Chapter 11 - Bolting

- Certification Requirements
- Testing Requirements
- Bolt Placement and Connection
- Inspection
Certification Requirements

Certification.

(a) **A-325 and A-490 High-Strength Bolt Assemblies** used on steel girder or truss bridges.
   A certified copy of the mill test report.

(b) **All other bolt assemblies** [A-307 excluding Guardrail Bolts, Eye Bolts, Ribbed and Unfinished, A-449, F-1554 and A-325/A-490 materials not covered by the provisions in (a) above].
   A certified copy of the mill test report.
## Certified Mill Test Report Requirements

<table>
<thead>
<tr>
<th>Test</th>
<th>A325</th>
<th>A449</th>
<th>A307</th>
<th>A687</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Analysis</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Hardness Test</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Tensile Strength (* by Wedge Test Method)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Proof Load Test</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Rotational Capacity Test</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charpy V-Notch</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
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</tbody>
</table>

*Certified Mill Test Report shall state that Wedge Test Method was used (For ASTM A307 and A449 bolts the Wedge Test Method is required only for square and hexagon head bolts. Wedge Test Method not required for ASTM A687. See appropriate specifications).*

*Proof Load Test and/or Yield Test as allowed or specified by the applicable ASTM Specification.

*Rotational Capacity Test required for Zinc Coating (Galvanized) bolts only. This test shall be conducted using the actual nuts that are used on the project.*

*The requirements set forth in this table are to alert the Contractor to the requirements for testing and certification as specified in the applicable ASTM Specifications and are not intended to alter the requirements of the specification.*
LOT #: 032655  pg.1 of 1

TEST REPORT

PRODUCTION INFORMATION:

PART #: AAA075200
SIZE: 3/4(10)UNC2AX2
LOT #: 032655
DESCRIPTION: HHS
ASTM SPEC: A325-1 10
MFG DATE: 6/02/11
FINISH: PLAIN

CHEMISTRY FROM RAW MATERIAL SUPPLIER:

GRADE: 1045  HEAT NO: 20102490  ASTM SPEC: A-29  STEEL MILL SUPPLIER: BETA

<table>
<thead>
<tr>
<th>C</th>
<th>Mn</th>
<th>P</th>
<th>S</th>
<th>Si</th>
<th>Ni</th>
<th>Cr</th>
<th>Mo</th>
<th>Cu</th>
<th>Sn</th>
<th>Al</th>
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<tr>
<td>0.46</td>
<td>0.70</td>
<td>0.0100</td>
<td>0.0070</td>
<td>0.20</td>
<td>0.05</td>
<td>0.20</td>
<td>0.010</td>
<td>0.11</td>
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<td>0.0050</td>
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MECHANICAL PROPERTIES:

PRODUCTION QTY 59,820
PCS SAMPLED 8
ISSUE DATE 5/13/11
SAMPLED BY RC
TESTED BY RC
H.T. P.O. 1022780-01
TEST METHODS ASTM F606
VISUAL INSPECTION PER ASTM F701
PCS SAMPLED 8
LOT PASSED PASSED

TENSILE STRENGTH

<table>
<thead>
<tr>
<th>WEDGE 6 DEGREE</th>
<th>PROOF LOADING</th>
<th>HARDNESS</th>
</tr>
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<tbody>
<tr>
<td>LBS. 40,100</td>
<td>LBS. 28,400</td>
<td>SURFACE 31</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Samples</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>AVG.</th>
</tr>
</thead>
<tbody>
<tr>
<td>TENSILE LOAD</td>
<td>47,900</td>
<td>47,500</td>
<td>48,000</td>
<td>47,900</td>
<td>47,100</td>
<td>47,400</td>
<td>47,900</td>
<td>47,100</td>
<td>47,500</td>
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<tr>
<td>PROOF LOAD STRETCHMENT</td>
<td>.0000</td>
<td>.0000</td>
<td>.0002</td>
<td>.0000</td>
<td>.0001</td>
<td>.0000</td>
<td>.0000</td>
<td>.0001</td>
<td>.0000</td>
</tr>
<tr>
<td>HRC-SURF</td>
<td>39.7</td>
<td>39.7</td>
<td>39.8</td>
<td>31.5</td>
<td>30.6</td>
<td>31.0</td>
<td>31.7</td>
<td>30.8</td>
<td>31.5</td>
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<tr>
<td>HRC-CORE</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
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</tbody>
</table>

The SLSL LLC Laboratory has been accredited by the American Association for Laboratory Accreditation in accordance with the standards of the International Laboratory Accreditation Committee (ILAC). The test certificate meets or exceeds all relevant standards for testing laboratories. The sample size is based on the requirements of the ASTM specification used in the test. The data is a true representation of the material provided by the supplier and tested according to the specified standards. This test certificate is issued only to the parts listed on the document and may not be reproduced or distributed except in full. Thread style and dimensional requirements are complied with ASME B18.2.1 specifications.

