520 (2305)
1½" (38.1)	505 (2240)	580 (2585)	625 (2785)	660 (2935)	670 (2985)	670 (2985)
1¾" (44.5)	650 (2895)	755 (3260)	780 (3465)	810 (3610)	825 (3660)	825 (3660)
2" (50.8)	800 (3550)	885 (3935)	930 (4140)	965 (4290)	975 (4340)	975 (4340)

For SI: 1" = 25.4 mm, 1 lb. = 4.4482 N
 1. Values shall be adjusted by all applicable adjustment factors per CAN/CSA-O86 Section 10.2 and 10.11.5 for wood screws.
 2. Fastener penetration is that threaded length embedded in the main member, including the tip.

Table 6: FlatLOK® Factored Withdrawal Design Values, W

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5.4.2. Head pull-through in accordance with *CAN/CSA-O86* Section 10.11.5.3

5.4.2.1. The factored design values for head pull-through for FlatLOK® fasteners are specified in [Table 7](#).

Side Member Thickness Minimum in. (mm)	Factored Head Pull-Through Load (per each fastener in a connection) Lb (N)
1.5 (38.1)	255 (1145)
For SI: 1" = 25.4 mm, 1 lb. = 4.4482 N 1. Values for each fastener in a connection per <i>CAN/CSA-O86</i> Section 10.11.5.3.	

Table 7: FlatLOK® Factored Head Pull-Through Design Values

5.4.3. Edge and End Distance

5.4.3.1. Fastener edge and end distances shall be as specified in [Figure 3](#) and [Table 8](#).

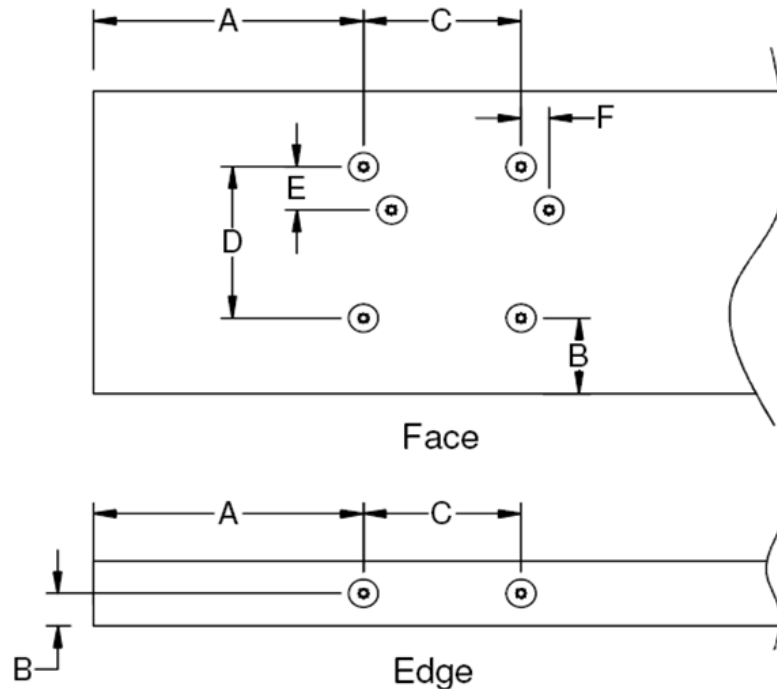


Figure 3: FlatLOK® Edge & End Distance Requirements

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

For SI: 1" = 25.4 mm
1. Edge distances, end distances and spacing of fasteners shall be sufficient to prevent splitting of the wood or as shown in this table, whichever is the more restrictive. These values have been determined by testing and may not correlate with *CAN/CSA-O86* Section 10.9.2.1.

Table 8: FlatLOK® Edge & End Distance Requirements

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

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6. Installation:

- 6.1. FlatLOK[®] fasteners shall be installed in accordance with the applicable code, the approved construction documents, this TER, the manufacturer's installation instructions, CAN/CSA-O86 and standard framing practice as applied to wood fasteners.
 - 6.1.1. If the manufacturer's installation instructions conflict with this report, the TER instructions supersede and should be used.
- 6.2. Use a 1/2" 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. Test and Engineering Substantiating Data:

- 7.1. The product(s) evaluated by this TER falls within the scope of one or more of the model, state or local building codes for building construction. The testing and/or substantiating data used in this TER is limited to buildings, structures, building elements, construction materials and civil engineering related specifically to buildings.
- 7.2. The provisions of model, state or local building codes for building construction do not intend to prevent the installation of any material or to prohibit any design or method of construction. Alternatives shall use consensus standards, performance-based design methods or other engineered alternative means of compliance. This TER assesses compliance with defined standards, generally accepted engineering analysis, performance-based design methods, etc. in the context of the pertinent building code requirements.
- 7.3. Testing for withdrawal, shear and head pull through by SBCRI, under contract with Qualtim, Inc., in accordance with ASTM D1761.
- 7.4. ASTM A510 – *Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel.*
- 7.5. ASTM A153 – *Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.*
- 7.6. CAN/CSA-O86 – *Engineering Design In Wood.*
- 7.7. Some information contained herein is the result of testing and/or data analysis by other sources, which DrJ relies on to be accurate as it undertakes its engineering analysis.
- 7.8. DrJ has reviewed and found the data provided by other professional sources are credible. This information has been approved in accordance with DrJ's procedure for acceptance of data from approved sources.
- 7.9. DrJ's responsibility for data provided by approved sources is in accordance with professional engineering law.
- 7.10. Where appropriate, DrJ relies on the derivation of design values, which have been codified into law through codes and standards. This includes review of code provisions and any related test data that helps with comparative analysis or provides support for equivalency to an intended end-use application.

