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ICC-ES Evaluation Report

ESR-3531

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DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES
SECTION: 06 05 23—WOOD, PLASTIC, AND COMPOSITE FASTENINGS

REPORT HOLDER:

GRABBER CONSTRUCTION PRODUCTS, INC.

5255 WEST 11000 NORTH, SUITE 100
HIGHLAND, UTAH 84003-8955

EVALUATION SUBJECT:

GRABBER LAG-MASTER™ AND TIE-MASTER™ MULTI-PURPOSE WOOD FASTENERS



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DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES
Section: 06 05 23—Wood, Plastic, and Composite Fastenings

REPORT HOLDER:

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EVALUATION SUBJECT:

GRABBER LAG-MASTER™ AND TIE-MASTER™ MULTI-PURPOSE WOOD FASTENERS

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2015, 2012 and 2009 *International Building Code*® (IBC)
- 2015, 2012 and 2009 *International Residential Code*® (IRC)
- 2013 *Abu Dhabi International Building Code* (ADIBC)[†]

[†]The ADIBC is based on the 2009 IBC. 2009 IBC code sections referenced in this report are the same sections in the ADIBC.

Properties evaluated:

- Structural
- Corrosion resistance

2.0 USES

The Grabber Lag-Master™ and Tie-Master™ Multi-purpose Wood Fasteners described in this report are used in engineered wood-to-wood connections in accordance with the IBC and the ANSI/AWC National Design Specification (NDS) for Wood Construction. The fasteners may be used under the IRC when an engineered design is submitted in accordance with IRC Section R301.1.3.

3.0 DESCRIPTION

3.1 General:

The Grabber Lag-Master™ and Tie-Master™ Multi-purpose Wood Fasteners are proprietary, partially threaded dowel-type fasteners. The threads are formed by rolling and have a pitch of 10 threads-per-inch. See Table 1 for designations and dimensions and Figure 1 for depictions of the fasteners. The fasteners are available in boxes of loose fasteners.

3.1.1 Lag-Master™: Lag-Master™ fasteners have $\frac{3}{8}$ -inch (9.5 mm) hex washer style heads and are available in lengths ranging from $2\frac{7}{8}$ to 6 inches (73 to 152 mm).

3.1.2 Tie-Master™: Tie-Master™ fasteners have countersunk heads with a Torx T40 recess and are available in lengths ranging from 4 to 12 inches (102 to 305 mm).

3.2 Material:

3.2.1 Lag-Master™ and Tie-Master™ Fasteners: The Lag-Master™ and Tie-Master™ fasteners are manufactured from carbon steel wire complying with ASTM A510, Grades 10B18 through 10B22, and are heat-treated to achieve case and core hardness in accordance with the manufacturer's specifications. The fasteners are mechanically galvanized in accordance with ASTM B695 Class 55.

3.2.2 Wood Members: Wood members must be solid-sawn lumber having an assigned specific gravity, as specified in Table 12.3.3A of NDS-15 (Table 11.3.3.A of NDS-12 for the 2012 IBC, Table 11.3.2A of NDS-05 for the 2009 IBC) of 0.50 or greater. The thickness of the wood main member, t_m , must be equal to or greater than the screw length less the thickness of the side member, t_s . For the purposes of resisting lateral loads, the side member must have a minimum thickness, t_s , as specified in Table 3. For the purposes of resisting pull-through loads, the side member must have a minimum thickness, t_s , of $\frac{3}{4}$ inch (19.1 mm).

4.0 DESIGN AND INSTALLATION

4.1 Design:

4.1.1 General: The Grabber Lag-Master™ and Tie-Master™ Multi-purpose Wood Fasteners are intended for use with sawn lumber. The Lag-Master™ fasteners are used with side members with thickness ranging from $1\frac{1}{2}$ to $4\frac{1}{4}$ inches (38 to 108 mm). The Tie-Master™ fasteners are used with side members with thickness ranging from $1\frac{1}{2}$ to $10\frac{1}{2}$ inches (38 to 267 mm). Allowable fastener tension and shear strengths are shown in Table 1.

