

## ICC-ES Evaluation Report

ESR-2764

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DIVISION: 03 00 00—CONCRETE  
Section: 03 21 00—Reinforcing Steel

## REPORT HOLDER:

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

## EVALUATION SUBJECT:

HRC 500/510 XTENDER® MECHANICAL COUPLER  
SYSTEM

## 1.0 EVALUATION SCOPE

## Compliance with the following codes:

- 2009 *International Building Code*® (2009 IBC)
- 2006 *International Building Code*® (2006 IBC)

## Property evaluated:

Structural

## 2.0 USES

The HRC 500/510 Xtender® Mechanical Coupler system is used for tension and compression mechanical splices of deformed steel reinforcing bars used in the design and construction of structural concrete members. The splices comply with Section 12.14.3.2 of ACI 318 (ACI 318 is referenced in IBC Section 1901.2). The mechanical splices are for use as either Type 1 or Type 2 mechanical splices of deformed steel reinforcing bars in accordance with Section 21.1.6 of ACI 318-08 or Section 21.2.6 of ACI 318-05.

## 3.0 DESCRIPTION

## 3.1 General:

The HRC 500/510 Xtender® Mechanical Coupler system consists of an HRC 500 threaded male coupler component, an HRC 510 threaded female coupler component and two steel reinforcing bars that are prepared with headed upset ends. Dimensions and a typical assembly are shown in Table 1.

HRC 500/510 is a positional coupler, allowing pre-bent and pre-tied reinforcing bars to be installed without rotating the reinforcing steel. The coupler is used to mechanically butt-splice No. 4 through No. 11 and No. 14 steel reinforcing bars.

## 3.2 Material:

**3.2.1 HRC 500/510 Couplers:** The couplers are manufactured from steel complying with either Grade 1144/1141 ASTM A 311-04 or ASTM A 576-90b (reapproved 2006)

**3.2.2 Steel Reinforcing Bars:** The deformed steel reinforcing bars used with the couplers must comply with ASTM A 706 Grade 60 or ASTM A 615 Grade 60 for all bar sizes. No. 8, 11 and 14 steel reinforcing bars can also comply with ASTM A 615, Grade 75, as an alternative, except where noted otherwise in this report. The reinforcing bars must have headed ends complying with the specification provided by Headed Reinforcement Corporation (HRC).

## 4.0 DESIGN AND INSTALLATION

## 4.1 General:

The HRC 500/510 Xtender® Mechanical Coupler System must be installed in accordance with the applicable code and this evaluation report. The splice locations must be detailed on the plans approved by the code official. All required spacing and coverage described in Sections 7.6 and 7.7 of ACI 318 must be measured from the outside of the coupler. As Type 2 splices, the couplers are permitted in any location within a member for all seismic design categories.

## 4.2 Installation:

**4.2.1 Shop Preassembled Coupler and Steel Reinforcing Bars:** Where the threaded male and female couplers are preassembled onto headed steel reinforcing bars by HRC-approved fabricators, excessive rust and adhered concrete must be removed from the coupler threads, if necessary, with a wire brush and lubricant prior to field assembly of the couplers. The male and female coupler components are screwed together hand-tight without the need to rotate the bars themselves. (See Figure 1.) The assembly must then be tightened using the torque values as defined in Table 1. Since the two coupler parts are free to rotate around the bar axis, it may be necessary to hold one coupler part stationary with a pipe wrench while torque is being applied to the corresponding component. Visual inspection must be performed according to Figure 2. Full threads must not be visible. The male collar and female sleeve must not touch or bottom out.

**4.2.2 Jobsite Assembled Coupler and Steel Reinforcing Bars:** Where the couplers are installed onto the ends of the steel reinforcing bars at the jobsite, the installation process is as described in the steps below and as illustrated in Figure 3.

**Step 1:** The Xtender<sup>®</sup> splicing system must have a minimum length of straight reinforcement bar equal to approximately six times the diameter of the bar being spliced, but not less than 6 inches (152 mm), to accommodate the Xtender<sup>®</sup> upsetting equipment.

**Step 2:** The threaded male nut must be inserted over the reinforcing bar with head seat towards the end of the bar. The end of the reinforcing bar must be heated over a length equal to approximately two bar diameters and to a temperature between 1800°F (982°C) and 2250°F (1232°C). Heating should be carried out such that the end of the reinforcing bar is evenly heated.

**Step 3:** The Xtender<sup>®</sup> upsetting machine must be inserted over the heated end of the reinforcing bar and a hydraulic pressure of 8,000 to 10,000 psi (55.2 MPa to 69 MPa) applied to the upsetting equipment. The bar must be air-cooled after the upsetting equipment is removed from the bar.

