



Technical Evaluation Report

TO ASSIST WITH CODE COMPLIANCE

FastenMaster FlatLOK™ Fasteners

TER No. 1501-08

OMG, Inc
d/b/a FastenMaster

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Subject to Renewal: July 1, 2017

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 TER, 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.

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.



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2. Applicable Codes and Standards:¹

- 2.1. 2009, 2012 and 2015 International Building Code (IBC)
- 2.2. 2009, 2012 and 2015 International Residential Code (IRC)
- 2.3. ASTM A510 – Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel
- 2.4. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- 2.5. ASTM D1761 – Standard Test Methods for Mechanical Fasteners in Wood
- 2.6. AWC NDS – National Design Specification for Wood Construction

3. Performance Evaluation:

- 3.1. FlatLOK™ fasteners were tested and evaluated to determine their structural resistance properties, which are used to develop reference design values for allowable stress design (ASD). The following conditions were evaluated:
 - 3.1.1. Withdrawal strength in accordance with ASTM D1761.
 - 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.
 - 3.1.3. Head pull-through in accordance with ASTM D1761.
- 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:

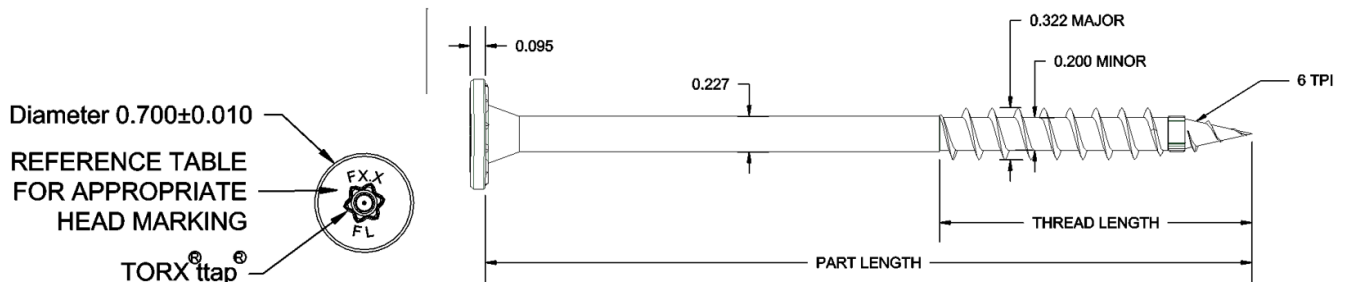


Figure 1: FastenMaster FlatLOK™

- 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 [IBC Section 2304.9](#)² and [IRC Section R317.3](#).
 - 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 ([IBC Section 2304.9.5](#)³ and [IRC Section R317.3](#)), 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.

¹ Unless otherwise noted, all references in this code compliant research report (TER) are from the 2012 version of the codes and the standards referenced therein, including, but not limited to, ASCE 7, SDPWS and WFCM. This product also complies with the 2000-2006 versions of the IBC and IRC and the standards referenced therein. As required by law, where this research report is not approved, the building official shall respond in writing, stating the reasons this research report was not approved. For variations in state and local codes, if any, see [Section 8](#)

² [2015 IBC Section 2304.10](#)

³ [2015 IBC Section 2304.10.5](#)

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4.4. The fasteners evaluated in this TER are set forth in [Table 1](#).

Fastener Name	Head (in.)			Fastener Length ¹ (in.)	Shank Diameter ² (in.)	Thread Length ¹ (in.)	Thread Diameter (in.)		Nominal Bending Yield ³ (f _{yb} , psi)	Allowable Fastener Strength	
	Marking	Diameter	Thickness				Minor	Major		Tensile (lbf)	Shear (lbf)
FlatLOK™	F2.9FL	0.70"	0.095"	2 ⁷ / ₈ "	0.227"	1.75"	0.200"	0.322"	171,600	1940	1230
	F3.5FL			3 ¹ / ₂ "		2.00"					
	F4.0FL			4"							
	F4.5FL			4 ¹ / ₂ "							
	F5.0FL			5"							
	F6.0FL			6"							
	F6.75FL			6 ³ / ₄ "							

For SI: 1" = 25.4 mm, 1 lbf = 4.45 N, 1 psi = 6.895 kPa.

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

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 *NDS*.

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

5.1.4. Design

5.1.4.1. Design of FlatLOK™ fasteners is governed by the applicable code and the provisions for dowel-type fasteners in *NDS*.

