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ESR-3330

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DIVISION: 05 00 00—METALS

SECTION: 05 05 02—METAL FASTENINGS

REPORT HOLDER:

LINDAPTER

LINDSAY HOUSE, BRACKENBECK ROAD
BRADFORD, WEST YORKSHIRE BD7 2NF
UNITED KINGDOM

EVALUATION SUBJECT:

HOLLO-BOLT® 3 PART AND HOLLO-BOLT® 5 PART FASTENERS

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ICC-ES Evaluation Report

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EVALUATION SUBJECT:

HOLLO-BOLT® 3 PART AND HOLLO-BOLT® 5 PART FASTENERS

1.0 EVALUATION SCOPE

Compliance with the following code:

- 2015, 2012 and 2009 *International Building Code®* (IBC)
- 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.

Property evaluated:

Structural

2.0 USES

Hollo-Bolt® Fasteners are designed for connecting structural steel to hollow structural section (HSS) steel members and other structural steel elements where access is difficult or restricted to one side only. Hollo-Bolt® fasteners are intended for use with rectangular or square HSS members and are recognized for resisting static tension and shear loads in bearing-type connections. The fasteners are alternatives to bolts described in Section J3 of AISC 360, which is referenced in Section 2205.1 of the IBC, for bearing-type connections.

The Hollo-Bolt® Fasteners may be used to resist wind loads, and seismic loads in Seismic Design Categories (SDC) A through F in accordance with Section 1613.3.5 of the 2015 and 2012 IBC, and Section 1613.5.6 of the 2009 IBC.

3.0 DESCRIPTION

3.1 General:

Hollo-Bolt® 3 Part Fasteners are assembled from three components, consisting of the core bolt, the body (sleeve) including the shoulder (collar), and the cone. The steel core bolt features a threaded shank and hexagonal head. The body is a steel segmented hollow cylinder, with four slits 90 degrees from each other. The collar is a circular element having two flat surfaces (to accommodate an open-ended wrench) with a circular hole integral with the sleeve. The cone is a steel circular internally threaded nut with grooves on the outer surface. Nominal Hollo-Bolt® sizes include $^5/_{16}$ inch (M8), $^3/_8$ inch (M10), $^1/_2$ inch (M12), $^5/_8$ inch (M16), and $^3/_4$ inch (M20), with each size of bolt available in three lengths.

The Hollo-Bolt® 5 Part Fasteners are similar, except that they include a nitrile rubber washer and separate collar. Figure 1 provides a picture of the Hollo-Bolt® 3 Part and Hollo-Bolt® 5 Part. Table 1 provides part codes, design strengths, and installation information.

3.2 Materials:

3.2.1 Set Screw: The core bolt is manufactured from steel complying with EN ISO 898-1, Class 8.8, having a specified F_u of 116,030 psi (800 MP_a).

3.2.2 Body (Sleeve) with Integral Collar, Body (Sleeve without Collar), Collar and Cone: The parts are manufactured from free cutting carbon steel Grade 11SMn30 or 11SMnPb30, conforming to BS EN 10087, having a minimum tensile strength of 62,400 psi (430 N/mm^2) (sizes up to LHB16) or 56,500 psi (390 N/mm^2) (size LHB20); or cold drawn steel AISI C10B21, having a minimum tensile strength of 68,000 psi (470 N/mm^2).

3.2.3 Rubber Washer: The shore hardness is measured on the A scale at 80-90

3.2.4 Finish Coating: All components, except the rubber washer, are hot dipped galvanized/high temperature galvanized to BS EN ISO 1461, as described in the quality documentation.

4.0 DESIGN AND INSTALLATION

4.1 Design:

The fasteners are alternatives to bolts described in Section J3 of AISC 360, which is referenced in Section 2205.1 of the IBC, for bearing-type connections. The design of the Hollo-Bolt® Fasteners must comply with this report, Section J3 of AISC 360 and the strength design information for the Hollo-Bolt® provided in Table 1 of this report. The load-carrying capacity of the assembly depends on the fasteners, the type of elements connected (such as HSSs), and their cross sections (thickness). The allowable strength is limited by the strength of the weakest

component in the bolted assembly, which includes the affected elements of members and connecting elements and the fasteners. The capacity may be governed by the affected elements and/or connecting elements in the case of thin sections, or the Hollo-Bolt® in the case of thick wall sections (or a combination of the two). All limit states must be checked to determine the load-carrying capacity of the assembly. Combined tension and shear loading must comply with the following:

$$\left(\frac{Tension\ Demand}{Tension\ Capacity}\right)^2 + \left(\frac{Shear\ Demand}{Shear\ Capacity}\right)^2 \leq 1.0$$

4.2 Installation:

The Hollo-Bolt® fasteners must be installed in accordance with the details noted in this section, the manufacturer's installation instructions and the approved plans.

