



ICC-ES Evaluation Report

ESR-2935

Reissued May 2023

Revised January 2024

This report is subject to renewal May 2024.

DIVISION: 03 00 00—CONCRETE
Section: 03 21 00—Reinforcement Bars

REPORT HOLDER:

HEADED REINFORCEMENT CORPORATION

EVALUATION SUBJECT:

HRC 555 HEADED REINFORCING BARS

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2021, 2018, 2015 and 2012 *International Building Code*® (IBC)
- 2013 *Abu Dhabi International Building Code* (ADIBC)[†]
- Other Codes (see Section 8.0 for the 2006 IBC)

Property evaluated

Structural

2.0 USES

HRC 555 headed reinforcing bars are mechanical devices complying with ACI 318-19 and ACI 318-14 Sections 25.4.4 and 25.4.5 for the 2021, 2018 and 2015 IBC (ACI 318-11 Section 12.6 for the 2012 IBC) as Class HA headed deformed bars for use as mechanical anchorage to develop the steel reinforcement bars in tension as an alternate to standard hooks or development lengths of straight deformed steel reinforcement bars in reinforced, normal-weight concrete.

3.0 DESCRIPTION

3.1 General:

HRC 555 headed steel reinforcing bars are Class HA headed deformed bars complying with ASTM A970, which consists of a No. 4 (13 mm) through No. 11 (35 mm) reinforcing steel bar with a factory-forged head at one end or both ends of the bar. The net headed bearing area of the anchor head exceeds four times the nominal cross-sectional area of the bar. Dimensions and illustrations are provided in Table 1 and Figures 1 and 2.

3.2 Material:

The HRC 555 headed reinforcing bar is formed from deformed steel reinforcing bars and must comply with the following standards:

HRC 555 Size	Reinforcing Bar Grade
No. 4 through No. 11	ASTM A706 or A615 Grade 60
No. 8 through No. 11	ASTM A706 or A615 Grade 75
No. 5 through No. 11	ASTM A706 or A615 Grade 80

4.0 DESIGN AND INSTALLATION

4.1 General:

Structural design and installation must comply with HRC's installation instructions, ACI 318-19 and ACI 318-14 Section 25.4.4 for the 2021, 2018 and 2015 IBC (ACI 318-11 Section 12.6 for the 2012 IBC) and this evaluation report.

4.2 Special Inspection:

Special inspection must be provided at the jobsite as required by IBC Section 1704 and 1705. The inspector's duties include verifying grade and size of reinforcement bar, and verifying placement of the headed reinforcing bars and labeling of the products as noted in this evaluation report.

5.0 CONDITIONS OF USE

The HRC 555 headed reinforcing bar described in this report complies with, or is a suitable alternative to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

- 5.1** The HRC 555 headed reinforcing bars must be installed in accordance with the code, the manufacturer's published instructions, and this report. In the case of conflict between the manufacturer's published instructions and this report, this report governs.
- 5.2** For structures regulated under ACI 318-19 and ACI 318-14 Chapter 18 for the 2021, 2018 and 2015 IBC (ACI 318-11 Chapter 21 for the 2012 IBC), with the HRC headed reinforcing bars resisting earthquake-induced flexural, axial force, or both, in special moment frames, special structural walls, and all components of special structural walls including

coupling beams and wall piers; mill certificates of reinforcing bars must be submitted to the code official as evidence that the steel reinforcing bars comply with ACI 318-19 and ACI 318-14 Section 20.2.2.5 for the 2021, 2018 and 2015 IBC (ACI 318-11 Section 21.1.5.2 for the 2012 IBC), as applicable.

