



CERTIFICATION



Approved. Sealed. Code Compliant.

Technical Evaluation Report

TER 1203-03

FastenMaster® LedgerLOK™ Ledger
Board Fasteners for Use in Deck Ledger
Applications

OMG, Inc. DBA FastenMaster®

Product:

**LedgerLOK™ Ledger Board
Fastener**

Issue Date:

March 30, 2012

Revision Date:

July 2, 2019

Subject to Renewal:

July 1, 2020



**COMPANY
INFORMATION:**

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DIVISION: 06 00 00 - WOOD, PLASTICS AND COMPOSITES

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

SECTION: 06 11 00 - Wood Framing

SECTION: 06 15 00 - Wood Decking

1 PRODUCT EVALUATED¹

1.1 LedgerLOK™ Ledger Board Fastener

2 APPLICABLE CODES AND STANDARDS^{2,3}**2.1 Codes**

2.1.1 *IBC—12, 15, 18: International Building Code®*

2.1.2 *IRC—12, 15, 18: International Residential Code®*

2.2 Standards and Referenced Documents

2.2.1 *ANSI/AWC NDS: National Design Specification (NDS) for Wood Construction*

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

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

2.2.4 *ASTM F1575: Standard Test Method for Determining Bending Yield Moment of Nails*

¹ Building codes require data from valid research reports be obtained from approved sources. An approved agency, which is an approved source, is defined as "an established and recognized agency that is regularly engaged in...furnishing product certification where such agency has been approved..." Being approved, defined as "acceptable to the building official," is accomplished via accreditation using ISO/IEC 17065 evaluation procedures meeting code requirements of independence, adequate equipment, and experienced personnel. DrJ is an ISO/IEC 17065 ANSI-Accredited Product Certification Body - Accreditation #1131.

Through ANSI accreditation, DrJ certification can be used to obtain product approval in any country that is an IAF MLA Signatory and covered by an IAF MLA Evaluation per the Purpose of the MLA - "certified once, accepted everywhere." Manufacturers can go to jurisdictions in any IAF MLA Signatory Country and have their products readily approved by authorities having jurisdiction using DrJ's ANSI accreditation.

For more information on any of these topics or our mission, product evaluation policies, product approval process, and engineering law, see drjcertification.org.

² Unless otherwise noted, all references in this TER are from the 2018 version of the codes and the standards referenced therein (e.g., *ASCE 7*, *NDS*, *ASTM*). This material, design, or method of construction also complies with the 2000-2015 versions of the referenced codes and the standards referenced therein. As required by code, where this TER is not approved, the building official shall respond in writing stating the reasons this TER was not approved. For any variations in state and local codes, see Section 8.

³ All terms defined in the applicable building codes are italicized.

3 PERFORMANCE EVALUATION

- 3.1 LedgerLOK™ Ledger Board Fasteners were evaluated to determine their ability to provide code complying attachment of deck ledger boards to the building structure.
- 3.2 For conventionally framed buildings, the ledger is required to be attached to the band joist⁴ in accordance with IBC Section 1604.8.3 or IRC Section R507.9⁵ as applicable. IRC Table R507.9.1.3(1) is included for reference (Figure 1).

CONNECTION DETAILS	JOIST SPAN						
	6' and less	6'1" to 8'	8'1" to 10'	10'1" to 12'	12'1" to 14'	14'1" to 16'	16'1" to 18'
	On-center spacing of fasteners						
1/2-inch diameter lag screw with 1/2-inch maximum sheathing ^{c, d}	30	23	18	15	13	11	10
1/2-inch diameter bolt with 1/2-inch maximum sheathing ^d	36	36	34	29	24	21	19
1/2-inch diameter bolt with 1-inch maximum sheathing ^e	36	36	29	24	21	18	16

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 0.0479 kPa.