4.1.2 Connection Strengths: Reference withdrawal (W), lateral (Z), and head pull-through (P) design values for the fasteners installed in wood members are given in Tables 2, 3 and 4, respectively. These values are applicable to wood side and main members having a moisture content less than or equal to 19 percent at the time of screw installation and while in service. For unseasoned or partially seasoned wood members and wood members used in wet service conditions, the wet service factors, C_M , shown in the tables must be used to adjust the reference design values.

The allowable lateral load for a single-fastener connection is the lesser of (a) the reference lateral design value given in Table 3, adjusted by all applicable adjustment factors; or (b) the allowable fastener shear strength given in Table 1. The allowable load for a single-fastener connection in which the fastener is subject to tension is the least of (a) the reference withdrawal design value given in Table 2, adjusted by all applicable adjustment factors; (b) the reference head pull-through design value given in Table 4, adjusted by all applicable adjustment factors; or (c) the allowable fastener tension strength given in Table 1. Reference design values must be multiplied by all applicable adjustment factors, as specified for dowel-type fasteners and wood screws in the NDS. When the adjusted lateral design value (Z') of a single-fastener connection exceeds the allowable shear strength of the fastener itself, as specified in Table 1, the design lateral load of the connection must be limited to the shear value specified in Table 1, without any load duration adjustments. When the lesser of the adjusted withdrawal design value (W') and the adjusted pull-through design value (P') of a single-fastener connection exceeds the allowable tensile strength of the fastener itself, as specified in Table 1, the design load of the connection must be limited to the tension value specified in Table 1, without any load duration adjustments.

Connections containing multiple fasteners must be designed in accordance with Sections 11.2.2 and 12.6 of NDS-15 (Sections 10.2.2 and 11.6 of NDS-12 and NDS-05 for the 2012 and 2009 IBC, respectively). Where the fasteners are subjected to combined lateral and withdrawal loads, connections must be designed in accordance with Section 12.4.1 of NDS-15 (Section 11.4.1 of NDS-12 and NDS-05 for the 2012 and 2009 IBC, respectively).

When designing a connection, the structural members must be checked for load-carrying capacity in accordance with Section 11.1.2 of NDS-15 (Section 10.1.2 of NDS-12 and NDS-05 for the 2012 and 2009 IBC, respectively), and local stresses within the connection must be checked against Appendix E of the NDS to ensure the capacity of the connection and fastener group.

4.1.3 Use with Treated Wood:

4.1.3.1 IBC: The fasteners may not be used in contact with preservative-treated wood, with the exception that for applications under the 2015, 2012 and 2009 IBC, the fasteners may be used with SBX/DOT and zinc borate preservative-treated wood in interior, dry environments, in accordance with the Exception to 2015 IBC Section 2304.10.5.1 (2012 and 2009 IBC Section 2304.9.5.1). The fasteners may be used in fire-retardant-treated wood in interior locations in accordance with 2015 IBC Section 2304.10.5.4 (2012 and 2009 IBC Section 2304.9.5.4) and Grabber's recommendations.

4.1.3.2 IRC: The fasteners may be used in contact with preservative-treated wood in accordance with Exception 2 to IRC Section R317.3.1. The fasteners may be used in contact with fire-retardant-treated wood in accordance with IRC Section R317.3.3.

4.2 Installation:

The Lag-Master™ and Tie-Master™ fasteners must be installed in accordance with the report holder's published installation instructions and this report. The fasteners must be installed in accordance with Section 12.1.4 of NDS-15 (Section 11.1.4 of NDS-12 and NDS-05 for the 2012 and 2009 IBC, respectively).

The fasteners must be installed such that their main axis is oriented perpendicular to the wood grain. The side member must be in direct contact with the main member, such that no gap exists between the wood members.