**Step 4:** Steps 1 through 3 must be repeated using the other reinforcing bar and the female coupler, unless the bar and coupler have been preassembled offsite.

**Step 5:** Utilizing the right-handed threads, the two components are hand-tightened together as described in Section 4.2.1.

#### 4.3 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 reinforcing bar, coupler identification, heading of reinforcing bar (if applicable), position of coupler, and placement of reinforcing bar splices, as well as assembly of the coupler component.

#### 5.0 CONDITIONS OF USE

The HRC 500/510 Xtender<sup>®</sup> Mechanical Coupler System described in this report complies with, or is a suitable alternative to what is specified in, the code indicated in Section 1.0 of this report, subject to the following conditions:

- 5.1 The HRC 500/510 couplers must be installed in accordance with the code, the manufacturer's instructions, and this report. In the case of conflict between the manufacturer's published instructions and this report, this report governs.
- 5.2 Splice locations must comply with code requirements and be noted on plans approved by the code official.
- 5.3 For structures regulated by Chapter 21 of ACI 318 (as modified by IBC Section 1908.1), to splice reinforcing bars resisting earthquake-induced flexural and axial forces in frame members and in structural wall boundary elements with the mechanical splice system, the couplers are limited to use with ASTM A 706 Grade 60 or ASTM 615 Grade 60 steel reinforcing bars and mill certificates must be submitted to the code official as evidence that the steel reinforcing bars comply with ACI 318-08 Section 21.1.5 or ACI 318-05 Section 21.2.5 (denoted as ACI 318 Section 21.2.5.1 in 2006 IBC Section 1908.1.5).
- 5.4 Special inspections must be provided in accordance with Section 4.3 of this report.
- 5.5 Minimum concrete cover must be in accordance with the Section 1907.7 of the IBC, and must be measured from the outer surface of the coupler.
- 5.6 When couplers are preassembled onto the headed ends of the reinforcing bars at a fabricator's facility, the following statements apply:

5.6.1 The fabricator must be approved by the code official in accordance with IBC Section 1704.2. The fabricator must demonstrate, to the satisfaction of the code official, compliance with the XT-2 Operating Manual, dated February 13, 2009, defined by HRC.

5.6.2 The fabricator must be approved by the report holder, HRC.

5.6.3 For each coupler model type and steel reinforcing bar size and steel specification, the fabricator must demonstrate the following items to the satisfaction of the code official:

- a. The fabricator prepares the ends of the steel reinforcing bar as required by HRC in a manner consistent with the qualifying test specimens.
- b. For Type 2 splices, connections of each steel reinforcing bar using the fabricator-prepared steel reinforcing bars, tested in static tension, develop 100 percent of the specified tensile strength of the steel reinforcing bar and 125 percent of the specified yield strength of the reinforcing bar for use under the IBC. This may be demonstrated in test reports submitted to the code official.
- c. For Type 1 splices, connections of each steel reinforcing bar using fabricator-prepared steel reinforcing bars, tested in static tension, develop at least 125 percent of the specified yield strength of the steel reinforcing bars. This may be demonstrated in test reports submitted to the code official.

5.7 When couplers are jobsite-assembled onto the steel reinforcing bars that are prepared (headed) at the jobsite, the following statements apply:

5.7.1 The jobsite fabricator must be approved by HRC.

5.7.2 The jobsite fabricator must be approved by the code official in accordance with IBC Section 1704.2. The jobsite fabricator must demonstrate, to the satisfaction of the code official, compliance with the XT-1 Operating Manual, dated January 21, 2009, defined by HRC. For each coupler model type and steel reinforcing bar size and steel specification, the jobsite fabricator must demonstrate the following items to the satisfaction of the code official:

- a. The fabricator prepares the ends of the steel reinforcing bar as required by HRC in a manner consistent with the qualifying test specimens.
- b. For Type 2 splices, connections of each steel reinforcing bar using the fabricator-prepared steel reinforcing bars, tested in static tension, develop 100 percent of the specified tensile strength of the steel reinforcing bar and 125 percent of the specified yield strength of the reinforcing bar for use under the IBC. This may be demonstrated in test reports submitted to the code official. These tests must be

conducted prior to commencement, and periodically throughout the duration, of the jobsite preparation of the ends of the steel reinforcing bars. The frequency of the tensile tests must be acceptable to the registered design professional for the building project, and to the applicable code official.