5.1.4.2. Unless otherwise noted, adjustment of the design stresses for duration of load shall be in accordance with the applicable code.

5.2. FlatLOK™ Reference Lateral Design Values – Face Grain Applications

5.2.1. The reference lateral design values for shear load perpendicular and parallel to grain for FlatLOK™ fasteners are specified in [Table 2-6](#), as depicted in [Figure 2](#).

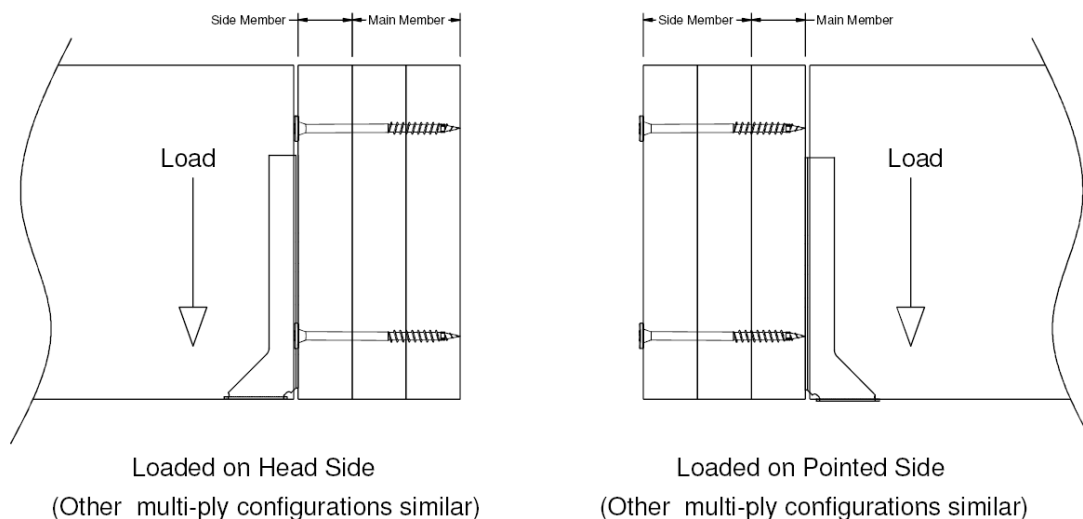


Figure 2: Loading Diagram for Shear Perpendicular to Grain

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Dimensional Lumber – Head Side Loading									
FlatLOK™ Fastener	Fastener Length (in.)	Side Member Thickness (in.)	Min. Penetration into Main Member (in.)	Lateral Design Values (lbf) by Species (Specific Gravity) & Load Orientation					
				SPF (0.42)		D.Fir (0.50)		S.Pine (0.55)	
				Z Perp	Z Para	Z Perp	Z Para	Z Perp	Z Para
FL278	2 ⁷ / ₈ "	1 ¹ / ₂ "	1 ³ / ₈ "	200	150	240	235	270	270
FL312	3 ¹ / ₂ "	1 ¹ / ₂ "	2"	200	150	240	235	270	270
FL004	4"	1 ¹ / ₂ "	2 ¹ / ₂ "	200	150	240	235	270	270
FL412	4 ¹ / ₂ "	1 ¹ / ₂ "	3"	320	245	480	350	550	440
FL005	5"	1 ¹ / ₂ "	3"	320	245	480	350	550	440
FL006	6"	1 ¹ / ₂ "	3"	320	245	480	350	550	440
FL634	6 ³ / ₄ "	1 ¹ / ₂ "	3"	320	245	480	350	550	440

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 NDS.

Table 2: FlatLOK™ Reference Lateral Design Values Using Dimensional Lumber with Loading on the Head Side

Dimensional Lumber – Point Side Loading									
FlatLOK™ Fastener	Fastener Length (in.)	Side Member Thickness (in.)	Min. Penetration into Main Member (in.)	Lateral Design Values (lbf) by Species (Specific Gravity) & Load Orientation					
				SPF (0.42)		D.Fir (0.50)		S.Pine (0.55)	
				Z Perp	Z Para	Z Perp	Z Para	Z Perp	Z Para
FL412	4 ¹ / ₂ "	3"	1 ¹ / ₂ "	200	–	260	–	290	–
FL006	6"	4 ¹ / ₂ "	1 ¹ / ₂ "	200	–	260	–	290	–

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 NDS.