- a. Ledgers shall be flashed in accordance with Section R703.4 to prevent water from contacting the house band joist.
- b. Snow load shall not be assumed to act concurrently with live load.
- c. The tip of the lag screw shall fully extend beyond the inside face of the band joist.
- d. Sheathing shall be wood structural panel or solid sawn lumber.
- e. Sheathing shall be permitted to be wood structural panel, gypsum board, fiberboard, lumber or foam sheathing. Up to 1/2-inch thickness of stacked washers shall be permitted to substitute for up to 1/2 inch of allowable sheathing thickness where combined with wood structural panel or lumber sheathing.

FIGURE 1. DECK LEDGER CONNECTION TO BAND JOIST^{A,B} FROM IRC TABLE R507.9.1.3(1) (DECK LIVE LOAD = 40 PSF, DECK DEAD LOAD = 10 PSF, SNOW LOAD ≤ 40 PSF)

- 3.2.1 Where a band joist is not used, as in some truss installations, an engineered design is required. See Appendix A for additional code requirements for ledger attachments.
- 3.3 Ultimate connection capacities and deflections of typical ledger board connections were match tested and evaluated pursuant to the provisions of the *IBC* and *IRC*. See Appendix B for a description of testing methods.
- 3.4 Any code compliance issues not specifically addressed in this section are outside the scope of this TER.
- 3.5 Any engineering evaluation conducted for this TER was performed on the dates provided in this TER and within DrJ's professional scope of work.

4 PRODUCT DESCRIPTION AND MATERIALS

- 4.1 The product evaluated in this TER is shown in Figure 2.

⁴ The term "band joist" is used throughout this report. Other regionally used terms synonymous with band joist include rim board, band board, header board, and header joist.

⁵ 2009 IRC Section R502.2.2, 2015 IRC Section R507.2



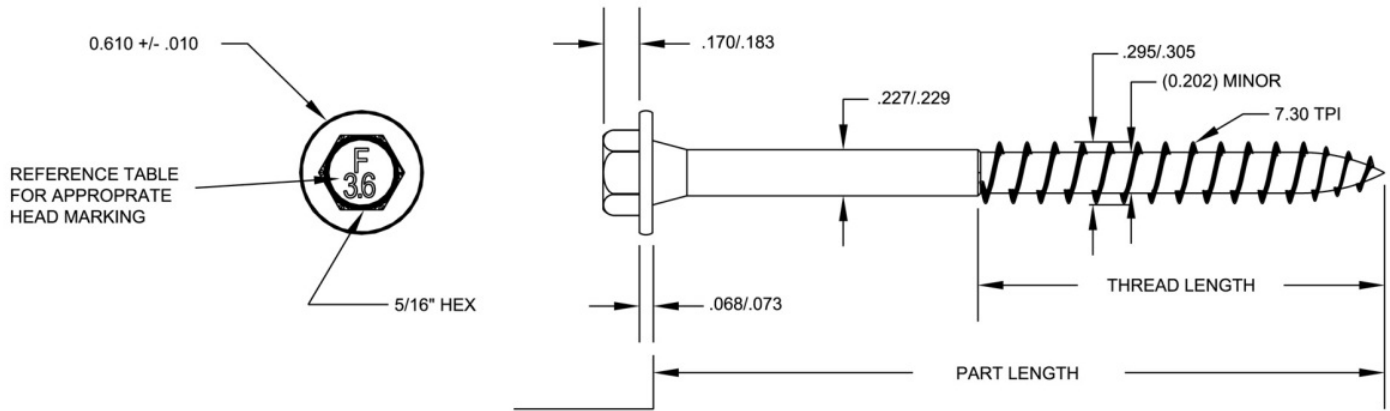


FIGURE 2. LEDGERLOK™ LEDGER BOARD FASTENERS (IN)

- 4.2 LedgerLOK™ fasteners are manufactured with carbon steel grade 1022 or 10B21 wire conforming to *ASTM A510* with a minimum ultimate tensile strength of 60 ksi.
- 4.3 LedgerLOK™ fasteners are manufactured using a standard cold-formed process followed by a heat-treating process. Allowable bending yield and critical dimensions are found in Figure 2 and Table 1.
 - 4.3.1 LedgerLOK™ fastener heads are a 5/16" hex drive with a built-in oversized washer.
 - 4.3.2 LedgerLOK™ fasteners have a gimlet point.
- 4.4 The following LedgerLOK™ fasteners were evaluated for this TER (Table 1).