- 5.3 The use of HRC 555 headed reinforcing bars must comply with ACI 318-19 and ACI 318-14 Section 20.2.2.5 for the 2021, 2018 and 2015 IBC (ACI 318-11 Section 21.1.5.2 for the 2012 IBC), as applicable, when used to resist earthquake-induced moments, axial force, or both in special seismic systems and anchor reinforcement in Seismic Design Categories (SDC) C, D, E and F.
- 5.4 Special inspections must be provided in accordance with Section 4.2 of this report.
- 5.5 Minimum concrete cover must be in accordance with ACI 318-19 Sections 20.5 and 25.4.4.1 and ACI 318-14 Sections 20.6 and 25.4.4.1 for the 2021, 2018 and 2015 IBC (ACI 318-11 Sections 7.7 and 12.6.1 for the 2012 IBC), as applicable, and must be measured from the outer surface of the HRC 555 headed reinforcing bar's head.
- 5.6 When steel reinforcing bars are headed at a fabricator's facility to form the HRC 555 headed reinforcing bar, the following statements apply:
 - 5.6.1 The fabricator must be approved by the code official in accordance with IBC Section 1704.2.
 - 5.6.2 The fabricator must be approved by the report holder, HRC.
 - 5.6.3 The fabricator must demonstrate, to the satisfaction of the code official, compliance with the XT-2 Operating Manual, as defined by HRC.
 - 5.6.4 For each HRC 555 headed steel reinforcing bar size, the fabricator must demonstrate to the satisfaction of the code official that the headed steel reinforcing bars are consistent with the qualifying test specimens. This may be demonstrated in test reports submitted to the code official.
- 5.7 HRC 555 headed reinforcing bar calculations and installation details for each project complying with the IBC and ACI 318 must be submitted to the code official for approval, with this information prepared by a registered design professional when required by the statutes of the jurisdiction in which the headed bars are installed.
- 5.8 The HRC 555 headed reinforcing bar that is headed by Headed Reinforcement Corporation (HRC) is formed/headed in Fountain Valley, California, under a quality control program with inspections by ICC-ES. All other heading operations must comply with Section 5.6, above.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Headed Deformed Bars (AC347), dated January 2013, editorially revised April 2020.

7.0 IDENTIFICATION

7.1 Reinforcing Bars Headed by HRC:

HRC 555 headed reinforcing bars manufactured by HRC are labeled with the bar size, the product name (HRC 555), the letters "HA" to indicate conformance with ASTM A970 and the symbol "F01" to indicate the product having been manufactured at HRC's facility, and the ICC-ES evaluation report number (ESR-2935).

7.2 Reinforcing Bars Headed by Fabricator:

HRC 555 headed reinforcing bars manufactured by a fabricator approved by the code official must be labeled with the bar size, the product name (HRC 555), the letters "HA" to indicate conformance with ASTM A970, and includes initials or other markings to identify the approved fabricator's facility. The headed deformed bars must be accompanied to the jobsite with paperwork, as required by the code official, indicating the headed reinforcing bars were manufactured by the fabricator approved by the code official per Section 5.6 of this report.

7.3 The report holder's contact information is the following:

HEADED REINFORCEMENT CORPORATION
11200 CONDOR AVENUE
FOUNTAIN VALLEY, CALIFORNIA 92708
(714) 557-1455
www.hrc-usa.com
engineer@hrc-usa.com

8.0 2006 International Building Code® (IBC).

8.1 Evaluation Scope:

In addition to the code referenced in Section 1.0, the products in this report were evaluated for compliance with the requirements of the 2006 *International Building Code*® (IBC). The HRC 555 headed reinforcing bars, as described in this report, are suitable alternatives to what is specified in the 2006 IBC, subject to the provisions of Section 8.2 through 8.7.

8.2 Uses:

The HRC 555 headed bar is a mechanical device complying with ACI 318-05 Section 12.6, for use as mechanical anchorage to develop the steel reinforcement bars in tension as an alternate to standard hooks or development lengths of straight deformed steel reinforcement bars in reinforced, normal-weight concrete. Related sections in ACI 318 that permit or require mechanical anchorage of reinforcing bars are Sections 12.1.1, 12.10.6, 12.11.2, 12.11.3, 12.11.4 and 12.12.1.

HRC 555 headed bars can also be used as an alternative to tension lap splices specified by ACI 318-05 Section 12.15.

8.3 Description:

See Section 3.0.

8.4 Design and Installation:

8.4.1 General:

The installation parameters of the HRC 555 headed deformed bars (including the concrete compressive strength, headed bar spacing, concrete coverage and headed deformed bar anchorage length) must be such that the reinforcing bar tensile force based on the headed end concrete bearing strength, $f_{c,bear}$, exceeds the tensile force at specified yield strength, f_y , of the reinforcing bar according to Section 8.4.2, and the headed bars are installed in accordance with Section 8.4.2. The minimum anchorage length and minimum lapped splice length of the headed deformed bars must comply with Sections 8.4.3 and 8.4.4, respectively.