Table 3: FlatLOK™ Reference Lateral Design Values Using Dimensional Lumber with Loading on the Point Side

Engineered Lumber – Head Side Loading									
FlatLOK™ Fastener	Fastener Length (in.)	Side Member Thickness (in.)	Min. Penetration into Main Member (in.)	Lateral Design Values (lbf) by Species (Specific Gravity) & Load Orientation					
				LVL (0.50)		LSL (0.50)			
				Z Perp	Z Para	Z Perp	Z Para		
FL278	2 ⁷ / ₈ "	1 ¹ / ₄ "	1 ¹ / ₄ "	375	235	435	235		
FL312	3 ¹ / ₂ "	1 ³ / ₄ "	1 ³ / ₄ "	375	235	435	235		
FL005	5"	1 ³ / ₄ "	3 ¹ / ₄ "	560	350	480	350		
FL634	6 ³ / ₄ "	1 ³ / ₄ "	5"	560	350	480	350		
FL634	6 ³ / ₄ "	3 ¹ / ₂ "	3 ¹ / ₄ "	560	350	480	350		

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 NDS.

Table 4: FlatLOK™ Reference Lateral Design Values Using Engineered Lumber in Face Grain Applications with Loading on the Head Side

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Engineered Lumber – Point Side Loading							
FlatLOK™ Fastener	Fastener Length (in.)	Side Member Thickness (in.)	Min. Penetration into Main Member (in.)	Lateral Design Values by Species (Specific Gravity) & Load Orientation			
				LVL (0.50)		LSL (0.50)	
				Z Perp	Z Para	Z Perp	Z Para
FL312	3½"	1¾"	1¾"	330	235	260	235
FL005	5"	3½"	1½"	330	235	260	235
FL634	6¾"	5"	1¾"	330	235	260	235
FL634	6¾"	3¼"	3½"	330	235	260	235

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 *NDS*.

Table 5: FlatLOK™ Reference Lateral Design Values Using Engineered Lumber with Loading on the Point Side

5.3. FlatLOK™ Reference Lateral Design Values – Edge Grain Applications

Dimensional and Engineered Lumber							
FlatLOK™ Fastener	Fastener Length (in.)	Side Member Thickness (in.)	Min. Penetration into Main Member (in.)	Lateral Design Values by Species (Specific Gravity) Parallel to Grain Loading			
				SPF (0.42)	D.Fir (0.50)	S.Pine (0.55)	LSL ³ (0.50)
FL006	6"	3½"	2½"	235	300	285	225

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 *NDS*.
3. Minimum thickness 1¼".

Table 6: FlatLOK™ Reference Lateral Design Values in Edge Grain Applications

5.4. FlatLOK™ Reference Withdrawal Design Values

5.4.1. The design provisions for withdrawal noted in *NDS* Table 12.2B apply to FlatLOK™ fasteners, unless otherwise noted in this TER. Reference withdrawal design values for FlatLOK™ fasteners in select lumber species are specified in [Table 7-9](#).

Face Grain Applications					
Thread Penetration into Main Member (in.)	Reference Withdrawal Design Values by Species (Specific Gravity)				
	SPF (0.42)	D.Fir (0.50)	S.Pine (0.55)	LVL (0.50)	LSL (0.50)
1"	90	145	140	140	140
1¼"	125	190	210	210	220
1½"	160	240	280	275	295
1¾"	195	285	355	345	375
2"	230	335	425	410	450

1. Values shall be adjusted by all applicable adjustment factors per *NDS* Section 10.3 for wood screws.
2. Fastener penetration is that threaded length embedded in the main member, including the tip.

Table 7: FlatLOK™ Reference Withdrawal Design Values in Face Grain Applications

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Edge Grain Applications					
Thread Penetration into Main Member (in.)	Reference Withdrawal Design Values by Species (Specific Gravity)				
	SPF (0.42)	D.Fir (0.50)	S.Pine (0.55)	LVL (0.50)	LSL (0.50)
1"	100	160	125	125	125
1 1/4"	145	215	190	185	195
1 1/2"	190	275	260	240	265
1 3/4"	235	330	325	300	335
2"	280	390	390	360	405

1. Values shall be adjusted by all applicable adjustment factors per *NDS* Section 10.3 for wood screws.
2. Fastener penetration is that threaded length embedded in the main member, including the tip.

