

HIGH-STRENGTH STRUCTURAL BOLTING INSPECTION: 2016, 2013, 2010 AND 2007 CBC

Disciplines: Structural	History:	Revised 05/08/18	Issued 01/12/11
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Division of the State Architect (DSA) documents referenced within this publication are available on the [DSA Forms](#) or [DSA Publications](#) webpages.

PURPOSE: This Interpretation of Regulations (IR) provides clarification of specific code requirements relating to the responsibilities of special inspectors for performing high-strength bolting special inspection on projects under DSA jurisdiction.

SCOPE: This IR is applicable to both shop and field structural bolting activities utilizing American Society for Testing and Materials (ASTM) F3125 fasteners.

BACKGROUND: The California Building Code (CBC) requires sampling and testing of high-strength structural bolts (HSB) and either periodic or continuous special inspection of high-strength structural bolting operations. Refer to *IR 17-8: Sampling and Testing of High Strength Bolts, Nuts, and Washers* or *IR 17-8.16: Sampling and Testing of High Strength Bolts, Nuts, and Washers: 2016 and 2013 CBC* for material identification, sampling and testing requirements of high-strength structural bolts, nuts, and washers. Special inspection of the installation and tightening of all HSBs shall be conducted in accordance with the CBC, applicable reference standards (e.g., Specification for Structural Joints Using High-Strength Bolts by the Research Council on Structural Connections [RCSC], American Institute of Steel Construction [AISC] 360, AISC 341, etc.) and the requirements of this IR.

- 1. QUALIFICATIONS:** Special inspectors conducting high-strength structural bolting special inspection shall meet the following minimum requirements:
 - 1.1** Hold valid certification from the International Code Council (ICC) as a certified Structural Steel and Bolting Special Inspector (S1).
 - 1.2** Meet the minimum age and experience requirements specified in the California Administrative Code (CAC), Section 4-335(f) (2010 CAC, § 4-333[d]; 2007 CAC, § 4-333[c]).
 - 1.3** Possess knowledge of the CAC special inspection and reporting requirements, Section 4-335 (2010 CAC, § 4-333[d]; 2007 CAC, § 4-333[c]), HSB requirements of the CBC and applicable reference standards.
- 2. SPECIAL INSPECTORS:** A specially qualified person utilized, where required by code, to inspect aspects of the work such as structural steel welding or masonry construction. A special inspector may be hired by the laboratory of record (LOR) or through an independent contract with the school district or owner. Refer to CAC Section 4-335(f) and *IR 17-12: Special Inspection Reporting Requirements* for additional information.
- 3. INSPECTION DUTIES FOR ALL HSB INSTALLATION TECHNIQUES:**
 - 3.1** Review and understand the applicable portions of the DSA-approved construction documents (e.g., plans, specifications, addenda, construction change documents, etc.). Accepted shop drawings, erection drawings, referenced codes and standards must also be reviewed and understood. (Note that shop/erection drawings are NOT DSA-approved documents and shall NOT be used as a basis for acceptance).