1. Holes must be drilled into the sections to be fixed, ensuring that the resulting holes have the correct diameter and spacing according to the manufacturer's published specifications, and the correct design requirements for the connection, as indicated in the approved plans. Holes must be standard diameter holes conforming to AISC 360, where the bolt hole diameters must be no greater than the bolt shell diameter plus $^1/_{16}$ inch (1.6 mm).
2. Burrs in the holes must be removed before insertion of the Hollo-Bolt® Fasteners.
3. The structural steel elements to be fastened adjacent to each other must be positioned to ensure:
    a. That the two sections are lined up and rest one against the other without any gap. Clamps must be used as necessary to hold the two sections together and prevent formation of gaps.
    b. That the holes are aligned, using a mandrel if necessary.
4. The Hollo-Bolt® must be positioned in the holes. The collar must rest flat against the section with no gap.
5. The collar must be held in position using a suitable open-ended wrench, and then the core bolt must be tightened to the specified torque.

The tightening tool must then be removed and the tightening torque on the bolt must be verified. If necessary, the tightening torque must be corrected.

4.3 Special Inspection:

Special inspection is required in accordance with Sections 1705.1 and 1705.2 of the 2015 and 2012 IBC or Sections 1704.3 and 1704.15 of the 2009 IBC, whichever is applicable. The manufacturer must submit inspection procedures to verify proper installation of the Hollo-Bolt®. Where Hollo-Bolt® fasteners are used for seismic or wind load resistance, special inspection requirements must comply with Sections 1704.3 and 1705 of the 2015 and 2012 IBC or Sections 1705, 1706 and 1707 of the 2009 IBC.

4.4 Packaging:

Each package of the Hollo-Bolt® 3 Part and 5 Part Fasteners must include the following information: installation and safety instructions, minimum and maximum fixing ranges (thickness of the elements), installation torque, and special inspection requirements.

5.0 CONDITIONS OF USE

The Hollo-Bolt® Fasteners described in this report comply with, or are suitable alternatives to what is specified in, the code noted in Section 1.0 of this report, subject to the following conditions:

5.1 Calculations and details showing that the Hollo-Bolt® fasteners are adequate to resist the applied loads must be submitted to the code official for approval. The connected steel base materials and connecting elements also must be adequate to support the applied loads. The calculations and details must be signed and sealed by a registered design professional, when required by the statues of the jurisdiction in which the project is to be constructed.

5.2 Fire-resistive construction: Where not otherwise prohibited in the code, Hollo-Bolt® fasteners are permitted for use with fire-resistance-rated construction provided that at least one of the following conditions is fulfilled:

- The Hollo-Bolt® fasteners are used to resist wind or seismic forces only.
- Hollo-Bolt® fasteners that support a fire-resistance-rated envelope or a fire-resistance-rated membrane, are protected by approved fire-resistance-rated materials, or have been evaluated for resistance to fire exposure in accordance with recognized standards.
- The Hollo-Bolt® fasteners are used to support nonstructural elements.

5.3 Special inspection must be provided as specified in Section 4.3 of this report.

5.4 Use of Hollo-Bolt® fasteners in seismic force–resisting structures assigned to Seismic Design Category D, E or F (IBC), isintended to be used as a force-controlled component and is not expected to undergo significant inelastic deformation, and the registered design professional shall consider this forced-controlled behavior in his design.

5.5 Use of the Hollo-Bolt® fasteners in applications where the applicable code requires slip-critical installation, is beyond the scope of this report.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Expansion Bolts in Structural Steel Connections (Blind-Bolts) (AC437), dated October 2014 and editorially revised December 2016.

7.0 IDENTIFICATION

The Hollo-Bolt® fastener package is labeled with the product part number, quantity, batch number, an image of the product, and the evaluation report number (ESR-3330). The fastener is identified by an eight-character part number (LHBMXX#X). The first three letters (LHB) indicate it is a Lindapter Hollo-Bolt®, the next three characters denote the Hollo-Bolt® size (for example M08) and the last two digits indicate the length of the Hollo-Bolt® (for example #1, #2 or #3).