TABLE 1. FASTENER DESIGNATION

Fastener Name	Fastener Designation	Head Marking	Length ¹ (in)	Thread Length ² (in)	Unthreaded Shank Diameter (in)	Minor Thread (Root) Diameter (in)	Nominal Bending Yield (psi) ³
LedgerLOK™	FMLL358	F3.6	3 ⁵ / ₈ "	2"	0.228"	0.202"	200,700
LedgerLOK™	FMLL005	F5.0	5"	3"			

SI: 1" = 25.4 mm, 1 psi = 0.00689 MPa

1. Measured from the underside of the head to the bottom of the tip
2. Includes tip; see Figure 2
3. Determined in accordance with methods specified in *ASTM F1575*, based on minor thread diameter using a 5% offset of the load displacement curves developed from bending tests.

- 4.5 The fasteners have a proprietary galvanized and epoxy coating, which provides corrosion protection that exceeds that provided by code approved hot-dipped galvanized coatings meeting *ASTM A153 (IBC Section 2304.10.5⁶ and IRC Section R317.3)*.
 - 4.5.1 Fasteners are approved for use in exterior conditions and in pressure-treated wood, including ground contact ACQ. The proprietary coating has been tested and found to exceed the corrosion protection provided by code approved hot-dipped galvanized coatings meeting *ASTM A153 (IBC Section 2304.10.5 and IRC Section R317.3)*.
- 4.6 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.
- 4.7 In-plant quality control procedures, under which the LedgerLOK™ fasteners are manufactured, are audited through an inspection process performed by an approved agency.

⁶ 2012 IBC Section 2304.9.5

5 APPLICATIONS

- 5.1 LedgerLOK™ Ledger Board Fasteners are designed specifically for attaching the deck ledger to the rim joist of a building in accordance with IBC Section 1604.8.3 and IRC Section R507.9.
- 5.2 The *IRC* provides prescriptive fastener spacing for the attachment of a deck ledger to a rim joist with ½"-diameter lag screws or through bolts as shown in IRC Table R507.9.1.3(1).
- 5.3 Table 2 provides the LedgerLOK™ fastener spacing required to provide performance at least equivalent to the lag screws found in IRC Table R507.9.1.3(1) in accordance with IBC Section 104.11 and Section 1604.8.3, IRC Section R104.11 and Section R507.9, and generally accepted engineering practice.
 - 5.3.1 Table 2 provides LedgerLOK™ fastener spacing for items found in IRC Table R507.9, as well as a wider range of materials commonly used for rim joists.
 - 5.3.1.1 In addition, an alternate loading condition (i.e., deck live load = 60 psf, deck dead load = 10 psf) required by some jurisdictions is shown.
- 5.4 Where the application exceeds the limitations set forth herein, design shall be permitted in accordance with accepted engineering procedures, experience, and technical judgment.

TABLE 2. LEDGERLOK™ FASTENER SPACING FOR ITEMS IN *IRC* TABLE 507.2 AND OTHER MATERIALS AND LOADING CONDITIONS

Loading Condition (Live Load) (psf)	2x Nominal Ledger Species	Rim Joist Material	Maximum On-center Spacing of LedgerLOK™ Ledger Board Fasteners (in)						
			Maximum Deck Joist Spans (ft)						
			Up to 6'	Up to 8'	Up to 10'	Up to 12'	Up to 14'	Up to 16'	Up to 18'
40	HF/SPF	2x Nominal Sawn Lumber	20	15	12	10	8	7	6
		1" min EWP	25	19	15	12	10	9	8
	DF/SP	Nominal Sawn Lumber	24	18	14	12	10	9	8
		1" min EWP	25	19	15	12	10	9	8
60	HF/SPF	2x Nominal Sawn Lumber	14	11	8	7	6	5	4
		1" min EWP	18	13	10	9	7	6	6
	DF/SP	Nominal Sawn Lumber	17	13	10	8	7	6	5
		1" min EWP	18	13	10	9	7	6	6