Clearance holes for the fastener shanks and pilot holes for the threaded portion of the fasteners must be drilled prior to installation of the Lag-Master™ and Tie-Master™ fasteners. The clearance holes in the side members must be $\frac{13}{64}$ inch (5.16 mm) in diameter for both the Lag-Master™ and Tie-Master™ fasteners. The pilot holes in the main members must be $\frac{1}{8}$ -inch in diameter with length equal to the length of the threaded portion of the fastener.

A hammer must not be used to install the fasteners. The Lag-Master™ fasteners must be installed by turning with a wrench or socket. Upon installation, the underside of the Lag-Master™ fastener head must be flush with the surface of the side member. The Tie-Master™ fasteners must be installed by turning with star drive (Torx) bits. Upon installation, the top of the Tie-Master™ fastener head must be flush with the surface of the side member.

Minimum end distances, edge distances and spacing of the fasteners must be sufficient to prevent splitting of the wood, or as required by Table 5, whichever is greater.

5.0 CONDITIONS OF USE

The Grabber Lag-Master™ and Tie-Master™ Multi-purpose Wood Fasteners described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

- 5.1 The fasteners must be installed in accordance with the manufacturer's published installation instructions and this report. In case of a conflict between this report and the manufacturer's installation instructions, this report governs.
- 5.2 Use of the fasteners in wood structural panel diaphragms and shear walls is outside the scope of this report.
- 5.3 Calculations and details demonstrating compliance with this report must be submitted to the code official. The calculations and details must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.
- 5.4 Refer to Section 4.1.3 for guidance regarding use of the fasteners in contact with preservative-treated or fire-retardant-treated wood.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Alternate Dowel Type Threaded Fasteners (AC233), dated April 2015 (editorially revised August 2015).

7.0 IDENTIFICATION

The fasteners are identified by a 'G' or a proprietary symbol marked on the fastener head as shown in Figure 1. Packages of fasteners are identified with the company name (Grabber®), fastener series (Lag-Master™ or Tie-Master™), fastener size and length and the evaluation report number (ESR-3531).

TABLE 1—LAG-MASTER™ AND TIE-MASTER™ FASTENERS

| FASTENER DESIGNATION | | OVERALL LENGTH ¹ (inches) | THREAD LENGTH ² (inches) | ROOT THREAD DIAMETER D _r (inches) | SHANK DIAMETER (inches) | OUTSIDE THREAD DIAMETER (inches) | SPECIFIED BENDING YIELD STRENGTH ³ (psi) | ALLOWABLE FASTENER STRENGTH | |
|----------------------|---------------------------------------|---|--|--|----------------------------|-------------------------------------|--|-----------------------------|----------------|
| | | | | | | | | Tension (lbf) | Shear (lbf) |
| Lag-Master | #14 x 2 ⁷ / ₈ " | 2 ⁷ / ₈ | 1.46 | 0.180 | 0.200 | 0.250 | 150,000 | 1,826 | 905 |
| | #14 x 3" | 3 | 1.46 | | | | | | |
| | #14 x 3 ³ / ₈ " | 3 ³ / ₈ | 1.81 | | | | | | |
| | #14 x 3 ¹ / ₂ " | 3 ¹ / ₂ | 1.81 | | | | | | |
| | #14 x 3 ⁵ / ₈ " | 3 ⁵ / ₈ | 1.81 | | | | | | |
| | #14 x 3 ⁷ / ₈ " | 3 ⁷ / ₈ | 1.96 | | | | | | |
| | #14 x 4" | 4 | 1.96 | | | | | | |
| | #14 x 4 ¹ / ₂ " | 4 ¹ / ₂ | 2.48 | | | | | | |
| | #14 x 4 ⁷ / ₈ " | 4 ⁷ / ₈ | 2.48 | | | | | | |
| | #14 x 5" | 5 | 2.48 | | | | | | |
| | #14 x 5 ⁷ / ₈ " | 5 ⁷ / ₈ | 2.91 | | | | | | |
| #14 x 6" | 6 | 2.91 | | | | | | | |
| Tie-Master | #14 x 4" | 4 | 2.48 | 0.180 | 0.200 | 0.250 | 150,000 | 1,492 | 1,046 |
| | #14 x 4 ¹ / ₂ " | 4 ¹ / ₂ | | | | | | | |
| | #14 x 5" | 5 | | | | | | | |
| | #14 x 6" | 6 | | | | | | | |
| | #14 x 8" | 8 | | | | | | | |
| | #14 x 10" | 10 | | | | | | | |
| #14 x 12" | 12 | | | | | | | | |

For SI: 1 inch = 25.4 mm; 1 lbf = 4.45 N; 1 psi = 6.9 kPa.

