

**Use of FastenMaster FrameFAST® Fasteners
To Provide Top Plate Roll Resistance to Trusses &
Rafters Attached to the Tops of Walls**

TER No. 1703-06

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

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DIVISION: 06 00 00 – WOOD, PLASTICS AND COMPOSITES
Section: 06 00 90 – Wood and Plastic Fastenings

1. Product Evaluated

- 1.1. FastenMaster FrameFAST® Structural Wood Screw (FrameFAST® fasteners)
- 1.2. For the most recent version of this Technical Evaluation Report (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.
- 1.3. This TER can be used to obtain product approval in any country that is an IAF MLA Signatory (all countries found [here](#)) and covered by an [IAF MLA Evaluation](#) per the [Purpose of the MLA](#) (as an example, see [letter to ANSI](#) from the Standards Council of Canada). Manufacturers can go to jurisdictions in the U.S., Canada and other [IAF MLA Signatory Countries](#) and have their products readily approved by authorities having jurisdiction using [DrJ's ANSI accreditation](#).
- 1.4. Building code regulations require that evaluation reports are provided by an approved agency meeting specific requirements, such as those found in [IBC Section 1703](#). Any agency accredited in accordance with ANSI ISO/IEC 17065 meets this requirement within ANSI's scope of accreditation. For a list of accredited agencies, visit ANSI's [website](#). For more information, see drjcertification.org.

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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- 1.5. Requiring an evaluation report from a specific private company (i.e. ICC-ES, IAPMO, CCMC, DrJ, etc.) can be viewed as discriminatory and is a violation of international, federal, state, provincial and local anti-trust and free trade regulations.
- 1.6. DrJ's code compliance work:
 - 1.6.1. Conforms to code language adopted into law by individual states and any relevant consensus based standard such as an ANSI or ASTM standard.
 - 1.6.2. Complies with accepted engineering practice, all professional engineering laws and by providing an engineer's seal DrJ takes professional responsibility for its specified scope of work

2. Applicable Codes and Standards:¹

- 2.1. 2012, 2015 and 2018 International Building Code (IBC)
- 2.2. 2012, 2015 and 2018 International Residential Code (IRC)
- 2.3. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- 2.4. ASTM D1761 – Standard Test Methods for Mechanical Fasteners in Wood
- 2.5. AWC NDS – National Design Specification for Wood Construction, American Wood Council
- 2.6. ICC-600 – Standard for Residential Construction in High-Wind Regions
- 2.7. SDPWS Wind & Seismic – Special Design Provisions for Wind and Seismic

3. Performance Evaluation:

- 3.1. FrameFAST® fasteners used in truss to top plate connections were evaluated to specifically assess the effect of "Top Plate Roll" (TPR).
 - 3.1.1. TPR is defined as the turning or "rolling" of the top plate of a wall assembly in relation to the truss assembly above and/or off the wall assembly below.
 - 3.1.2. TPR is caused by eccentric load path connections (i.e., the connections of the truss to top plate and the top plate to stud are not directly lined up vertically).
 - 3.1.3. This condition is shown in [Figure 1](#).

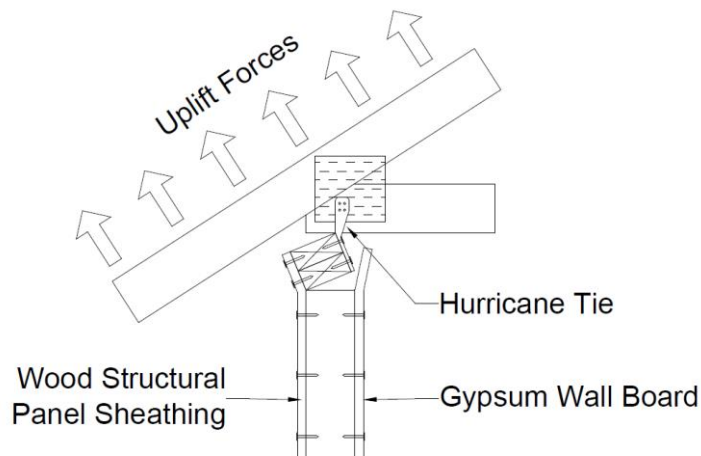


Figure 1: Illustration of Top Plate Roll²

¹ Unless otherwise noted, all references in this code compliant research report (TER) are from the 2018 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 2000-2015 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 Illustration from Simpson Strong-Tie Technical Bulletin - T-HTIECONPATH10, dated 9/10.