8.4.2 Installation Parameters:

The headed deformed bars must be placed so that c_b/d_b is equal to or greater than 2.5, and the installation parameters must satisfy Eq-1:

$$f_{c,bear} \times A_{brg} \geq f_y \times A_b, \text{ pounds (N)} \quad (\text{Eq-1})$$

where:

$$f_{c,bear} = 0.6f'_c \omega_t(2c_b) / (A_{brg})^{0.5} < 8f'_c, \text{ psi (Pa)}$$

$$\omega_t = 0.6 + 0.4 (c_2/c_b) < 2.0$$

f'_c = Specified 28-day concrete compressive strength with the maximum value of f'_c to be used in the calculation limited to 6,000 psi (41.3 MPa) [minimum of 24 MPa is required under ADIBC Appendix L, Section 5.1.1].

c_b = The minimum of half the center-to-center reinforcing bar spacing or the least overall concrete cover dimension measured to the center of the reinforcing bar, inches (mm).

c_2 = Dimension orthogonal to c_b , inches (mm). If c_b is determined by half the center-to-center reinforcing bar spacing, c_2 is the lesser of the concrete cover in the orthogonal direction measured to the center of the reinforcing bar or half the center-to-center reinforcing bar spacing orthogonal to c_b . c_2 must always be equal to or greater than c_b .

A_{brg} = Net headed bearing area as specified in Table 1, square inches (mm²).

A_b = Nominal cross-sectional area of the reinforcing bar as specified in Table 1, square inches (mm²).

f_y = Specified yield strength of the reinforcing bar, psi (MPa).

d_b = Reinforcing bar nominal diameter, inch (mm).

8.4.3 Minimum Anchorage Length:

The minimum anchorage length, L_a , of headed deformed bars must be eight times the steel reinforcing bar diameter or 6 inches (152 mm), whichever is greater. (See Table 1.) Anchorage length is defined as the distance from the critical section to the concrete bearing face of the headed end of the headed deformed bar. Critical section is defined as that location in the concrete member where the full steel bar stress is required.

8.4.4 Headed Bar Lap Splices:

When HRC 555 headed deformed bars are used as an alternative to the code-required lapped splices of deformed bar reinforcement, the minimum lap length, L_s , as measured between bearing faces of opposing heads of the headed deformed bars, must be in accordance with Eq-2 defined below (see Figure 2):

$$L_s = 1.3(L_a + S_b \tan 35^\circ) \tag{Eq 2}$$

where:

L_a = Minimum anchorage length, inches (mm).

S_b = Centerline spacing between lapped headed bars, inches (mm).

8.4.5 Termination of Headed Deformed Reinforcing Bars:

Longitudinal headed deformed reinforcing bars originating in members, such as (but not limited to) beams, corbels, or brackets, and terminated in an adjacent member, must be extended to the far face of the confined region of the adjacent member.

8.4.6 Special Inspection:

Special inspection must be provided at the jobsite as required by IBC Section 1704. The inspector's duties include verifying grade and size of reinforcement bar, and verifying placement of the headed reinforcing bars and labeling of the products as noted in this evaluation report.

8.5 Conditions of Use:

See Section 5.0, but replace the wording in Sections 5.2, 5.3 and 5.4 with the following:

Replacement for Section 5.2:

For structures regulated under Chapter 21 of ACI 318-05 (as modified by IBC Section 1908), with the mechanical anchors resisting earthquake-induced flexural and axial forces in frame members and in structural wall boundary elements with the HRC 555 system, mill certificates of reinforcing bars must be submitted to the code official as evidence that the steel reinforcing bars comply with ACI 318-05 Section 21.2.5 (denoted as ACI 318 Section 21.2.5.1 in IBC Section 1908.1.5).

Replacement for Section 5.3:

Special inspections must be provided in accordance with Section 8.4.6 of this report.

Replacement for Section 5.4:

Minimum concrete cover must be in accordance with Section 1907.7 of the IBC, and must be measured from the outer surface of the HRC 555 headed reinforcing bar's head.

8.6 Evidence Submitted:

Data in accordance with the ICC-ES Acceptance Criteria for Headed Ends of Concrete Reinforcement (AC347), dated August 2008.

8.7 Identification:

8.7.1 Reinforcing Bars Headed by HRC:

See Section 7.1.

8.7.2 Reinforcing Bars Headed by Fabricator:

See Section 7.2.

