

IAPMO ES

# Cover Sheet

Evaluation Criteria of

**Headed and Mechanically Anchored Deformed Reinforcement Bars In Tension**

**EC 006-200X**

Posted for public commenting on 10/16/2009 to 11/12/2009

**INTERNATIONAL ASSOCIATION OF PLUMBING  
AND MECHANICAL OFFICIALS, EVALUATION SERVICES**

**EVALUATION CRITERIA  
FOR**

**HEADED AND MECHANICALLY ANCHORED  
DEFORMED REINFORCEMENT BARS IN TENSION**

**EC 006-200X**

**1.0 INTRODUCTION**

- 1.1 Purpose:** This criteria establishes the requirements for recognition by IAPMO Evaluation Service (IAPMO-ES) of headed and mechanically anchored deformed reinforcement bars in tension (Manufactured Product) under the 2006 *International Building Code*® (IBC), the 2006 *International Residential Building Code*® (IRC), and *American Concrete Institute*® ACI 318-08. Bases of recognition are section 104.11 of the 2006 *International Building Code*®, section R104.11 of the International Residential Code and section 12.6 of the American Concrete Institute ACI 318-08.

The development of this criteria is to provide a guideline for the evaluation of headed and mechanically anchored deformed reinforcing Bars in tension, since the IBC, IRC, and associated reference standards do not specify design guidelines for these products.

- 1.2 Scope:** This criteria provides a basis for the testing and evaluation as applicable to the design of headed and mechanically anchored deformed steel reinforcing bars that develop the specified yield and specified tensile strengths tested without concrete. The use of headed and mechanical anchored deformed reinforcement for lap splices are outside the scope of this criteria.

**2.0 REFERENCE STANDARDS**

- 2.1** Standards referenced in this criteria shall be applied consistently with the specific code(s) complied.

2006 IBC	<i>International Building Code</i> ®
2006 IRC	<i>International Residential Code</i> ®
ACI 318-08	Building Code Requirements for Structural Concrete, American Concrete Institute.
ASTM A 370-05	Standard Test Methods and Definitions for Mechanical Testing of Steel Products, ASTM International.
ASTM A 615-04b	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A 706-04b	Standard Specification for Low Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

ASTM A 970-07	Standard Specification for Headed Steel Bars for Concrete Reinforcement.
ASTM E 8-04	Standard Test Methods for Tension Testing of Metallic Materials, ASTM International.

### 3.0 DEFINITIONS

- 3.1 Headed Deformed Reinforcement:** Deformed reinforcing bars with heads attached at one or both ends. Heads are attached to the bar end by means of internal tapered threads on the head mating to tapered threads on the bar end. The bearing surface of the head must be perpendicular to the axis of the reinforcing bar.
- 3.2  $A_b$ :** Nominal cross-sectional area of the bar.
- 3.3 Net Bearing Area of the Head:** The bearing area of the head  $A_{brg}$ , for deformed rebar is measured perpendicular to the axis of the bar. The net bearing area of headed deformed bar equals the gross area of the head minus the larger of the area of the bar and the area of any obstruction. The minimum net bearing area of the head of a headed deformed bar shall not be less than four times the area of the bar ( $4A_{br}$ ).
- 3.4 Development Length:** Length of embedded reinforcement required to develop the design strength of reinforcement at a critical section, reference ACI 318-08 Section 9.3.3.

### 4.0 BASIC INFORMATION

- 4.1 General:** Each submittal shall include the following information for an evaluation report:
- 4.1.1 Product Description:** Description of headed bar products shall include dimensions, designations, and material specifications.
- 4.1.2 Installation Instructions:** Installation instructions for the headed bars shall include product installation requirements and details regarding installation of the product.
- 4.1.3 Identification:** Headed bars shall be permanently hard stamped with the manufactures mark or logo and shall include the unique heat code identification. Packaging labels for headed bars shall include the manufacturer or a registered trademark, model or name of the product, size, and applicable IAPMO-ES evaluation report number.
- 4.2 Testing Laboratories:** Testing laboratories shall comply with the requirements for compliance with the International Accreditation Service (IAS) ISO/IEC standard 17025 or accredited independent agency recognized by the International Laboratory Accreditation or ANSO. Testing at a non-accredited laboratory may be permitted by IAPMO-ES, provided the testing is conducted under the supervision of an accredited laboratory and the supervising laboratory issues the test report.
- 4.3 Test Reports:** Test reports, submitted for approval by IAPMO-ES, shall consist of:
1. A description of the test procedures, test results, observations, tested assemblies, load measurements, and photographs of specimens and typical failures.
  2. A description of the test specimens.