8. Findings:

- 8.1. When used in accordance with the provisions of this report and the provisions of the applicable building codes defined in [Section 2](#), FlatLOK[®] fasteners have the factored design value properties defined herein and are approved for use as an alternative to those fasteners prescribed by the applicable code.
- 8.2. NBC Section 1.2.1 states:
 - 1.2.1 Compliance with this Code**
 - 1) Compliance with this Code shall be achieved by
 - a) complying with the applicable acceptable solutions in Division B (see Appendix A), or
 - b) using alternative solutions that will achieve at least the minimum level of performance required by Division B in the areas defined by the objectives and functional statements attributed to the applicable acceptable solutions (see Appendix A).
 - 2) For the purposes of compliance with this Code as required in Clause 1.2.1.1.(1)(b), the objectives and functional statements attributed to the acceptable solutions in Division B shall be the objectives and functional statements referred to in Subsection 1.1.2. of Division B.
- 8.3. NBC Section 2.3 includes additional guidance for Alternative Solutions.
- 8.4. This TER uses professional engineering law, the building code, ANSI/ASTM consensus standards and generally accepted engineering practice as its criteria for all testing and engineering analysis. DrJ's professional engineering work falls under the jurisdiction of each state Board of Professional Engineers, when signed and sealed.

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9. Conditions of Use:

- 9.1. Where required by the authority having jurisdiction (AHJ) in which the project is to be constructed, this report and the installation instructions shall be submitted at the time of permit application.
- 9.2. Any generally accepted engineering calculations needed to show compliance with this TER shall be submitted to the code official for review and approval.
- 9.3. Design loads shall be determined in accordance with the building code adopted by the jurisdiction in which the project is to be constructed.
- 9.4. The FlatLOK[®] fasteners covered in this TER shall be installed in accordance with this report and the [manufacturer's installation instructions](#). Where a conflict occurs, the more restrictive shall apply.
- 9.5. For conditions not covered in this TER, connections shall be designed in accordance with generally accepted engineering practice.
- 9.6. FastenMaster products are produced by OMG, Inc. at its facility located in Agawam, Massachusetts.
- 9.7. FlatLOK[®] fasteners are produced under a quality control program subject to periodic inspections.
- 9.8. Design
 - 9.8.1. Building Designer Responsibility
 - 9.8.1.1. Unless the AHJ allows otherwise, the Construction Documents shall be prepared by a Building Designer (e.g., Owner, Registered Design Professional, etc.) for the Building and shall be in accordance with *NBC* Section 2.2.1.2.
 - 9.8.1.2. The Construction Documents shall be accurate and reliable and shall provide the location, direction and magnitude of all applied loads and shall be in accordance with *NBC* Section 2.2.4.3.
 - 9.8.1.2.1. The location, direction and magnitude of all dead, live and lateral loads applicable to FlatLOK[®] fasteners, and any other loads that are going to be applied to FlatLOK[®] fasteners.
 - 9.8.1.2.2. All foundation anchorage designs required to resist uplift, gravity, and lateral loads.
 - 9.8.2. Construction Documents
 - 9.8.2.1. Construction Documents shall be submitted to the Building Official for approval and shall contain the plans, specifications and details needed for the Building Official to approve such documents.
- 9.9. Responsibilities
 - 9.9.1. The information contained herein is a product, engineering or building code compliance research report performed in accordance with the referenced building codes, testing and/or analysis through the use of accepted engineering procedures, experience and good technical judgment.
 - 9.9.2. Product, design and code compliance quality control are the responsibility of the referenced company. Consult the referenced company for the proper detailing and application for the intended purpose. Consult your local jurisdiction or design professional to assure compliance with the local building code.
 - 9.9.3. DrJ research reports provide an assessment of only those attributes specifically addressed in the Products Evaluated or Code Compliance Process Evaluated section.
 - 9.9.4. The engineering evaluation was performed on the dates provided in this TER, within DrJ's professional scope of work.
 - 9.9.5. The actual design, suitability and use of this research report for any particular building is the responsibility of the Owner, the Owner's authorized agent or the Building Designer.
 - 9.9.6. The use of this TER is dependent on the manufacturer's in-plant QC, the ISO/IEC 17020 third-party inspection process, proper installation per the manufacturer's instructions, the Building Official's inspection and any other code requirements that may apply to assure accurate compliance with the applicable building code.

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10. Identification:

- 10.1. FastenMaster® FlatLOK® fasteners described in this TER are identified by a label on the packaging material bearing the manufacturer's name, product name, TER number, and other information to confirm code compliance.
- 10.2. Additional technical information can be found at fastenmaster.com.

11. Review Schedule:

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



- [Mission and Professional Responsibilities](#)
- [Product Evaluation Policies](#)
- [Product Approval – Building Code, Administrative Law and P.E. Law](#)