MANUFACTURERS ID head marking: SL

AMENDED **

DATE: 5/13/11
INITIAL:

*Hearts of steel used have not had the following materials intentionally added: Bismuth, selenium, Tellurium, or Lead.

** Indicates the modified item, when and by whom.
Rotational Capacity Test Certificate

<table>
<thead>
<tr>
<th>Rotational Capacity Lot Number</th>
<th>Test Method</th>
<th>Test Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>DHG60666</td>
<td>FHWA</td>
<td>8/15/2010</td>
</tr>
</tbody>
</table>

**Test Equipment:**
- Model MS Skidmore
- Model#8726134 Torque Wrench

<table>
<thead>
<tr>
<th>Serial Number</th>
<th>Calibration Date</th>
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<tbody>
<tr>
<td>10668</td>
<td>6/1/2016</td>
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</table>

<table>
<thead>
<tr>
<th>Component Size and Description</th>
<th>Lot/</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4-10 x 2 1/4</td>
<td>270928AZ</td>
</tr>
<tr>
<td>3/4-10</td>
<td>PM871</td>
</tr>
<tr>
<td>3/8</td>
<td>C2656M</td>
</tr>
</tbody>
</table>

**Test Data - Minimum Installion Tension**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Fastener Tension (lbs.)</th>
<th>Torque (ft-lbs.)</th>
<th>Maximum Allowable Torque (ft-lbs.)</th>
<th>Pass / Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>28,000</td>
<td>230</td>
<td>437</td>
<td>Pass</td>
</tr>
<tr>
<td>2</td>
<td>28,000</td>
<td>200</td>
<td>437</td>
<td>Pass</td>
</tr>
</tbody>
</table>

**Test Data - Full Rotation**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Degrees of Rotation</th>
<th>Fastener Tension (lbs.)</th>
<th>Minimum Required</th>
<th>Pass / Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>240</td>
<td>36,000</td>
<td>32,000</td>
<td>Pass</td>
</tr>
<tr>
<td>2</td>
<td>240</td>
<td>38,000</td>
<td>32,000</td>
<td>Pass</td>
</tr>
</tbody>
</table>

We hereby certify that the product manufactured by LeJeune Bolt Company was fabricated, sampled, tested, and inspected in accordance with the standards and specifications stated above in effect as of the date of manufacture. The above data represents minimum values provided by LeJeune Bolt Company's suppliers which were generated in LeJeune Bolt Company's laboratory. This certified material test report relates only to the items listed on this document and may not be reproduced except in full.

Chief of Quality Assurance

[Signature]

[Date: 01-05-03]
Testing Requirements

Two classes of bolts:

Acceptance.
(a) A-325 and A-490 High-Strength Bolt Assemblies used on steel girder or truss bridges.

Documented measurements and visual inspection.

I. Rotational Capacity.

II. Direct Tension Indicator (DTI).

(b) All other bolt assemblies

Documented measurements and visual inspection.
High Strength Bolt Assemblies
A325 or A490 Bolts

- Used in friction type connections
- Bolts are tightened to a high tension, producing clamping forces which enable the steel surfaces to carry loads by friction
High Strength Bolt Assemblies
A325 or A490 Bolts

- Rotational Capacity Test
  - Checks lubrication of nut and threads of bolt for proper tension
  - 3 each - bolt/nut/washer
High Strength Bolt Assemblies
A325 or A490 Bolts

- Direct Tension Indicator (DTI) Test
  - Verifies the DTI
    - Dimples on DTI must be squished within a specified range of tension
  - 3 each - bolt/nut/washer/DTI (if bolt length is 4” or larger)
  - 6 each - bolt/nut/washer/DTI (if bolt length is less than 4”)
    - The additional 3 bolts are 4” or longer
Direct Tension Indicators

- Hardened washer with protrusions
- Placed under the bolt head
- Protrusions are flattened when bolt is tightened
- Marked for use with A325 or A490 bolts
Bolt Placement and Connection

Bolt Length

- Grip
- Washer face
- Hex head
- Length
- Thread
- Hex nut
- Dia.
Bolt Placement and Connection