TABLE 1—HOLLO-BOLT® BLIND FASTENER TECHNICAL DATA

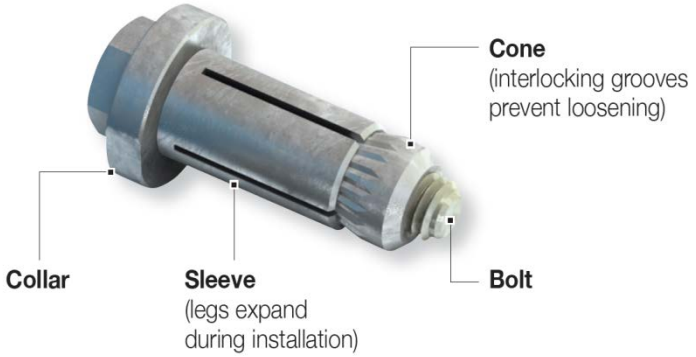
PART NUMBER & DESCRIPTION			DIMENSIONAL INFORMATION[3] (inches)							TECHNICAL		ALLOWABLE LOADING[2] STATIC AND SDC A, B & C ONLY				ALLOWABLE LOADING[2] STATIC AND SDC D, E & F ONLY			
												LRFD Method		ASD Method		LRFD Method		ASD Method	
Hollo-Bolt Part Number	Hollo-Bolt (Core Bolt Size)	Description	Core Bolt Length	Clamping Range Dim W		Across Flats of Collar A/F	Collar Thickness H	Dim A	Dim B	Dim d_1 Drill Diameter (Inches)	Torque (Ft lb)	Tensile lbs	Shear lbs	Tensile lbs	Shear lbs	Tensile lbs	Shear lbs	Tensile lbs	Shear lbs
				Min[1]	Max														
LHBM08#1	5/16	5/16" Hollo-Bolt Size 1	2	1/4	7/8	3/4	3/16	1 3/8	1/2	9/16	17	3775	3215	2340	2000	3305	2675	2045	1665
LHBM08#2	5/16	5/16" Hollo-Bolt Size 2	2 3/4	7/8	1 5/8	3/4	3/16	1 3/8	1/2	9/16	17	3775	3215	2340	2000	3305	2675	2045	1665
LHBM08#3	5/16	5/16" Hollo-Bolt Size 3	3 5/8	1 5/8	2 3/8	3/4	3/16	1 3/8	1/2	9/16	17	3775	3215	2340	2000	3305	2675	2045	1665
LHBM10#1	3/8	3/8" Hollo-Bolt Size 1	2 1/4	5/16	7/8	15/16	1/4	1 9/16	9/16	3/4	33	6160	5485	3820	3415	5485	4565	3395	2830
LHBM10#2	3/8	3/8" Hollo-Bolt Size 2	3	7/8	1 5/8	15/16	1/4	1 9/16	9/16	3/4	33	6160	5485	3820	3415	5485	4565	3395	2830
LHBM10#3	3/8	3/8" Hollo-Bolt Size 3	3 5/8	1 5/8	2 3/8	15/16	1/4	1 9/16	9/16	3/4	33	6160	5485	3820	3415	5485	4565	3395	2830
LHBM12#1	1/2	1/2" Hollo-Bolt Size 1	2 3/8	5/16	1	1 3/16	1/4	2	3/4	13/16	59	8545	7485	5305	4675	7465	6250	4630	3890
LHBM12#2	1/2	1/2" Hollo-Bolt Size 2	3 5/8	1	1 13/16	1 3/16	1/4	2	3/4	13/16	59	8545	7485	5305	4675	7465	6250	4630	3890
LHBM12#3	1/2	1/2" Hollo-Bolt Size 3	4 1/4	1 13/16	2 3/4	1 3/16	1/4	2	3/4	13/16	59	8545	7485	5305	4675	7465	6250	4630	3890
LHBM16#1	5/8	5/8" Hollo-Bolt Size 1	3	1/2	1 1/8	1 3/8	5/16	2 3/16	13/16	1 1/16	140	13915	11645	8635	7285	13330	9780	8270	6090
LHBM16#2	5/8	5/8" Hollo-Bolt Size 2	4	1 1/8	2	1 3/8	5/16	2 3/16	13/16	1 1/16	140	13915	11645	8635	7285	13330	9780	8270	6090
LHBM16#3	5/8	5/8" Hollo-Bolt Size 3	4 3/4	2	2 13/16	1 3/8	5/16	2 3/16	13/16	1 1/16	140	13915	11645	8635	7285	13330	9780	8270	6090
LHBM20#1	3/4	3/4" Hollo-Bolt Size 1	3 5/8	1/2	1 5/16	1 13/16	3/8	2 3/4	1	1 5/16	221	19985	18390	12410	11490	19355	15330	12005	9555
LHBM20#2	3/4	3/4" Hollo-Bolt Size 2	4 3/4	1 5/16	2 3/8	1 13/16	3/8	2 3/4	1	1 5/16	221	19985	18390	12410	11490	19355	15330	12005	9555
LHBM20#3	3/4	3/4" Hollo-Bolt Size 3	5 7/8	2 3/8	3 3/8	1 13/16	3/8	2 3/4	1	1 5/16	221	19985	18390	12410	11490	19355	15330	12005	9555

[1]The minimum clamping thickness specified is based on AC437 section 4.1.1

[2]From tests performed we have used the following lowest factors for the LRFD and ASD calculations:
Tensile: LRFD ϕ = 0.51, ASD Ω = 3.16
Shear: LRFD ϕ = 0.50, ASD Ω = 3.21
ASD Method is approximately equal to LRFD Method divided by 1.6

[3]See Figure 2 for additional information on dimensions.