SI: 1" = 25.4 mm, 1 psf = 0.0479 kN/m²

1. Based on load duration of 1.0. Spacing may be adjusted by the applicable load duration as specified in *NDS* 2012.
2. Fasteners are required to have full thread penetration into the main member. Excess fastener length extending beyond the main member is not reflected in the table above.
3. Solid sawn band joists shall be HF, SPF, DF-L, or SP species, designed by others.
4. Fastener spacing is based on tested loads. The design values use the lesser of a 1/8" deflection or a factor of safety equivalent to or greater than that of the code compliant lag screw application as defined in Figure 3.
5. Fasteners shall be staggered from the top to the bottom along the length of the ledger while maintaining the required edge and end distances shown in Figure 3.
6. A maximum ½" structural sheathing may be installed between the ledger and the band joist.
7. Table values assume 10 psf dead load.

- 5.5 When installed in accordance with the spacing requirements of Table 2, LedgerLOK™ Ledger Board Fasteners provide equivalent performance to IRC Table R507.9.1.3(1).

6 INSTALLATION

- 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 For applications outside the scope of this TER, an engineered design is required.
- 6.3 *Installation Procedure*
 - 6.3.1 Choose a 3³/₈" or 5" LedgerLOK™ Ledger Board Fastener so that the threads fully engage the rim material and the fastener tip extends beyond the back face of the rim material when fully seated against the installed ledger.
 - 6.3.2 Using a high-torque, ½" variable-speed drill (18V if cordless), drive the fasteners through the ledger and sheathing. Continue into the rim joist until the built-in washer head is drawn firm and flush to the ledger board. Do not overdrive.
 - 6.3.3 Figure 3 shows a detail of the LedgerLOK™ Ledger Board Fastener deck connection, including minimum edge and end distances.

