

steel quiz

LOOKING FOR A CHALLENGE? *Modern Steel Construction's* monthly Steel Quiz tests your knowledge of steel design and construction. The answers for many of this month's questions can be found in the 2005 AISC *Specification for Structural Steel Buildings*, the 2010 AISC *Code of Standard Practice for Steel Buildings and Bridges* (both available as free downloads at www.aisc.org/freepubs), and the 13th Edition AISC *Steel Construction Manual* (available for purchase at www.aisc.org/manual).

- 1 True/False: After galvanizing, it is standard practice to increase the bolt hole size for the connection.
- 2 Where are the tolerances found for welded stiffener locations in buildings?
 - a) AISC *Code of Standard Practice*
 - b) AISC *Specification*
 - c) AWS D1.1
 - d) AWS D1.5
- 3 True/False: More than one filler can be used to account for gaps between connection plies.
- 4 True/False: The "building line" referenced in Section 7 of the AISC *Code of Standard Practice* is the exterior face of the building.
- 5 What is the minimum radius for induced camber of a member?
 - a) There are no limits.
 - b) The limit depends on the bender.
 - c) Between 10 and 14 times the member depth is recommended as a guide.
 - d) Both (b) and (c).
- 6 Straightness tolerances for the usual grade of HSS are governed by which ASTM standard(s)?
 - a) ASTM A500
 - b) ASTM A501
 - c) ASTM A6
 - d) ASTM A6 and A500
- 7 True/False: Fabrication tolerances for member camber and sweep of typical wide-flange shapes are shown in Table 2 of ASTM A6.
- 8 What is the plumbness tolerance for a typical structural steel column?
 - a) $L/400$
 - b) $L/500$
 - c) $L/600$
 - d) There are no published plumbness tolerances.
- 9 What is the tolerance for fit up of backup bars?
 - a) $1/8$ in.
 - b) $1/16$ in.
 - c) $3/32$ in.
 - d) None of the above.
- 10 An engineer designing with structural steel must account for what types of tolerances in their design?
 - a) Mill tolerance.
 - b) Fabrication tolerance.
 - c) Erection tolerance.
 - d) All of the above.

- 1 False. Enlarging the holes is not standard procedure and is not required in the usual case. If it is desired to do so, the resulting holes must be approved by the Structural Engineer of Record. The hole becomes an oversized hole after modification, and the change would have to be considered. Increasing the hole size for galvanized construction is not permitted in the AISC *Specification* or the RCSC *Specification for Structural Joints Using High-Strength Bolts* (available as a free download at www.boltcouncil.org). If the holes are oversized the connection must be designed as slip-critical.
- 2 (c) AWS D1.1 provides the guidelines for stiffener tolerances in buildings; see Sections 5.23.11 and 5.23.12. AWS D1.5 has the guidelines for stiffener tolerances in bridges; see Section 3.5.1.11 and 3.5.1.12.
- 3 True. More than one filler can be used, but note that the use of multiple fillers requires a strength reduction. Recent research has shown that the overall slip resistance of a connection can be reduced by the presence of multiple fillers. The 2010 AISC *Specification* will require that where bolts have not been added to distribute the load in the filler (undeveloped fillers), the full slip resistance can be used if there is one filler between connected parts. However, for two or more fillers between connected parts a 15% reduction in slip resistance is taken.
- 4 True. The AISC *Code of Standard Practice for Steel Buildings and Bridges* references "building line" in Sections 7.13.1.1 (b), (c), and (d), and Figures C-7.2, C-7.5 and C-7.6. The building line referenced in these sections is the established location of the exterior face of the building. For example, in Figure C-7.5 an exterior column for a building of 20 stories or less may slope toward the building line or exterior face of the building by up to $\frac{1}{500}$ slope or 1 in. maximum. Figure C-7.2 shows this as well since the building line wraps around the columns at the exterior building face.
- 5 (d) Limits on radii of curved shapes are essentially a function of the capabilities of the bender. Cold bending guidelines for shapes are found in Part 2 of the 13th Edition AISC *Steel Construction Manual*. They are summarized below:
1. The minimum radius for camber induced by cold bending in members up to a nominal depth of 30 in. is between 10 and 14 times the depth of the member. Deeper members may require a larger minimum radius.
 2. Cold bending may be used to provide sweep in members to practically any radius desired.
 3. A length limit of 40 to 50 ft is practical.
- 6 (a) Tolerances for HSS are found in their respective ASTM material specifications. For example, ASTM A500 is the material specification for non-weathering, cold-formed HSS. You can find a summary of these requirements in Tables 1-27 and 1-28 of the 13th Edition AISC *Steel Construction Manual*.
- 7 False. ASTM A6 tolerances are for incidental mill camber. Small amounts of incidental mill camber are common and do not typically cause problems in construction. The tolerances specified in Section 6 of the AISC *Code of Standard Practice* apply to fabricator "induced" camber.
- 8 (b) Erection tolerances are given in Section 7.13 of the AISC *Code of Standard Practice* (a free download at www.aisc.org/freepubs). Section 7.13.1.1 deals specifically with column plumbness. In general, the plumbness must be within $L/500$. However, there are other requirements that can govern in specific cases, see the AISC *Code*.
- 9 (b) The 2008 AASHTO/AWS D1.5M/D1.5 *Bridge Welding Code* has a tolerance for steel backing. Section 3.13.5, Weld Backing, states the following:
- Steel backing shall be placed and held in intimate contact with the base metal. The maximum gap between the steel backing and the base metal at the weld root shall be 2 mm [$\frac{1}{16}$ in.]...*
- The $\frac{1}{16}$ -in. tolerance is also present in butt joints where backing is used in Section 5.22.1.1 in AWS D1.1/D1.1M *Structural Welding Code—Steel*. Section 5.22.1.1, Faying Surface, states the following:
- The separation between faying surfaces of plug and slot welds, and of butt joints landing on a backing, shall not exceed $\frac{1}{16}$ in. [2mm]...*
- Both AWS D1.5 and D1.1 are available for purchase on the American Welding Society website, www.aws.org.
- 10 (d) An engineer designing with structural steel must account for all of these types of tolerances.



Anyone is welcome to submit questions and answers for Steel Quiz. If you are interested in submitting one question or an entire quiz, contact AISC's Steel Solutions Center at 866.ASK.AISC or at solutions@aisc.org.