**Bolt Length**

Bolt Length = Connection plate thickness (grip) + thickness of nut (same as bolt diameter) + thread projection (1/4”) + thickness of washer(s) + thickness of DTI

**Example:** Two ½” plates connected using a ¾” bolt diameter with washer and DTI

\[
= (\frac{1}{2}” + \frac{1}{2}”) + (\frac{3}{4}” + \frac{1}{4}”) + 3/16” + 1/8” = 2 \frac{5}{16}” \text{ or } 2 \frac{1}{2}”
\]

grip nut & thread washer DTI round up to nearest ¼”
Bolt Placement and Connection

Bolt Length

**Figure 11.3** Bolt Length

<table>
<thead>
<tr>
<th>Bolt Diameter Size</th>
<th>Length to Add</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/8”</td>
<td>7/8”</td>
</tr>
<tr>
<td>3/4”</td>
<td>1”</td>
</tr>
<tr>
<td>7/8”</td>
<td>1 1/8”</td>
</tr>
<tr>
<td>1”</td>
<td>1 1/4”</td>
</tr>
</tbody>
</table>

*Add to the grip to determine total bolt length required.

**Figure 11.4** Thickness of Washers

<table>
<thead>
<tr>
<th>Washer Type</th>
<th>*Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat Washer</td>
<td>3’1/16’</td>
</tr>
<tr>
<td>Beveled Washer</td>
<td>5’1/16’</td>
</tr>
<tr>
<td>Direct Tension Indicator (DTI)</td>
<td>1/8’</td>
</tr>
</tbody>
</table>

*Add to the grip to determine total bolt length required.
Bolt Placement and Connection
Connected Plates

- Clean and Free of any materials that could compromise the connection
  - Dirt
  - Burrs
  - Oil
  - Paint (except shop applied primer)
  - galvanizing
Bolt Placement and Connection

- Bolt heads are showing in conspicuous or visible locations
  - Flange Splice - Bolts placed with head down
  - Web Splice - Bolts placed with head to exterior face of girders

- Bolt tightening shall progress from the inside of the connection to the outside
Turn-of-Nut Installation Method

- Hardened washers are not required
- The nut shall first be snug tightened
- The nut shall then be rotated to amount given in the table, depending on bolt length
# Turn-of-Nut Installation Method

## Nut Rotation from Snugged Condition (a,b)

<table>
<thead>
<tr>
<th>Geometry of Outer Faces of Bolted Parts</th>
<th>Up to and including 4 diameters</th>
<th>Over 4 diameters but not exceeding 8 diameters</th>
<th>Over 8 diameters but not exceeding 12 diameters (c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both Faces Normal to Bolt Axis</td>
<td>1/3 turn</td>
<td>1/2 turn</td>
<td>2/3 turn</td>
</tr>
<tr>
<td>One Face Normal to Bolt Axis and Other Face Sloped Not More Than 1:20, Bevel Washer Not Used</td>
<td>1/2 turn</td>
<td>2/3 turn</td>
<td>5/6 turn</td>
</tr>
<tr>
<td>Both Faces Sloped Not More Than 1:20 From Normal to Bolt Axis, Bevel Washers Not Used</td>
<td>2/3 turn</td>
<td>5/6 turn</td>
<td>1 turn</td>
</tr>
</tbody>
</table>

- **a** Nut rotation is relative to bolt, regardless of the element (nut or bolt) being turned. For bolts installed by 1/2 turn and less, the tolerance should be plus or minus 30 degrees; for bolts installed by 2/3 turn and more, the tolerance should be plus or minus 45 degrees.

- **b** Applicable only to connections in which all material within grip of the bolt is steel.

- **c** No research work has been performed by the Research Council Riveted and Bolted Structural Joints to establish the turn-of-nut procedure when bolt lengths exceed 12 diameters. Therefore, the required rotation must be determined by actual tests in a suitable tension device simulating the actual conditions.
**Inspection DTIs**

- Use a 0.005” feeler gage.

- Contractor shall check sufficient number of bolts in each joint to insure proper tension.

- SDDOT inspector shall Check a minimum of 20% of bolts in each joint, with a minimum of 4 in each joint.

- Half of the gaps must be refused with the feeler gage to be ok, but still must have at least one visible gap left.
Inspection
Other Items to consider

- Use new bolt each time
  - Once bolt is at full tension it can not be reused again
  - If it needs to be loosened the bolt should be discarded

- Make sure washer does not turn

- Tighten bolts within 10 second if using an impact wrench

- Anchor bolts require rolled threads (not cut threads)