- c. For Type 1 splices, connections of each steel reinforcing bar using the fabricator-prepared steel reinforcing bars, tested in static tension, develop 125 percent of the specified yield strength of the steel reinforcing bar. This may be demonstrated in test reports submitted to the code official. These tests must be conducted prior to commencement, and periodically throughout the duration, of the jobsite preparation of the ends of the steel reinforcing bars. The frequency of the tensile tests must be acceptable to the registered design professional for the building project, and to the applicable code official.

- 5.8 The headed reinforcing bars for the HRC 500/510 couplers that are headed by Headed Reinforcement Corporation are formed/headed in Fountain Valley, California under a quality control program with inspections by Smith-Emery Laboratories (AA-554). All other heading operations must comply with Sections 5.6 and 5.7, above.

## 6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Mechanical Connector Systems for Steel Reinforcing Bars (AC133), dated January 2010.

## 7.0 IDENTIFICATION

### 7.1 Couplers Shipped to Fabricator or Jobsite:

Each coupler is stamped or labeled with the product designation of "HRC 510" (female) or "HRC 500" (male), the bar size, lot number and "T2" to designate the use of the coupler as a Type 2 Splice. The packaging for the coupler is labeled with this same information and the Xtender logo and the ICC-ES evaluation report number (ESR-2764).

### 7.2 Couplers Shipped to Jobsite Already Attached to Reinforcing Bars:

#### 7.2.1 Couplers Attached to Reinforcing Bars by HRC:

Each coupler attached to a reinforcing bar at the HRC facility must be labeled as indicated in Section 7.1 and be accompanied to the jobsite with tags or labels bearing the HRC company name and the ICC-ES evaluation report number (ESR-2764) and paperwork indicating the couplers and bars were assembled by HRC.

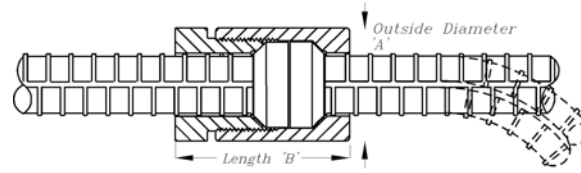
#### 7.2.2 Couplers Attached to Reinforcing Bars by Approved Fabricators:

Couplers attached to reinforcing bars by a fabricator approved by the code official must be labeled as indicated in Section 7.1 and be accompanied to the jobsite with tags or labels and paperwork, as required by the code official indicating the couplers and bars were assembled by the fabricator approved by the code official.

TABLE 1—DIMENSIONS OF HRC 500/510 COUPLERS

Bar size	#4	#5	#6	#7	#8	#9	#10	#11	#14
A - Coupler OD [in]	1.375	1.500	1.625	1.875	2.125	2.375	2.625	2.875	3.500
B -Typical Length [in]	2.00	2.13	2.38	2.88	3.13	3.50	3.75	4.25	5.13
Torque [lbf-ft]	100	100	150	150	150	250	250	250	250

For SI: 1 inch = 25.4 mm, 1 sq.in. = 645 mm<sup>2</sup>, 1 foot = 305 mm.



COUPLER CROSS SECTION



FIGURE 1—500/510 SERIES COUPLERS

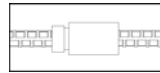
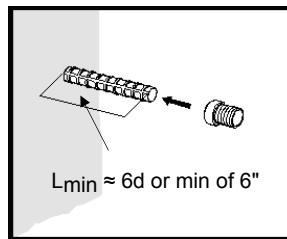
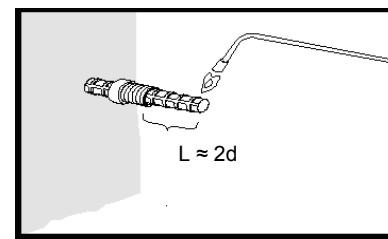


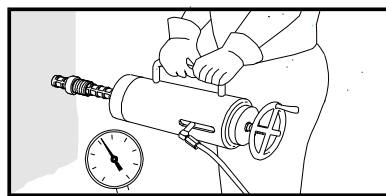
FIGURE 2—500/510 VISUAL INSPECTION



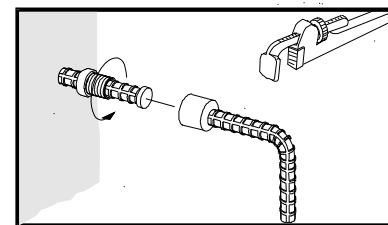
Step 1



Step 2



Step 3



Step 5

FIGURE 3—PROCESS STEPS FOR JOBSITE-ASSEMBLED COUPLERS AND REINFORCING BARS



FIGURE 4—XTENDER LOGO