¹The overall length of a LAG-MASTER™ fastener is measured from the underside of the head to the bottom of the tip. The overall length of a TIE-MASTER™ fastener is measured from the top of the head to the bottom of the tip.

²Length of thread includes tip.

³Bending yield strength determined in accordance with ASTM F1575 using the root diameter.

TABLE 2—REFERENCE WITHDRAWAL DESIGN VALUES (W)¹
Tabulated Withdrawal Design Values (W) Are in Pounds per Inch of Thread Penetration into Side Grain of Main Member

| FASTENER DESIGNATION | | THREAD LENGTH ² , L (inches) | W (lbf/in.) ³ | WET SERVICE FACTOR |
|----------------------|---------------------------------------|--|--------------------------|--------------------|
| | | | Specific Gravity = 0.50 | |
| Lag-Master | #14 x 2 ⁷ / ₈ " | 1.46 | 192 | 0.55 |
| | #14 x 3 | 1.46 | | |
| | #14 x 3 ³ / ₈ " | 1.81 | | |
| | #14 x 3 ¹ / ₂ " | 1.81 | | |
| | #14 x 3 ⁵ / ₈ " | 1.81 | | |
| | #14 x 3 ⁷ / ₈ " | 1.96 | | |
| | #14 x 4 | 1.96 | | |
| | #14 x 4 ¹ / ₂ " | 2.48 | | |
| | #14 x 4 ⁷ / ₈ " | 2.48 | | |
| | #14 x 5" | 2.48 | | |
| | #14 x 5 ⁷ / ₈ " | 2.91 | | |
| #14 x 6 | 2.91 | | | |
| Tie-Master | #14 x 4" | 2.48 | 180 | 0.65 |
| | #14 x 4 ¹ / ₂ " | | | |
| | #14 x 5" | | | |
| | #14 x 6" | | | |
| | #14 x 8" | | | |
| | #14 x 10" | | | |
| #14 x 12" | | | | |

For SI: 1 inch = 25.4 mm; 1 lbf/in = 175 N/m.

¹Values shall be multiplied by all applicable adjustment factors (see NDS).

²Reference withdrawal design values must be multiplied by the length of the thread penetration in the main member. Length includes tapered tip.

³Specific gravity must be the assigned specific gravity for sawn lumber per the NDS.

TABLE 3—REFERENCE LATERAL DESIGN VALUES (Z) FOR SINGLE SHEAR (TWO-MEMBER) CONNECTIONS LOADED PARALLEL (Z_{||}) OR PERPENDICULAR (Z_⊥) TO THE GRAIN¹ For Sawn Lumber with Both Members of Identical Specific Gravity