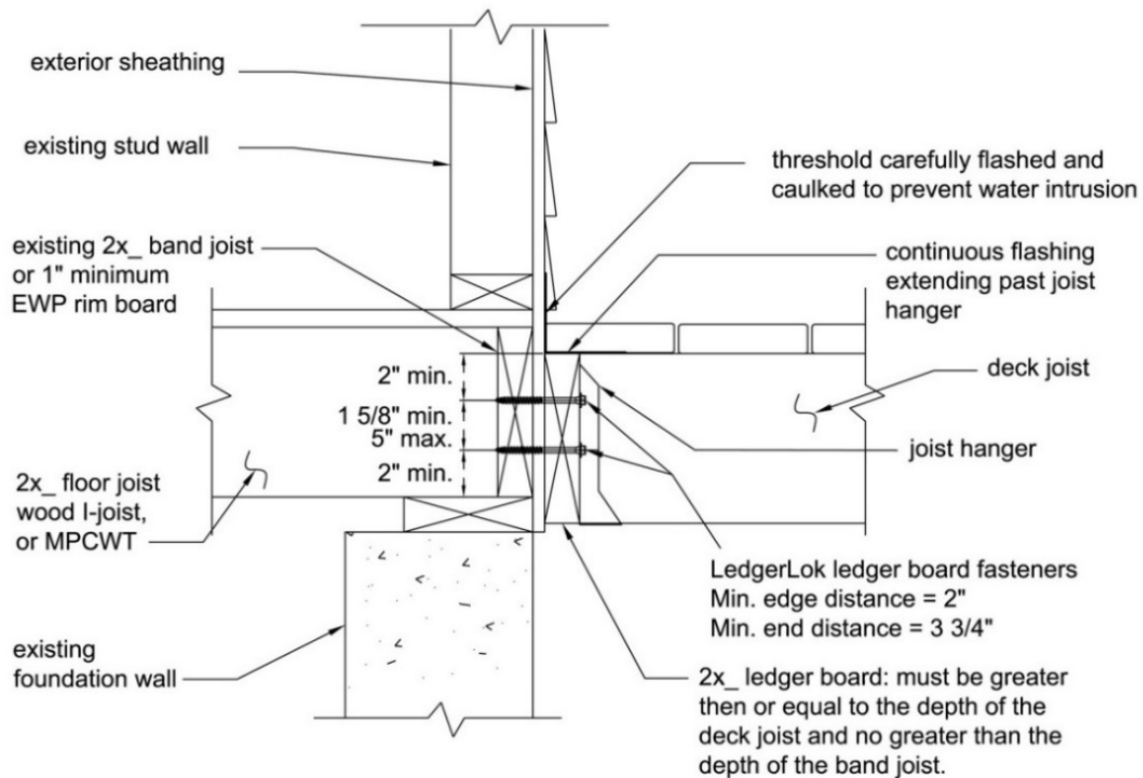


FIGURE 3. LEDGERLOK™ LEDGER BOARD FASTENER DECK CONNECTION

- 6.3.4 Stagger the fasteners from the top to the bottom along the length of the ledger while maintaining the required edge and end distances.

7 TEST ENGINEERING SUBSTANTIATING DATA

- 7.1 Testing conducted by the SBCRI under contract with Qualtim, Inc. for OMG, Inc.; *SBCRI-12-0101*; Final report date: March 23, 2012
- 7.2 DCA 6, Prescriptive Residential Wood Deck Construction Guide; AF&PA; 2010
- 7.3 Proprietary testing conducted by Washington State University for OMG, Inc.; Final report date: August 4, 2005
- 7.4 FastenMaster Technical Bulletin; *LedgerLOK™ Ledger Board Fastener*, 2011

- 7.5 Some information contained herein is the result of testing and/or data analysis by other sources which conform to IBC Section 1703 and relevant professional engineering law. DrJ relies on accurate data from these sources to perform engineering analysis. DrJ has reviewed and found the data provided by other professional sources to be credible.
- 7.6 Where appropriate, DrJ's analysis is based on design values that have been codified into law through codes and standards (e.g., *IBC*, *IRC*, *NDS*®, and *SDPWS*). 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, and concrete), DrJ relies upon the grade mark, stamp, and/or design values provided by raw material suppliers to be accurate and conforming to the mechanical properties defined in the relevant material standard.

8 FINDINGS

- 8.1 When used and installed in accordance with this TER and the manufacturer's installation instructions, the product(s) listed in Section 1.1 are approved for the following:
- 8.1.1 When used in accordance with this TER and the manufacturer's installation instructions, FastenMaster® LedgerLOK™ Ledger Board Fasteners are a suitable alternative to the requirements of the IBC Section 1604.8.3 and IRC Section R507.9.
- 8.2 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*.
- 8.3 This product has been evaluated in the context of 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 applicable to this evaluation, they are listed here.
- 8.3.1 No known variations

9 CONDITIONS OF USE

- 9.1 LedgerLOK™ fastener spacing shall not exceed Table 2 for code compliance and the installation conditions considered.
- 9.2 Where required by the building official, also known as 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.
- 9.3 Any generally accepted engineering calculations needed to show compliance with this TER shall be submitted to the AHJ for review and approval.
- 9.4 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 or registered design professional).
- 9.5 At a minimum, this product shall be installed per Section 6 of this TER and the manufacturer's installation instructions.
- 9.6 This product is manufactured under a third-party quality control program in accordance with IBC Section 104.4 and 110.4 and IRC Section R104.4 and R109.2.