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- 3.2. The TPR condition is assessed with respect to existing building code requirements.
- 3.3. For general FrameFAST® truss to top plate connection design information, see [TER No. 1503-03](#).
- 3.4. Connections other than those addressed in [Section 3](#) are outside the scope of this TER.
- 3.5. Any code compliance issues not specifically addressed in this section are outside the scope of this TER.

4. Product Description and Materials:

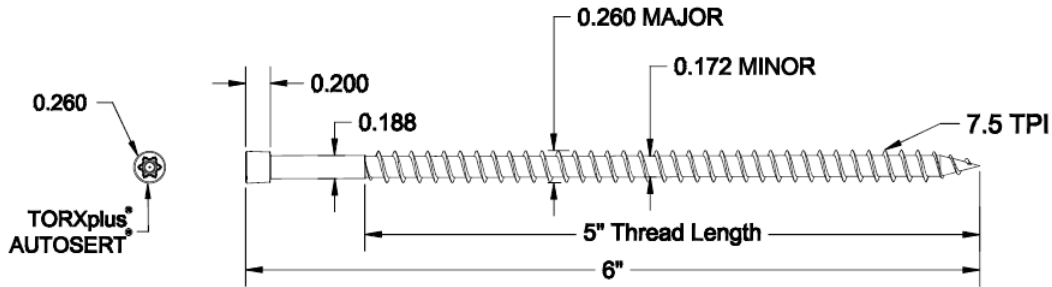


Figure 1: FrameFAST® Fastener Specification (FMFF006)

- 4.1. FrameFAST® fasteners are manufactured with modified 10B21 carbon steel wire conforming to the manufacturers specifications and are coated with a proprietary finish.
- 4.2. FrameFAST® fasteners are manufactured using a standard cold-formed process followed by a heat-treating process.
- 4.3. FrameFAST® fasteners are approved for use in interior and exterior conditions and in pressure-treated wood.
- 4.4. In-plant quality control procedures, under which the FrameFAST® fasteners are manufactured, are audited through an inspection process performed by an approved agency.
- 4.5. The FrameFAST® fasteners evaluated in this TER are designated as follows:

Fastener	Fastener Designation	Fastener Length ¹ (in.)	Thread Length ¹ (in.)	Head Diameter (in.)	Head Height	Shank Diameter ² (in.)	Minor Thread (Root) Diameter	Major Thread (Root) Diameter	Bending Yield ² (<i>f_y</i> , psi)	Allowable Fastener Strength ²	
										Tensile (psi)	Shear (psi)
FrameFAST®	FMFF006	6"	5"	0.260"	0.200"	0.188"	0.172"	0.260"	166,600	155,900	120,360

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. Bending yield, tension and shear values determined at minor root diameter.

Table 1: Fastener Designation for the Evaluated FrameFAST® Fasteners

5. Applications:

5.1. General Code Requirements

- 5.1.1. Neither the *IBC* nor the *IRC* contain requirements that specifically address the potential for TPR due to an eccentric load path.
- 5.1.2. There are no code-defined deflection requirements for deformations caused by uplift.
- 5.1.3. The design for uplift is an allowable stress design load consideration. Uplift loads must be resisted by the fastening system used.

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5.2. IRC Requirements

5.2.1. [Table 2](#) defines the connection, per [IRC Table R602.3\(1\)](#)³

Item	Description of Building Elements	Number and Types of Fastener	Spacing of Fasteners
6	Rafter or roof truss to plate	3-16d box nails (3 ¹ / ₂ " x 0.135"); or 3-10d common nails (3" x 0.148"); or 4-10d box (3" x 0.128"); or 4-3" x 0.131" nails	2 toe nails on one side and 1 toe nail on opposite side of each rafter or truss

Table 2: Excerpt from IRC Table R602.3(1) Fastener Schedule for Structural Members⁵

5.2.2. [IRC Section R802.11](#) discusses the roof to wall uplift resistance in terms of resistance to load with no deflection criteria.

Where the uplift force does not exceed 200 pounds, rafters and trusses spaced not more than 24 inches (610 mm) on center shall be permitted to be attached to their supporting wall assemblies in accordance with Table R602.3(1).

5.2.3. [IRC Section R802.11.1.1](#)⁴ addresses truss to top plate connections for trusses.

R802.11.1.1 Truss uplift resistance. Trusses shall be attached to supporting wall assemblies by connections capable of resisting uplift forces as specified on the truss design drawings. Uplift forces shall be permitted to be determined as specified by Table R802.11, if applicable, or as determined by accepted engineering practice.