Table 8: FlatLOK™ Reference Withdrawal Design Values in Edge Grain Applications

End Grain Applications					
Thread Penetration into Main Member (in.)	Reference Withdrawal Design Values by Species (Specific Gravity)				
	SPF (0.42)	D.Fir (0.50)	S.Pine (0.55)	LVL (0.50)	LSL (0.50)
2"	175	295	285	–	–

1. Values shall be adjusted by all applicable adjustment factors per *NDS* Section 10.3 for wood screws.
2. Fastener penetration is that threaded length embedded in the main member, including the tip.

Table 9: FlatLOK™ Reference Withdrawal Design Values in End Grain Applications

5.5. Head Pull-Through Design Values

5.5.1. The reference design values for head pull-through for FlatLOK™ fasteners are specified in [Table 10](#).

Min. Side Member Thickness (in.)	Head Pull-Through Design Value (lbs.)					
	SPF (0.42)	DF (0.50)	SP (0.55)	LVL (0.50)	LSL (0.50)	OSB
1.5	395	530	595	650	750	100

1. Values shall be adjusted by all applicable adjustment factors per *NDS* Section 10.3 for withdrawal of wood screws.

Table 10: FlatLOK™ Reference Head Pull-Through Design Values

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5.5.2. Edge and end distance

5.5.2.1. Fastener edge and end distances shall be as specified in [Figure 3](#) and [Table 11](#).

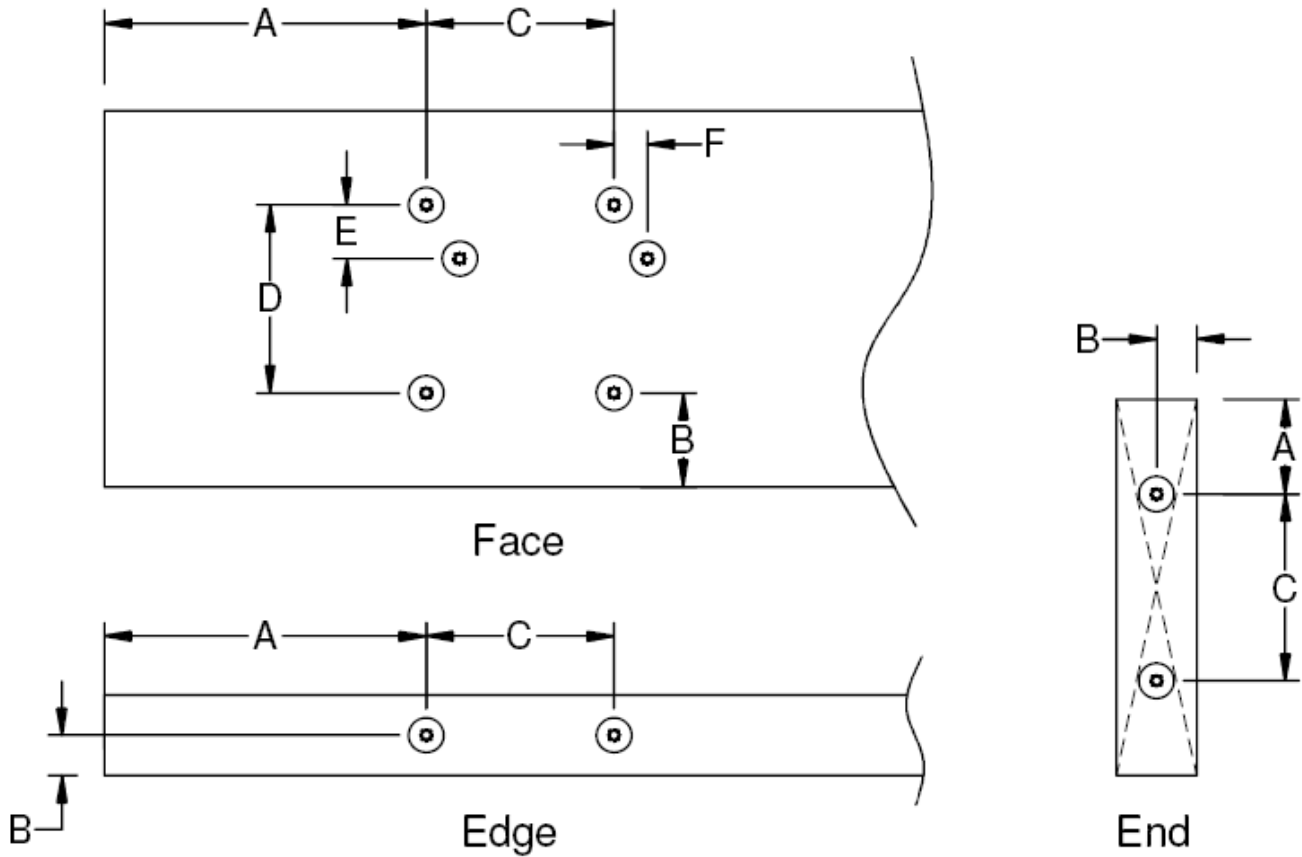


Figure 3: FlatLOK™ Edge & End Distance Requirements

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

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.

Table 11: FlatLOK™ Edge & End Distance Requirements

5.5.3. 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. FlatLOK™ fasteners shall be installed in accordance with the applicable code, the approved construction documents, this TER, the [manufacturer's installation instructions](#), NDS, and standard framing practice as applied to wood fasteners.
 - 6.1.1. In the event of a conflict between the manufacturer's installation instructions and this TER, the more restrictive shall govern.
- 6.2. 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. Test and Engineering Substantiating Data:

- 7.1. Testing for withdrawal, shear and head pull through by SBCRI, under contract with Qualtim, Inc., in accordance with *ASTM D1761*.
- 7.2. *ASTM A510 – Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel.*
- 7.3. *ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.*
- 7.4. *National Design Specification for Wood Construction (NDS).*
- 7.5. 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.
- 7.6. 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.
- 7.7. 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 (e.g., *IRC, WFCM, IBC, SDPWS*, etc.). 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 TER and the provisions of the applicable building codes defined in [Section 2](#), FlatLOK™ fasteners have the reference design value properties defined herein and are approved for use as an alternative to those fasteners prescribed by the applicable code.
- 8.2. [IBC Section 104.11](#) and [IRC Section R104.11](#) ([IFC Section 104.9](#) is similar) state:

104.11 Alternative materials, design and methods of construction and equipment. The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been *approved*. An alternative material, design or method of construction shall be *approved* where the *building official* finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code. ... Where the alternative material, design or method of construction is not *approved*, the *building official* shall respond in writing, stating the reasons the alternative was not *approved*.⁴

⁴ The last sentence is adopted language in the 2015 codes.

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8.3. This product has been evaluated with the codes listed in [Section 2](#), and is compliant with all known state and local building codes. Where there are known variations in state or local codes that are applicable to this evaluation, they are listed here:

8.3.1. No known variations

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.

9. Conditions of Use:

9.1. Where required by the authority having jurisdiction (AHJ) in which the project is to be constructed, this TER 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 TER and the [manufacturer's installation instructions](#).

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

9.6. [Manufacturer's installation instructions](#) shall be followed as provided in [Section 6](#) and at fastenmaster.com/products/flatlok-structural-wood-screw.html.

9.7. FlatLOK™ fasteners products are produced by OMG, Inc. at its facility located in Agawam, Massachusetts.

9.8. FlatLOK™ fasteners are produced under a quality control program subject to periodic inspections performed by an approved agency in accordance with [IBC Section 1703.5.2](#).

9.9. Design

9.9.1. Building Designer Responsibility

9.9.1.1. 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 [IRC Section R106](#) and [IBC Section 107](#).

9.9.1.2. 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 [IRC Section R301](#) and [IBC Section 1603](#).

9.9.2. Construction Documents

9.9.2.1. 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.

9.10. Responsibilities

9.10.1. 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 technical judgment.

9.10.2. DrJ research reports provide an assessment of only those attributes specifically addressed in the Products Evaluated or Code Compliance Process Evaluated section.

9.10.3. The engineering evaluation was performed on the dates provided in this TER, within DrJ's professional scope of work.

9.10.4. This product is manufactured under a third-party quality control program in accordance with [IRC Section R104.4](#) and [R109.2](#) and [IBC Section 104.4](#) and [110.4](#).

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- 9.10.5.** The actual design, suitability and use of this research report for any particular building is the responsibility of the Owner or the Owner's authorized agent, and the report shall be reviewed for code compliance by the Building Official.
- 9.10.6.** 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.

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, certification mark, 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 TER, visit drjengineering.org.
- 11.2.** For information on the current status of this TER, contact [DrJ Engineering](#).



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