- 9.7 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. Therefore, the TER shall be reviewed for code compliance by the building official for acceptance.
- 9.8 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 product(s) listed in Section 1.1 are identified by a label on the board or 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

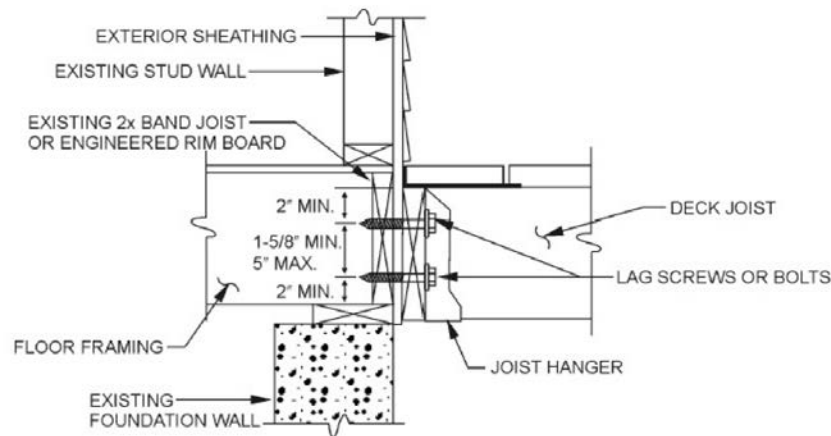
- 11.1 This TER is subject to periodic review and revision. For the most recent version of this TER, visit drjcertification.org.
- 11.2 For information on the current status of this TER, contact [DrJ Certification](#).

APPENDIX A

Code Requirements for Ledger Attachments

For guidance on designing the connection of the deck ledger to trusses where a band joist is not used, see SBCA's Tech Note, *Attachment of Residential Deck Ledger to Metal Plate Connected Wood Truss Floor System*.

- 1) IRC Section R507.8⁷ contains the following code requirements (IBC Section 1604.8.3 is similar):
 - a) Where supported by attachment to an exterior wall, decks shall be positively anchored to the primary structure and designed for both vertical and lateral loads.
 - i) Attachment shall not be accomplished by the use of toenails or nails subject to withdrawal.
- 2) IRC Section R507.9.1 details how vertical loads shall be transferred to band joists with ledgers:
 - a) IRC Section R507.9.1.1
Deck ledgers shall be a minimum 2-inch by 8-inch (51 mm by 203 mm) nominal, pressure-preservative-treated Southern pine, incised pressure-preservative-treated hem-fir, or approved, naturally durable, No. 2 grade or better lumber...
 - b) IRC Section R507.9.1.2
Band joists supporting a ledger shall be a minimum 2-inch-nominal (51 mm), spruce-pine-fir or better lumber or a minimum 1-inch by 9½-inch (25 mm x 241 mm) dimensional, Douglas fir or better, laminated veneer lumber. Band joists shall bear fully on the primary structure capable of supporting all required loads.
 - c) IRC Section R507.9.1.3⁸
Fasteners used in deck ledger connections in accordance with Table R507.9.1.3(1) shall be hot-dipped galvanized or stainless steel and shall be installed in accordance with Table R507.9.1.3(2) and Figures R507.9.1.3(1) and R507.9.1.3(2).



For SI: 1 inch = 25.4 mm.

FIGURE 4. PLACEMENT OF LAG SCREWS AND BOLTS IN BAND JOISTS, IRC FIGURE R507.9.1.3(2)

- d) Tables R507.9.1.3(1) and R507.9.1.3(2)⁹ cover the placement of lag screws or bolts in deck ledgers:
The tip of the lag screw shall fully extend beyond the inside face of the band joist.

⁷ 2012 IRC Section R507.1, 2015 IRC Section R507.1

⁸ 2012 IRC Section R507.2, 2015 IRC Section R507.2

⁹ 2012 IRC Section R507.2.1, 2015 IRC Section R507.2.1

Lag screws or bolts shall be staggered from the top to the bottom along the horizontal run of the deck ledger in accordance with Figure R507.9.1.3(1).

The minimum distance from bottom row of lag screws or bolts to the top edge of the ledger shall be in accordance with Figure R507.9.1.3(1).