5.2.4. [IRC Section R802.11.1.2](#)⁵ then addresses the connection for rafters.

R802.11.1.2 Rafter uplift resistance. Individual rafters shall be attached to supporting wall assemblies by connections capable of resisting uplift forces as determined by Table R802.11 or as determined by accepted engineering practice. Connections for beams used in a roof system shall be designed in accordance with accepted engineering practice.

5.3. IBC Requirements

5.3.1. [IBC Section 1604.8.1](#) and [1604.9](#) contain the following requirements:

1604.8.1 General. Anchorage of the roof to walls and columns, and of walls and columns to foundations, shall be provided to resist the uplift and sliding forces that result from the application of the prescribed loads.

1604.9 Wind and Seismic Detailing. Lateral force-resisting systems shall meet seismic detailing requirements and limitations prescribed in this code and ASCE 7 Chapters 11, 12, 13, 15, 17 and 18 as applicable, even where wind load effects are greater than seismic load effects.

5.3.2. There are a number of other requirements addressing specific conditions, all of which only address the resistance to applied load. There is no mention of deformation requirements.

5.4. There are two standards referenced by the *IRC* and *IBC* that contain provisions that could prescriptively address the potential for TPR.

5.4.1. *ICC 600* Section 304.1 states:

... Connectors resisting uplift of the roof framing shall be fastened to the top plate on the same side of the wall as the top plate to wall uplift connection.

5.4.2. *SDPWS* Section 4.4.1.5 states that, when using wood structural panels for top plate to stud uplift resistance:

Roof or upper level uplift connectors shall be on the same side of the wall as the sheathing unless other methods are used to prevent twisting of the top plate due to eccentric loading.

5.5. FastenMaster commissioned testing conducted at the SBC Research Institute (SBCRI) to assess the occurrence of TPR.

5.5.1. Test assembly construction, see [Photo 1](#)

³ [2015 IRC Table R602.3\(1\)](#) Fastening Schedule includes this requirement at row #6 and adds 4-10d box (3" x 0.128") or 4-3" x 0.131" nails.

⁴ [2012 IRC Section R802.11.1.2](#).

⁵ [2012 IRC Section R802.11.1.3](#).

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5.5.1.1. Double 2x4 top plates and trusses constructed from SPF #2.

5.5.1.2. ½" gypsum wallboard installed to interior side of wall using #6 x 1¼" drywall screws. Fasteners along the top edge of the drywall were installed into the lower top plate at 7" o.c.

5.5.1.3. Wood structural panel (WSP) sheathing was installed on the exterior wall in accordance with the code.

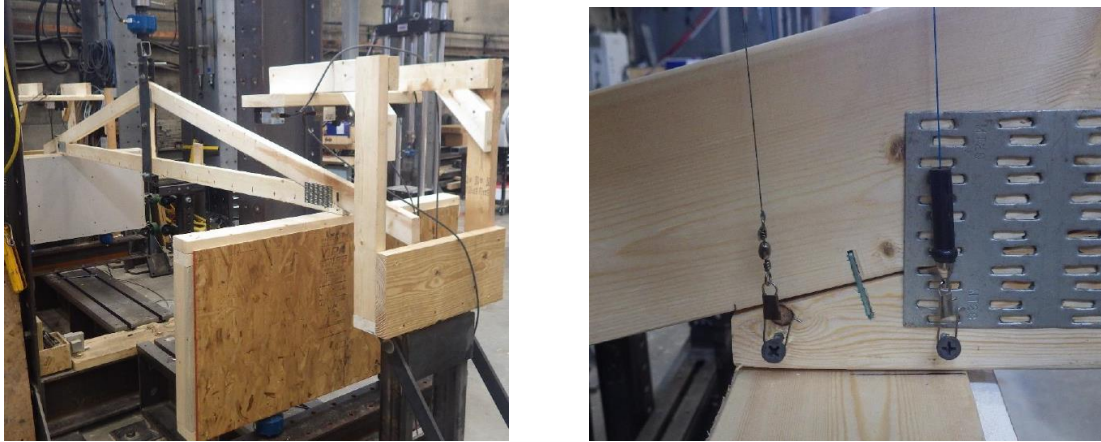


Photo 1: Wall Construction Test Setup

5.5.1.4. FrameFAST® fasteners were installed at a 22.5° angle from vertical, beginning ½" from the inside edge of the lower top plate and driven up through both plates and into the truss.