| FASTENER DESIGNATION | | SIDE MEMBER THICKNESS, <i>t_s</i> (inches) | | MINIMUM FASTENER PENETRATION, <i>P</i> (inches) | Z (lbf) ² Specific Gravity = 0.50 | WET SERVICE FACTOR |
|----------------------|---------------------------------------|--|--------------------------------|---|---|--------------------|
| | | Min. | Max. | | | |
| Lag-Master | #14 x 2 ⁷ / ₈ " | 1 ¹ / ₂ | 1 ¹ / ₂ | 1 ³ / ₈ | 215 | 0.70 |
| | #14 x 3" | | 1 ¹ / ₂ | 1 ¹ / ₂ | | |
| | #14 x 3 ³ / ₈ " | | 1 ³ / ₄ | 1 ⁵ / ₈ | | |
| | #14 x 3 ¹ / ₂ " | | 1 ³ / ₄ | 1 ³ / ₄ | | |
| | #14 x 3 ⁵ / ₈ " | | 2 | 1 ⁵ / ₈ | | |
| | #14 x 3 ⁷ / ₈ " | | 2 ¹ / ₂ | 1 ³ / ₈ | | |
| | #14 x 4" | | 2 ¹ / ₂ | 1 ¹ / ₂ | | |
| | #14 x 4 ¹ / ₂ " | | 3 | 1 ¹ / ₂ | | |
| | #14 x 4 ⁷ / ₈ " | | 3 ¹ / ₂ | 1 ³ / ₈ | | |
| | #14 x 5" | | 3 ¹ / ₂ | 1 ¹ / ₂ | | |
| | #14 x 5 ⁷ / ₈ " | | 4 ¹ / ₄ | 1 ⁵ / ₈ | | |
| | #14 x 6" | | 4 ¹ / ₄ | 1 ³ / ₄ | | |
| Tie-Master | #14 x 4" | 1 ¹ / ₂ | 2 ¹ / ₂ | 1 ¹ / ₂ | 215 | 0.70 |
| | #14 x 4 ¹ / ₂ " | | 3 | | | |
| | #14 x 5" | | 3 ¹ / ₂ | | | |
| | #14 x 6" | | 4 ¹ / ₂ | | | |
| | #14 x 8" | | 6 ¹ / ₂ | | | |
| | #14 x 10" | | 8 ¹ / ₂ | | | |
| | #14 x 12" | | 10 ¹ / ₂ | | | |

For SI: 1 inch = 25.4 mm; 1 lbf = 4.45N.

¹Values shall be multiplied by all applicable adjustment factors (see NDS).

²Specific gravity must be the assigned specific gravity for sawn lumber per the NDS.

TABLE 4—REFERENCE PULL-THROUGH DESIGN VALUES (P)¹

| FASTENER DESIGNATION | MINIMUM SIDE MEMBER THICKNESS, <i>t_s</i> (inch) | P (lbf) FOR SPECIFIC GRAVITY ² OF 0.5 | WET SERVICE FACTOR |
|----------------------|--|--|--------------------|
| LAG-MASTER™ | 3/4 | 221 | 0.55 |
| TIE-MASTER™ | 3/4 | 208 | 0.65 |

For SI: 1 inch = 25.4 mm; 1 lbf = 175 N/m.

¹Values shall be multiplied by adjustment factors, as applicable to the reference withdrawal values, W, in accordance with the NDS.

²Specific gravity must be the assigned specific gravity for sawn lumber per the NDS.

TABLE 5—LAG-MASTER™ and TIE-MASTER™ CONNECTION GEOMETRY REQUIREMENTS¹

| CONDITION | | MINIMUM DISTANCE OR SPACING | |
|------------------------------------|--------------------------------|-----------------------------|--------|
| | | Fastener Diameters | Inches |
| End distance | Loading toward end | 15 | 3 |
| | Loading away from end | 15 | 3 |
| | Loading perpendicular to grain | 15 | 3 |
| Edge distance | Any load direction | 15 | 3 |
| Spacing between fasteners in a row | Loading parallel to grain | 15 | 3 |
| | Loading perpendicular to grain | 10 | 2 |
| Spacing between rows | In-line rows | 5 | 1 |
| | Staggered rows ² | 2.5 | 1/2 |

For SI: 1 inch = 25.4 mm

¹End distances, edge distances and fastener spacing must be sufficient to prevent splitting of the wood, or as required by this table, whichever is the more restrictive.

²Values for spacing between staggered rows apply where fasteners in adjacent rows are offset by half of the spacing between fasteners in a row.

