
HIGH STRENGTH BOLTING INSPECTION

IR 17-9

References:

- California Code of Regulations (CCR), Title 24
- Part 1, California Administrative Code, Section 4-333
- Part 2, 2007/2010 California Building Code (CBC), Section 1704A.3.3,
Table 1704A.3, Item 2
- DSA IR 17-8 "Sampling and Testing of High Strength Bolts, Nuts, and Washers"

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Discipline: Structural

This Interpretation of Regulations (IR) is intended for use by the Division of the State Architect (DSA) staff, and as a resource for design professionals, to promote more uniform statewide criteria for plan review and construction inspection of projects within the jurisdiction of DSA which includes State of California public elementary and secondary schools (grade 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 reviewed on a regular basis and is subject to revision at any time. Please check the DSA web site for currently effective IRs. Only IRs listed in the document at <http://www.dgs.ca.gov/dsa/Resources/IRManual.aspx> at the time of plan submittal to DSA are considered applicable.

Purpose: The purpose of this Interpretation of Regulations (IR) is to clarify the minimum requirements and responsibilities of special inspectors performing high strength bolting (HSB) special inspection.

Scope: This IR is applicable to both shop and field bolting activities.

Foundation anchor bolts are outside the scope of this IR.

Background: The California Building Code (CBC) requires testing of High Strength Bolts (HSB) and either periodic or continuous special inspection of HSB operations. Refer to DSA IR 17-8 for requirements for HSB sampling and testing. Inspection of the installation and tightening of all HSBs shall be conducted in accordance with ANSI/AISC 341.

1. Qualifications: Special inspectors conducting bolting inspection shall meet the following minimum requirements:

- 1.1** Have valid certification as a Structural Steel and Bolting Special Inspector by the International Code Council (ICC),
- 1.2** Be not less than 25 years of age, and
- 1.3** Possess knowledge of the administrative requirements of Title 24 Part 1, HSB requirements of Title 24, Part 2, and AISC specifications.

2. Approval: DSA approval of a HSB special inspector may be required for a project prior to performing any HSB work in accordance with Section 4-333(c) of Title 24, Part 1. To be approved for a project, the HSB special inspector may be required to demonstrate the following to the satisfaction of DSA:

- 2.1** The minimum requirements defined in Section 1 above,
- 2.2** At least 3 years experience in construction or inspection work on projects similar to the project for which the inspector is applying, and
- 2.3** That adequate time and attention will be provided to the project.

3. Inspection Duties for All HSB Installation Techniques:

- 3.1** Review and understand the applicable portions of the DSA approved plans, specifications, change orders and other DSA approved documents. Approved 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).
- 3.2** Review manufacturer's material test reports for conformance with documents listed in Paragraph 3.1 above.
- 3.3** Conduct material identification for all bolting materials, which includes but is not limited to markings and condition. Bolts, nuts, and washers must be in containers sealed by the manufacturer with accompanying mill test reports at the time of the inspection to be considered identifiable.
- 3.4** Verify that the all bolts, nuts and washers are sampled and tested as required by the California Building Code (CBC), and IR 17-8 "Sampling and Testing High Strength Bolts, Nuts and Washers."
- 3.5** Visually inspect all sampled fastener assemblies for proper markings, condition and manufacturer's defects (e.g.: "head burst").
- 3.6** Verify that all bolting material is stored in suitable containers, protected from dirt, 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 suitable containers. Bolting materials shall also be controlled so that used, rejected, or unidentified materials are not mixed with identified materials.
- 3.7** Visually inspect the surface conditions of the bolts, nuts, and washers.
- 3.8** Verify that all applicable bolt installation procedures and manufacturer's instructions are available on the project site; and that they are current and accurate.
- 3.9** Verify that all bolt installers are familiar with the requirements and are able to install bolts in accordance with the accepted procedures.
- 3.10** Inspect the condition of bolted joints prior to assembly; verify bolt hole size and condition, bolt diameter and shank lengths. Check holes for unfair reaming, flame cutting, or slotting.
- 3.11** Verify that all bolts have been installed.
- 3.12** 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.
- 3.13** Mark completed joints that have been inspected and accepted with a distinguishing mark. The mark shall include: Testing laboratory initials (if applicable), 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 standards.
- 4.2 Verify that faying surface requirements are met for 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 load indicating device (e.g., Skidmore-Wilhelm) is currently calibrated.
- 4.4 Additional requirements apply to the following tightening methods:

4.4.1 "Turn-of-the-Nut" Method:

- After all bolts have been brought to the "snug-tight" condition in accordance with Section 3.12, 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 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" Bolts:

- Tightening to the snug tight condition, tightening to the final pretensioned condition, and shearing the break neck shall be accomplished in three 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 break neck of one bolt is sheared prior to obtaining the final pretension in all bolts in the connection that bolt shall be removed and replaced.
- Fastener 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 Tightening:

- 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 and progressing systematically to the free edges until the torque for all bolts reaches the calibrated torque. Several tightening cycles may be needed.

4.4.4 Direct Tension Indicators (DTI):

- In addition to the requirements of Section 6.4, "direct tension indicators" shall be included in the bolts 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 3.12, 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 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 and proceeding to the free edges, until the final specified gap is obtained for all bolts.

5. Galvanized Fasteners: Only ASTM A 325 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 bolts are not permitted to be reused;

- ASTM A 490
- ASTM A 325 Galvanized

7. Reporting: Provide detailed special inspection reports to the project inspector on a daily basis.

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.

7.2 Inspection reports must state that the work was inspected in accordance with, and met the requirements of, the DSA approved documents. Reports must be submitted as required by Title 24, Part 1, Section 4-333(c). A special inspection report form ([DSA-250](#)) is available on the DSA web site.

7.3 Reports shall also be presented to the project inspector on a daily basis. Copies of the daily reports shall be sent to the school district and the architect, structural engineer, project inspector, and DSA within 14 days of the date of the inspection. Reports indicating non-compliance shall be submitted immediately.

7.4 At the conclusion of the work, the high strength bolting inspector is required to sign and submit a verified report. The verified report shall be made on form ([DSA-292](#)) available on the DSA website. The report shall include the special inspector's ICC Structural Steel and Bolting Special Inspector certification number.

8. Failure to Perform: Failure to inspect 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 DSA acceptance or approval. This includes but is not limited to withdrawal of acceptance or approval to work on any current or future projects under DSA jurisdiction.