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- 3.2 Review manufacturer's material test reports for conformance with documents listed in Section 3.1 above.
- 3.3 Conduct material identification and verify the sampling for testing for all high-strength fastener assemblies and components as required by the CBC, and either IR 17-8.16 or IR 17-8 dependent upon which CBC edition served as the basis for project design.
- 3.4 Verify that all bolting material is stored in suitable containers, protected from contamination, moisture, and weather. Only the number of fasteners required for one shift of work shall be removed from storage at a time. At the end of the shift, unused fasteners shall be returned to the containers. Bolting materials shall also be controlled so that used, rejected, or unidentified materials are not incorporated in the work.
- 3.5 Visually inspect the surface conditions and markings (when applicable) of the bolts, nuts, and washers. Identify and report as non-conforming any fastener components installed having visible defects (e.g., quench cracks, forging cracks, head-burst, etc.) exceeding limits specified in ASTM F788.
- 3.6 Verify that all applicable bolt installation procedures and manufacturer's instructions are available on the project site and that they are current and accurate.
- 3.7 Verify that all bolt installers are familiar with the requirements and are able to install bolts in accordance with the accepted procedures.
- 3.8 Inspect the condition of bolted joints prior to assembly as follows:
- Verify bolt hole is the proper type (standard, short slotted, etc.) and size.
 - Check the condition of the bolt holes. For example, verify holes to receive bolts have no unfair reaming, unapproved flame cutting or slotting.
 - Check for appropriate bolt diameter, shank lengths (e.g., threads included or excluded at the faying surface).
 - Verify the faying surfaces are properly prepared.
- 3.9 Verify that all required bolts have been installed.
- 3.10 Verify that all bolts have been tightened in a systematic manner, to bring the joint into a snug-tight condition, beginning with the most rigid part of the connection and progressing to the free edges. Several tightening cycles may be needed.
- 3.11 Mark completed joints that have been inspected and accepted with a distinguishing mark. The mark shall include: Laboratory of Record initials, inspector's initials, inspection date and acceptance status of the joint.

4. ADDITIONAL REQUIREMENTS FOR CONNECTIONS THAT REQUIRE

PRETENSIONING: All requirements of Section 3 of this document shall apply in addition to the following:

- 4.1 Inspect pretensioning operations to verify the proper application of the bolting procedures and conformance with the DSA-approved documents and applicable reference standards.
- 4.2 Verify that faying surface requirements are met for all slip-critical joints.
- 4.3 Observe the pre-installation verification procedures for each fastener assembly lot prior to the start of work on each day. Verify that the bolt tension calibrator (e.g., Skidmore-Wilhelm) is currently calibrated.

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4.4 Additional requirements apply to the following tightening methods per CBC Table 1705A.2.1 (2010 and 2007 CBC Table 1704A.3):

4.4.1 “Turn-of-Nut” Method:

- After all bolts have been brought to the snug-tight condition in accordance with Section 3.10, the face of the nut and the protruding bolt point shall be match-marked in the presence of the HSB special inspector.
- After match-marking, bolts shall be tightened the specified number of turns. Bolts shall be tightened in a systematic manner from the most rigid part of the connection. This final tightening operation shall be performed in the presence of the HSB special inspector.

4.4.2 Tension-Control “Twist-Off-Type” Bolts:

- Hardened washers under the nut are always required when the tension-control pretensioning method is used.
- Tightening to the snug-tight condition, tightening to the final pretensioned condition and shearing the shear groove shall be accomplished in two separate tightening operations in the presence of the HSB special inspector. Each tightening operation shall be completed for all bolts in the connection before proceeding to the next tightening operation. Tightening shall always start at the most rigid part of the connection and proceed systematically to the free edges. If the shear groove of one bolt is sheared prior to obtaining the final pretension in all bolts in the connection, that bolt shall be removed and replaced.
- Manufacturer-applied lubrication of Tension-Control bolts is essential to the reliable performance of these fasteners. Bolts that have been exposed to moisture, contaminants, or lubricants other than the factory coatings applied by the manufacturer shall not be used.

4.4.3 Calibrated Wrench Method:

- Hardened washers under the element to be turned are always required when the calibrated wrench method is used.
- At least once each working day, installation wrenches shall be calibrated on an acceptable, calibrated tension measuring device, such as a “Skidmore-Wilhelm,” in the presence of the HSB special inspector.
- Wrenches shall be calibrated to provide a tension of 1.05 times the specified installation tension.
- Wrenches shall be calibrated with identical equipment, operator, compressor, hose length, bolts, nuts, washers, etc. as used in the production operation.
- Any time any component of the installation process is changed (operator, wrench, compressor, hose, fastener components, etc.) the calibration procedure shall be redone.
- Following initial tightening to the snug-tight condition the connection shall be tightened using the calibrated wrench beginning with the most rigid part of the connection and progressing systematically to the free edges until the torque for all bolts reaches the calibrated torque. Several tightening cycles may be needed.