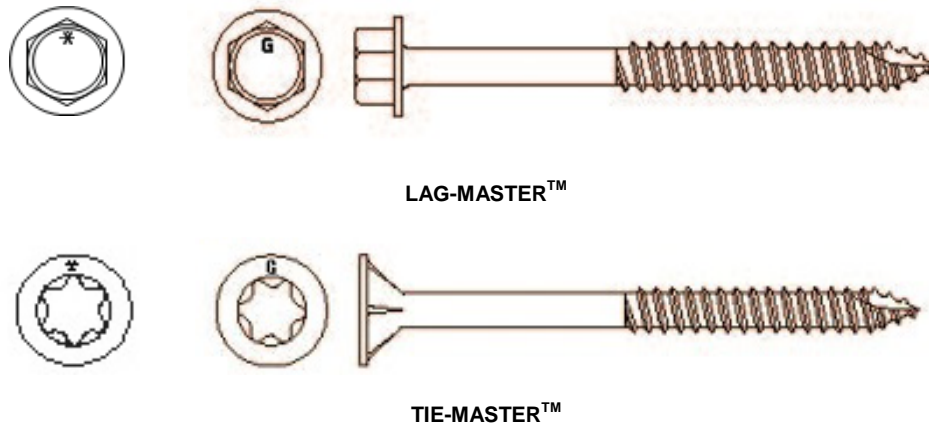


FIGURE 1—GRABBER FASTENERS

ICC-ES Evaluation Report

ESR-3531 CBC and CRC Supplement

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EVALUATION SUBJECT:

GRABBER LAG-MASTER™ AND TIE-MASTER™ MULTI-PURPOSE WOOD FASTENERS

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that Grabber Lag-Master™ and Tie-Master™ Multi-purpose Wood Fasteners, recognized in ICC-ES master evaluation report ESR-3531, have also been evaluated for compliance with the codes noted below.

Applicable code editions:

- 2016 *California Building Code*® (CBC), Chapter 23
- 2016 *California Residential Code*® (CRC)

2.0 CONCLUSIONS

2.1 The Grabber Lag-Master™ and Tie-Master™ Multi-purpose Wood Fasteners, described in Sections 2.0 through 7.0 of the master evaluation report ESR-3531, comply with CBC Chapter 23, provided the design and installation are in accordance with the 2015 *International Building Code*® provisions noted in the master report and the additional requirements of the CBC Chapters 17, 17A, and 23, as applicable.

2.2 The Grabber Lag-Master™ and Tie-Master™ Multi-purpose Wood Fasteners, described in Sections 2.0 through 7.0 of the master evaluation report ESR-3531, comply with the CRC, provided the design and installation are in accordance with the 2015 *International Residential Code*® provisions noted in the master report.

This supplement expires concurrently with the master report, reissued April 2018.

ICC-ES Evaluation Report

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GRABBER LAG-MASTER™ AND TIE-MASTER™ MULTI-PURPOSE WOOD FASTENERS

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Purpose:

The purpose of this evaluation report supplement is to indicate that the Grabber Lag-Master™ and Tie-Master™ Multi-purpose Wood Fasteners, recognized in ICC-ES master evaluation report ESR-3531, have also been evaluated for compliance with the codes noted below.

Applicable code editions:

- 2014 *Florida Building Code—Building*
- 2014 *Florida Building Code—Residential*

2.0 CONCLUSIONS

The Grabber fasteners, described in Sections 2.0 through 7.0 of the master evaluation report ESR-3531, comply with the *Florida Building Code—Building* and the *Florida Building Code—Residential*, provided the design and installation are in accordance with the 2012 *International Building Code*® provisions noted in the master report and the following:

The self-drilling screws must be limited to dry, interior locations, which include exterior walls which are protected by an exterior wall envelope.

Use of the Grabber fasteners has also been found to be in compliance with the High-Velocity Hurricane Zone provisions of the *Florida Building Code—Building* and the *Florida Building Code—Residential*.

For products falling under Florida Rule 9N-3, verification that the report holder's quality-assurance program is audited by a quality-assurance entity approved by the Florida Building Commission for the type of inspections being conducted is the responsibility of an approved validation entity (or the code official, when the report holder does not possess an approval by the Commission).

This supplement expires concurrently with the master report, reissued April 2018.