5.5.2. The published allowable design loads are shown in [Table 3](#).

Fastener Designation	Minimum Penetration into Truss/Rafter/Wood Structural Support (in.) ¹	Species Group (Specific Gravity) ^{2,3}	Uplift (lbf) ⁴			F1 – Parallel to Wall			F2 – Perpendicular to Wall		
			1.0	1.33	1.6	1.0	1.33	1.6	1.0	1.33	1.6
6" FMFF006	2½"	So. Pine (0.55)	430	575	690	175	235	285	305	405	485
		Douglas Fir-Larch (0.50)	410	545	655	190	250	300	285	375	455
		Spruce-Pine-Fir (0.42)	370	495	595	205	275	330	250	335	400

1. Wood truss and rafter members shall be a minimum of 2" nominal thickness. Design of truss and rafter members by others.
 2. Equivalent specific gravity of structural composite lumber (SCL) shall be equal to or greater than the specific gravities provided in this table. Refer to product information from SCL manufacturer.
 3. For applications involving members with different specific gravities, use the allowable load corresponding to the lowest specific gravity.
 4. Use reduction factor of 0.80 when connecting each ply of multiply trusses to the top plate.

Table 3: Allowable Loads for Uplift & Lateral Resistance for Selected Load Durations & Wood-Specific Gravities Using FrameFAST® Fasteners

5.5.3. Where it is anticipated that loads will be applied to a single fastener simultaneously in more than one direction, additional evaluation is required to account for the combined effect of these loads using accepted engineering practice.

5.5.3.1. Consult a professional engineer, as needed, for complex design conditions.

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6. Installation:

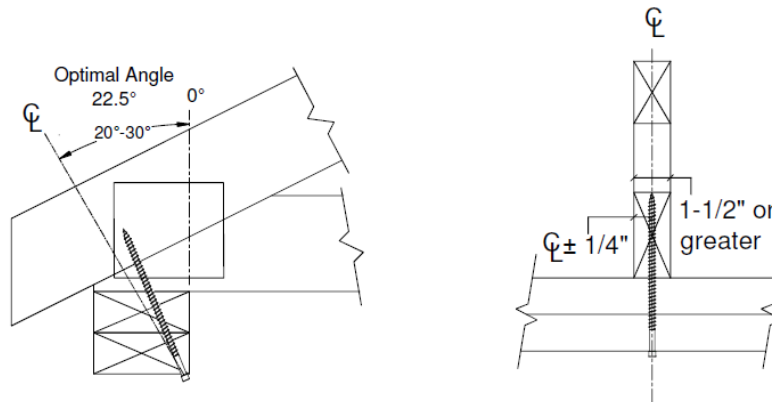


Figure 3: Installation of FrameFAST® Fasteners on Wood Truss or Rafter to Double Top Plate

- 6.1.** Installation shall comply with the manufacturer's installation instructions and this TER. In the event of a conflict between the manufacturer's installation instructions and this TER, the more restrictive shall govern.
- 6.2.** Select a FrameFAST® fastener with a length sufficient to fully embed 2½" of the fastener length into the truss or rafter. See [Figure 3](#) and [Figure 4](#) for guidance.
- 6.3.** Install one (1) FrameFAST® fastener upward through the wall top plates or wood structural framing member at the bottom corner of the top plates and into the center of the wood truss or rafter. The fastener should be installed at a 20°-30° angle and should penetrate the wood truss or rafter within ¼" of the centerline. See [Figure 3](#) and [Figure 4](#).
 - 6.3.1.** If the wood truss or rafter is located directly over a top plate splice, offset the fastener ¼" to one side of the splice and insert the fastener upward through the wall top plates or wood structural framing member at the bottom corner of the top plates and into the center of the truss or rafter. The fastener should be installed at a 20°-30° angle.
- 6.4.** Use a ½" low RPM/high torque drill to drive the fastener head flush with the surface of the wall framing or wood structural framing member.

7. Test and Engineering Substantiating Data:

- 7.1.** FrameFAST® fastener testing conducted by SBCRI, under contract with Qualtim, Inc., 2017 for the following conditions:
 - 7.1.1.** Uplift capacity of FrameFAST® fasteners as evaluated for head pull through and withdrawal of fasteners.
 - 7.1.2.** FrameFAST® fastener performance when used as a truss hold-down.
- 7.2.** FrameFAST® fastener testing conducted by SBCRI, under contract with Qualtim, Inc., 2015 for the following conditions:
 - 7.2.1.** Uplift capacity of FrameFAST® fasteners as evaluated for head pull through and withdrawal of fasteners.
 - 7.2.2.** FrameFAST® fastener performance when used as a truss hold-down.
 - 7.2.3.** FrameFAST® fastener performance when loaded laterally.
- 7.3.** The product(s) evaluated by this TER fall 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.
- 7.4.** 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 engineering mechanics based means of compliance. This TER assesses compliance with defined standards, accepted engineering analysis, performance-based design methods, etc. in the context of the pertinent building code requirements.