Lindapter Hollo-Bolt® 3 part and 5 part



3 part Hollo-Bolt®

5 part Hollo-Bolt®

FIGURE 1—TYPICAL HOLLO-BOLT® 3 PART AND 5 PART FASTENERS

CORRECT INSTALLATION

Type	Clearance Hole Ø	Hole Distance		Edge Distance
	d_1	min A	min B	B+C
LHBM08	9/16"	1 3/8"	1/2"	> 11/16"
LHBM10	3/4"	1 9/16"	9/16"	> 7/8"
LHBM12	13/16"	2"	3/4"	> 1"
LHBM16	1 1/16"	2 3/16"	13/16"	> 1 5/16"
LHBM20	1 5/16"	2 3/4"	1"	> 1 5/16"

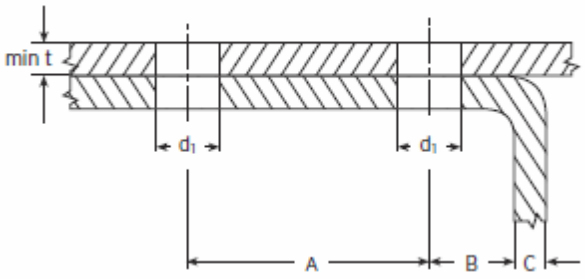
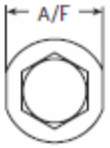


FIGURE 2—INSTALLATION INSTRUCTIONS

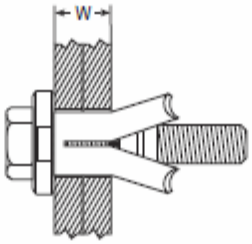
CORRECT INSTALLATION

Product Code	Max. Clamping Range W	Outer Ply min t	Collar A/F	Torque ft lb
LHBM08 #1	1/8" - 7/8"	-	3/4"	17
LHBM08 #2	7/8" - 1 5/8"	-	3/4"	17
LHBM08 #3	1 5/8" - 2 3/8"	-	3/4"	17
LHBM10 #1	1/8" - 7/8"	-	15/16"	33
LHBM10 #2	7/8" - 1 5/8"	-	15/16"	33
LHBM10 #3	1 5/8" - 2 3/8"	-	15/16"	33
LHBM12 #1	1/8" - 1"	-	1 3/16"	59
LHBM12 #2	1" - 1 13/16"	-	1 3/16"	59
LHBM12 #3	1 13/16" - 2 3/4"	-	1 3/16"	59
LHBM16 #1	1/2" - 1 1/8"	5/16"	1 3/8"	140
LHBM16 #2	1 1/8" - 2"	5/16"	1 3/8"	140
LHBM16 #3	2" - 2 13/16"	5/16"	1 3/8"	140
LHBM20 #1	1/2" - 1 5/16"	5/16"	1 13/16"	221
LHBM20 #2	1 5/16" - 2 3/8"	5/16"	1 13/16"	221
LHBM20 #3	2 3/8" - 3 3/8"	5/16"	1 13/16"	221

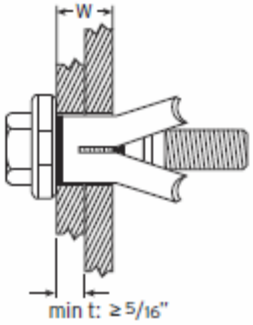
Across Flats



Hollo-Bolt:
5/16", 3/8", 1/2"



Hollo-Bolt:
5/8", 3/4"



Installation

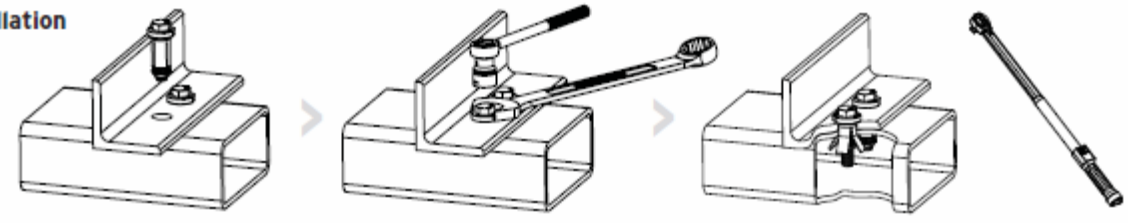


FIGURE 2—INSTALLATION INSTRUCTIONS (Continued)