Steel Quiz, a monthly feature in *Modern Steel Construction*, allows you to test your knowledge of steel design and construction. All references to LRFD specifications pertain to the 1999 *LRFD Specification for Structural Steel Buildings*, available as a free download at

www.aisc.org/lrfdspec

ASD references pertain to the 1989 *ASD Specification for Structural Steel Buildings*. Where appropriate, other industry standards are also referenced.

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This month's *Steel Quiz* on bolting was written by Brian Dekker, intern to the Steel Solutions Center. Note that the 2000 *RCSC Specification for Structural Joints Using ASTM A325 or A490 Bolts* is available for free download at www.boltcouncil.org.

QUESTIONS

1. Which bolts can be galvanized?
   a. ASTM A325
   b. ASTM A490
   c. Both A325 and A490
   d. Neither A325 nor A490

2. What needs to be done to keep nuts from loosening in a pretensioned joint?
   a. Use lock washers
   b. Use a jam nut
   c. Tack-weld the nut to the bolt
   d. Nothing

3. True or False: When using a galvanized bolt in a standard hole, the hole must be $^{3}/_{32}$" larger than the bolt instead of the standard $^{1}/_{16}$".

4. True or False: Slip critical connections must be designed for bearing.

5. True or False: The tension in a pretensioned bolt lowers the shear strength of that bolt.

6. True or False: A high-strength bolt must extend $^{1}/_{2}$" past the end of the nut to ensure full thread engagement.

7. What is the correct torque to pretension a 3", $^{3}/_{4}$" diameter ASTM A325 bolt?
   a. 5 ft-lb
   b. 50 ft-lb
   c. 500 ft-lb
   d. Torque varies and is not a suitable measure of pretension

8. True or False: When using a calibrated wrench to pretension a bolt, an ASTM F436 washer is required under the turned element.

9. If a galvanized faying surface is roughened by hand wire brushing, what slip class does the surface meet?
   a. Class A
   b. Class B
   c. Class C
   d. None of the above

10. True or False: When using a direct-tension indicator (DTI) under the nut, and you are turning the nut, there should be a flat washer between the nut and DTI.

TURN PAGE FOR ANSWERS

STEEL QUIZ

ANSWERS

1. **a.** Only A325 bolts may be galvanized. As described in Section 2.2 of the 2000 *RCSC Specification*, "ASTM Specifications permit the galvanizing of ASTM A325 bolts but not ASTM A490 bolts. Similarly, the application of zinc to ASTM A490 bolts by metallizing or mechanical coating is not permitted because the effect of mechanical galvanizing on embrittlement and delayed cracking of ASTM A490 bolts has not been fully investigated to date."

2. **d.** When properly installed, a nut on a pretensioned bolt will not loosen. No special procedures are required.

3. **False.** There are no provisions that allow for a hole larger than the clearances (hole sizes) shown in Table 3.1 of the 2000 *RCSC Specification for Structural Joints Using ASTM A325 or A490 Bolts.*

4. **True.** Slip critical connections are designed to resist slip under service loads. Unfortunately, one cannot assume that the connection will never slip into bearing. For this reason, bearing strength (and other bearing limit states) must be considered.

5. **False.** Shear strength is independent of the pretension induced in the bolt. See *RCSC Specification* Section 5.1.

6. **False.** As stated in the 2000 *RCSC Specification* Section 2.3.2, "The bolt length used shall be such that the end of the bolt extends beyond or is at least flush with the outer face of the nut when properly installed." No extension is required for proper performance.

7. **d.** Torque cannot be used to measure the pretension in a bolt unless it is calibrated (as for the calibrated wrench method). Depending on the conditions of the threads and surfaces in contact between the nut and washer/steel, for a given torque, pretension can vary up to 40%. For example, well-lubricated bolts require much less torque to obtain the pretension compared to rusted, dirty, or poorly lubricated bolts.

8. **True.** See the 2000 *RCSC Specification* Section 6.2.2.

9. **c.** See Section 3.2.2(c) of the 2000 *RCSC Specification*.

10. **True.** As shown in Figure C-8.1 of the 2000 *RCSC Specification*, there should be an ASTM F436 washer between the nut and the DTI. This ensures that the nut will not damage the DTI as it is turned, and the DTI will have a more uniform compressive force applied.