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- 7.5. 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.
- 7.6. DrJ has reviewed and found the data provided by other professional sources are credible. The information in this TER conforms with DrJ's procedure for acceptance of data from approved sources.
- 7.7. DrJ's responsibility for data provided by approved sources conforms with [IBC Section 1703](#) and any relevant professional engineering law.
- 7.8. 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, NDS, ACI, AISI, PS-20, PS-2*, etc.). This includes review of code provisions and any related test data that aids in comparative analysis or provides support for equivalency to an intended end-use application. Where the accuracy of design values provided herein is reliant upon the published properties of commodity materials (e.g. lumber, steel, concrete, etc), DrJ relies upon grade/properties provided by the raw material supplier to be accurate and conforming to the mechanical properties defined in the relevant material standard.

8. Findings:

- 8.1. TPR is not a significant concern for FrameFAST® fasteners at allowable design load levels.
- 8.2. When used and installed in accordance with this TER and the manufacturer's installation instructions, FrameFAST® fasteners can be used as an acceptable alternative to:
 - 8.2.1. Toe-nail connections, metal hurricane and seismic clips/straps, or nails to resist the uplift loads and lateral loads as provided for in [Table 3](#).
 - 8.2.2. Provide resistance to uplift loads due to wind negative pressure applied from the truss above lifting up on the top plate of the wall, per [Table 3](#).
- 8.3. [IBC Section 104.11](#) ([IRC Section R104.11](#) and [IFC Section 104.9](#) are similar) states:

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, not less than 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*.
- 8.4. 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:
 - 8.4.1. No known variations
- 8.5. 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 and/or by the Building Designer (e.g., Owner, Registered Design Professional, etc.).

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- 9.4. The FrameFAST® fasteners covered in this TER shall be installed in accordance with [Section 6](#) and the manufacturer's installation instructions.
- 9.4.1. For conditions not covered in this TER, connections shall be designed in accordance with accepted engineering practice.
- 9.5. Manufacturer's installation instructions shall be shipped to the jobsite with the materials or otherwise be available on the jobsite for inspection.
- 9.6. Structural framing members connected with FrameFAST® fasteners shall be designed in accordance with the requirements of their specific design standards/specifications as referenced in the building code adopted by the jurisdiction in which the project is to be constructed.
- 9.7. Loads applied shall not exceed those recommended by the manufacturer or as defined in this TER.
- 9.8. FastenMaster products are produced by OMG, Inc. at its facility located in Agawam, Massachusetts.
- 9.9. FrameFAST® fasteners are produced under a quality control program subject to periodic inspections in accordance with [IBC Section 1703.5.2](#).
- 9.10. Design
- 9.10.1. Building Designer Responsibility
- 9.10.1.1. 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](#).
- 9.10.1.2. 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](#).
- 9.10.2. Construction Documents
- 9.10.2.1. 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.
- 9.11. Responsibilities
- 9.11.1. The information contained herein is a product, material, detail, design and/or application TER evaluated in accordance with the referenced building codes, testing and/or analysis through the use of accepted engineering practice, experience and technical judgment.
- 9.11.2. DrJ TERs provide an assessment of only those attributes specifically addressed in the Products Evaluated or Code Compliance Process Evaluated sections.
- 9.11.3. The engineering evaluation was performed on the dates provided in this TER, within DrJ's professional scope of work.
- 9.11.4. 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](#).
- 9.11.5. 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, and the TER shall be reviewed for code compliance by the Building Official.
- 9.11.6. The use of this TER is dependent on the manufacturer's in-plant QC, the ISO/IEC 17020 third-party quality assurance program and procedures, proper installation per the manufacturer's instructions, the Building Official's inspection and any other code requirements that may apply to demonstrate and verify compliance with the applicable building code.

10. Identification:

- 10.1. The fasteners described in this TER are identified by the designation, "FrameFAST®" on the packaging material bearing the manufacturer's name, product name, TER number, and other information to confirm code compliance.
- 10.2. The packaging shall include OMG's name and address, fastener size, third-party inspection agency, and TER number.

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10.3. 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](#)