CONNECTION DETAILS	JOIST SPAN						
	6' and less	6'1" to 8'	8'1" to 10'	10'1" to 12'	12'1" to 14'	14'1" to 16'	16'1" to 18'
	On-center spacing of fasteners						
1/2-inch diameter lag screw with 1/2-inch maximum sheathing ^{c, d}	30	23	18	15	13	11	10
1/2-inch diameter bolt with 1/2-inch maximum sheathing ^d	36	36	34	29	24	21	19
1/2-inch diameter bolt with 1-inch maximum sheathing ^e	36	36	29	24	21	18	16

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 0.0479 kPa.

- a. Ledgers shall be flashed in accordance with Section R703.4 to prevent water from contacting the house band joist.
- b. Snow load shall not be assumed to act concurrently with live load.
- c. The tip of the lag screw shall fully extend beyond the inside face of the band joist.
- d. Sheathing shall be wood structural panel or solid sawn lumber.
- e. Sheathing shall be permitted to be wood structural panel, gypsum board, fiberboard, lumber or foam sheathing. Up to 1/2-inch thickness of stacked washers shall be permitted to substitute for up to 1/2 inch of allowable sheathing thickness where combined with wood structural panel or lumber sheathing.

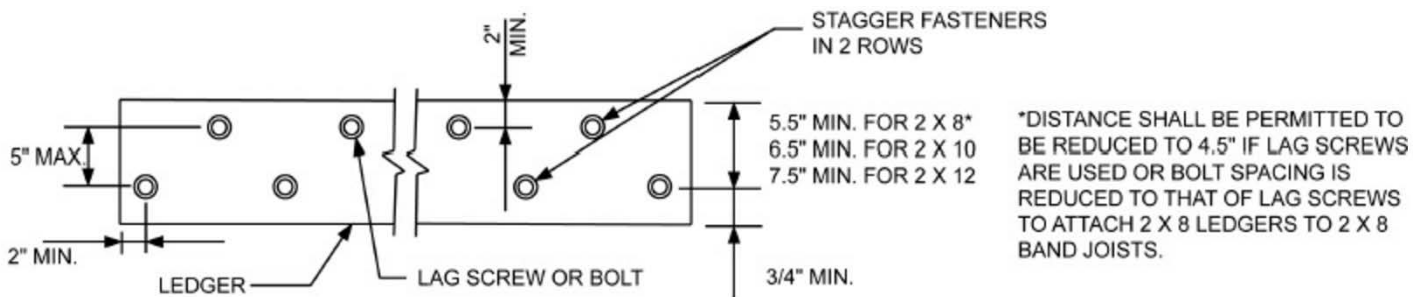
FIGURE 5. DECK LEDGER CONNECTION TO BAND JOIST^{A,B}, TABLE R507.9.1.3(1) (DECK LIVE LOAD = 40 PSF, DECK DEAD LOAD = 10 PSF, SNOW LOAD ≤40 PSF)

MINIMUM END AND EDGE DISTANCES AND SPACING BETWEEN ROWS				
	TOP EDGE	BOTTOM EDGE	ENDS	ROW SPACING
Ledger ^a	2 inches ^d	3/4 inch	2 inches ^b	1 5/8 inches ^b
Band Joist ^c	3/4 inch	2 inches	2 inches ^b	1 5/8 inches ^b

For SI: 1 inch = 25.4 mm.

- a. Lag screws or bolts shall be staggered from the top to the bottom along the horizontal run of the deck ledger in accordance with Figure R507.9.1.3(1).
- b. Maximum 5 inches.
- c. For engineered rim joists, the manufacturer's recommendations shall govern.
- d. The minimum distance from bottom row of lag screws or bolts to the top edge of the ledger shall be in accordance with Figure R507.9.1.3(1).

FIGURE 6. PLACEMENT OF LAG SCREWS AND BOLTS IN DECK LEDGERS AND BAND JOISTS, TABLE R507.9.1.3(2)



For SI: 1 inch = 25.4 mm.