- 4.4 Product Sampling and Preparation of Test:** The testing laboratory shall verify random sampling of the components, provided by the manufacturer that represents the production components.

## 5.0 TESTING AND PERFORMANCE REQUIREMENTS

### 5.1 Head Dimensions

- 5.1.1 General:** The heads shall be produced in such a manner that they are sufficiently rigid to produce uniform bearing without deformation up to the specified yield strength of the reinforcing bar.
- 5.1.2 Obstructions to the Head Bearing Area:** Obstructions or interruptions shall not extend more than 2db from the orthogonal bearing face of the head along the longitudinal axis of the reinforcing bar. The obstructions perpendicular to the axis of the bar shall not extend radially from the perimeter of the reinforcement more than 0.5db.
- 5.1.3 Bar Deformations:** Bar deformations shall not be interrupted from the orthogonal bearing surface of the head for more than a distance of 2db along the longitudinal axis of the bar. Interruptions could include gripping marks for holding the rebar during the fabrication process.
- 5.1.4 Tensile Tests:** Reports of tensile and cyclic testing shall be conducted in accordance with Section 6.1 of this criteria and shall be submitted for verification in compliance with the conditions cited in Section 6.2.

## 6.0 TEST METHODS

- 6.1 Anchorage capacity under cyclic elastic-plastic loading followed by monotonic tension.** At least five specimens shall be tested for each bar size and head type for which recognition is sought. Samples shall be tested in accordance with ASTM A370. The failure shall be defined in the report as one of the following: partial or total fracture of the bar, the head, or the head-to-bar connection. The headed rebar connection shall sustain stages 1 through 3 of the specified loading program shown in Table 1, without failure.

**Table 1: Loading Protocol for Cyclic Tension Tests**

Stage	1	2	3	4
<b>Maximum Load</b>	0.95f <sub>y</sub>	2ε <sub>y</sub>	5ε <sub>y</sub>	Load in Tension to Failure
<b>Minimum Load</b>	0.05f <sub>y</sub>	0.05f <sub>y</sub>	0.05f <sub>y</sub>	
<b>Number of Cycles</b>	20	4	4	

**Conditions of Evaluation:** Tensile strength after cycling per the requirements of Table 1 shall meet or exceed the minimum specified yield strength of the reinforcing bar per Section 12.6.4 of ACI 318-08. Additionally, the tensile strength of the headed bar assembly must meet or exceed the minimum specified tensile strength of the reinforcing bar, as defined in ASTM A615 or ASTM A706.

## **7.0 EVALUATION REPORT RECOGNITION**

- 7.1** Evaluation reports that comply with the above criteria shall include the manufacturer's name and products name of proprietary components and the description of the material specifications for all assembly components
- 7.2** The evaluation report shall also include:
1. Any recommendations for special inspections to be consistent with the requirements of the model code (section 1704.4 and 1704.13 of the IBC) and as required by IAPMO-ES.
  2. Reference in ACI 318-08 Figure R3.5.9 for headed deformed reinforcing bar with obstructions, Figure R12.6 (a) and Figure R12.6 (b) for development of headed deformed bars.
  3. When utilizing the equation in Section 12.6.2 of ACI 318-08 to calculate development length, the license design professional shall verify that the proposed heads meet "Class A" specifications per ASTM A970-07, that the maximum compressive design strength of concrete used in the calculation is 6,000 psi, and that conditions a-f as stated in Section 12.6.1 of ACI 318-08 have been met. For reinforcement that does not meet these requirements the anchorage shall be designed in accordance with ACI 318-05 appendix D.

**Adopted: Month &Year**