TABLE 1—DIMENSIONS OF HRC 555 HEADED REINFORCING BARS

Dimensions	Bar size	#4	#5	#6	#7	#8	#9	#10	#11
Rebar	Diameter, d_b [in]	0.500	0.625	0.750	0.875	1.000	1.128	1.270	1.410
	Area [sq.in.]	0.20	0.31	0.44	0.60	0.79	1.00	1.27	1.56
Head	* T_{min} [in]	0.25	0.31	0.38	0.44	0.5	0.56	0.64	0.70
	D [in]	1.14	1.42	1.69	1.97	2.25	2.56	2.87	3.19
	A_{brg} [sq.in.]	0.82	1.27	1.80	2.45	3.18	4.14	5.20	6.43

For SI: 1 inch = 25.4 mm, 1 sq.in. = 645 mm², 1 foot = 305 mm. * Head thickness should be no larger than bar diameter.

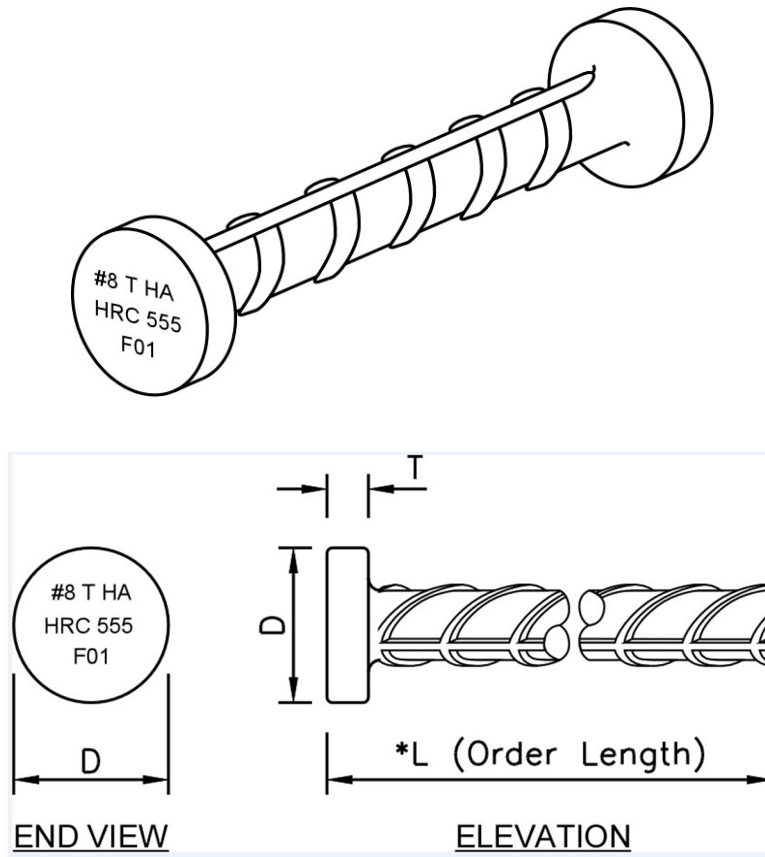


FIGURE 1—HRC 555
 The “T” is for the 2006 IBC.
 The “HA” is for the 2021, 2018, 2015 and 2012 IBC

TABLE 2—HEADED LAP SPLICES (2006 IBC) ¹

Bar size	#4	#5	#6	#7	#8	#9	#10	#11
Minimum Anchorage Length, L_a [in]	6.00	6.00	6.00	7.00	8.00	9.02	10.16	11.28
Center spacing, $S_b = 1.65 d_b$ [in]	0.83	1.03	1.24	1.44	1.65	1.86	2.10	2.33
Minimum Lap Length, L_s [in]	8.55	8.74	8.93	10.41	11.90	13.43	15.12	16.78
Comment:	Minimum spacing (edge of head touch spliced bar)							
Center spacing, $S_b = 2.5 d_b$ [in]	1.25	1.56	1.88	2.19	2.50	2.82	3.18	3.53
Minimum Lap Length, L_s [in]	8.94	9.22	9.51	11.09	12.68	14.30	16.10	17.87
Comment:	Clear spacing between heads during installation							

For **SI**: 1 inch = 25.4 mm.

¹ This table is limited to use under the 2006 IBC.

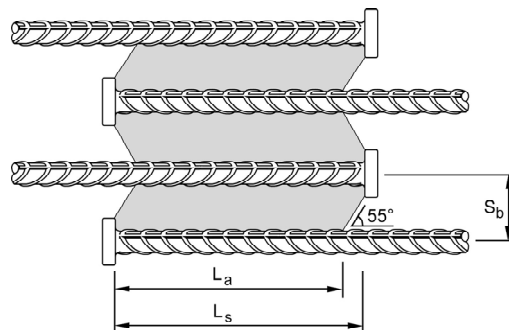


FIGURE 2—HRC 555 LAP SPLICE (2006 IBC)