FIGURE 7. PLACEMENT OF LAG SCREWS AND BOLTS IN LEDGERS, FIGURE R507.9.1.3(1)

APPENDIX B

Testing Procedure and Methodology

1. To determine the strength and load-deflection performance of the fasteners in a ledger connection, a two-joint assembly with connection of a ledger to a rim board was created. Load was applied to the joists, which transferred load to the ledger via hangers. String potentiometers were placed along the bottom of the ledger to measure vertical deflection during the test, while a load cell attached to an actuator-measured load applied. The rim board was fixed to prevent deflection and rotation during the test. To limit the variability, the comparison product was tested simultaneously with the FastenMaster® LedgerLOK™ with ledgers and rim boards cut congruently from the same piece of lumber. Immediately after testing, a section was cut near each fastener location to determine the moisture content and oven-dry specific gravity of each piece of lumber.
2. The performance of the code defined lag screw connection was then compared to the performance of the LedgerLOK™ Ledger Board Fasteners in the ledger application built per the code requirements.
 - 2.1. Testing was undertaken to directly compare fastener performance using matched lumber specimen testing where the FastenMaster® LedgerLOK™ Ledger Board Fastener was tested side by side with ½" diameter lag screws (see Figure 8 and Figure 9).

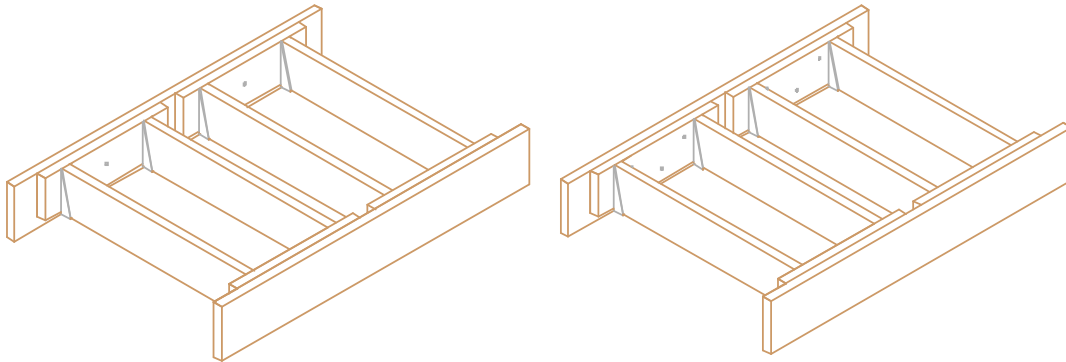


FIGURE 8. SINGLE AND THREE-FASTENER SETUPS

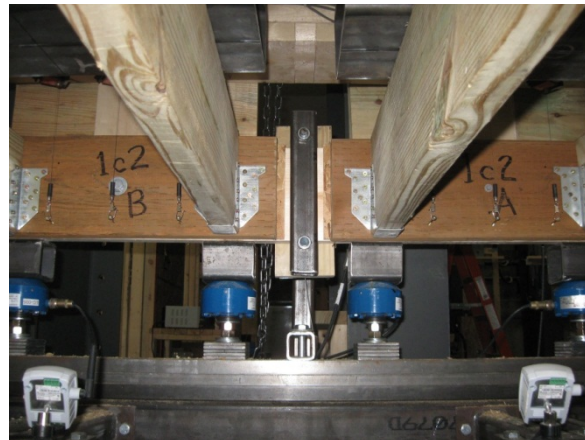


FIGURE 9. MATCHED LUMBER SPECIMEN TESTING OF LEDGERLOK™ LEDGER BOARD FASTENER AND ½" LAG SCREW

- 2.1.2. The testing and resulting analysis define comparative performance and the design parameters required for the LedgerLOK™ to be considered an equivalent alternative to the specified fasteners required by the building code in accordance with the provisions of IBC Section 104.11 and IRC Section R104.11.