HIGH-STRENGTH STRUCTURAL BOLTING INSPECTION: 2016, 2013, 2010 AND 2007 CBC**4.4.4 Direct Tension Indicators (DTI):**

- In addition to the requirements of Section 4.3, “direct tension indicators” shall be included in the bolt assemblies checked in the tension calibrating device. DTIs must meet the installed tolerances specified in Table 3 of ASTM F959.
- After all bolts in the joint have been brought to the snug tight condition in accordance with Section 3.10, each bolt shall be tightened in a sequence starting at the most rigid part of the connection and proceeding to the free edge until the gap between the fastener element and face of the DTI is two times the specified final gap. If any DTI is compressed to the final specified gap prior to completing this step that DTI shall be replaced. Note that A325 bolts can be loosened and reinstalled *only once*, A490 bolts may not be reinstalled. After all bolts are tightened so that the gap is twice the specified gap then bolts shall be tightened, starting at the most rigid part of the connection and proceeding to the free edges, until the final specified gap is obtained for all bolts.

5. GALVANIZED FASTENERS: Only ASTM F3125 Grade 325 (ASTM A325 prior to year 2016) designated high-strength bolts are permitted to be galvanized.

All galvanized high-strength bolts and nuts shall be shipped as an assembly together in the same container.

6. REUSE: The following bolt grades are **NOT** permitted to be reused;

- A490 (ASTM A490 prior to year 2016).
- A325 Galvanized (ASTM A325 Galvanized prior to year 2016).

7. REPORTING: The HSB special inspector shall provide detailed special inspection reports as described in CAC, Section 4-335(f)4 (2010 CAC, § 4-333[d]; 2007 CAC, § 4-333[c]) to the project inspector and others indicated to receive such reports. A *DSA 250: Special Inspection Report* form template is available on the DSA website.

7.1 Reports shall clearly describe the HSB installation process used and the inspection duties performed including all inspection listed above. Reports shall include a systematic list of accepted and rejected parts or joints. Reports shall clearly document joint locations by grid line and elevation or other acceptable means. Reports shall reference the details on the DSA-approved documents used as a basis for inspection. The HSB special inspector shall include his or her ICC Structural Steel and Bolting Special Inspector certification number on all reports.

8. FAILURE TO PERFORM: Failure to inspect the work in a professional and competent manner, report defective work, file all required reports in a truthful and timely manner, or fulfill any other duties defined by the code may result in withdrawal of HSB special inspector’s DSA acceptance. This includes but is not limited to withdrawal of acceptance or approval to work on any current or future projects under DSA jurisdiction.

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REFERENCES:

California Code of Regulations (CCR) Title 24

2016/2013 CBC, Section 1705A.2.1, Table 1705A.2.1, Item 2

2010/2007 CBC, Section 1704A.3.3, Table 1704A.3, Item 2

DSA IR 17-8.16 "Sampling and Testing of High-Strength Structural Bolts, Nuts, and Washers: 2016 and 2013 CBC"

DSA IR 17-8 "Sampling and Testing of High-Strength Structural Bolts, Nuts, and Washers"

This IR is intended for use by DSA staff and by design professionals to promote statewide consistency for review and approval of plans and specifications as well as construction oversight of projects within the jurisdiction of DSA, which includes State of California public schools (K–12), community colleges and state-owned or state-leased essential services buildings. This IR indicates an acceptable method for achieving compliance with applicable codes and regulations, although other methods proposed by design professionals may be considered by DSA.

This IR is subject to revision at any time. Please check DSA's website for currently effective IRs. Only IRs listed on the webpage at www.dgs.ca.gov/dsa/publications at the time of project application submittal to DSA are considered applicable.