

Bolt Spec Preview

by Tom Schlafly

Changes in the next edition of RCSC's bolting specification clarify some finer points of washer usage.

The Research Council on Structural Connections (RCSC) recently voted to include several changes in the *Specification for Structural Joints Using ASTM A325 or A490 Bolts* (also known as the "bolt spec"). RCSC will issue a revised document dated June 30, 2004, and AISC plans to incorporate the revised specification in the next *Manual of Steel Construction* when it is published in 2005. While the amendments will not create major changes to bolted connections, they will clarify a few key points. One change simply emphasizes a current requirement, and several others provide options to fabricators and erectors when $\frac{5}{16}$ " ASTM F436 washers, or hardened plates/bars are not readily available.

Slip Critical Connection Clarification

RCSC felt it was necessary to clarify the requirement that slip critical connections be designed to meet the strength requirements as shear/bearing joints (Sections 5.1, 5.2 and 5.3). These requirements are in addition to meeting the slip resistance requirements in Section 5.4. The requirement is not a new one, but it seemed to require additional emphasis. The shear/bearing limits are checked in slip critical joints because the joints may slip at or near the factored load. In some cases with class B or C faying surfaces, the shear/bearing strength may be less than the slip-critical strength. Under these conditions, the connection must be designed for the shear/bearing strength. Meeting these requirements provides the strength limit reliability for slip critical joints.

Revised Washer Requirements in Table 6.1

For many years, the bolt spec has required washers that are $\frac{5}{16}$ "-thick and hardened in accordance with ASTM F436 where pretensioned ASTM A490 bolts

greater than 1" diameter are used in oversized holes or slots in the outer ply. Similarly, bolted connections with long slots in the outer ply required $\frac{5}{16}$ "-thick hardened plate washers or hardened continuous bars. These requirements were in place because research showed normal washers deformed under the high loads generated by tightening ASTM A490 bolts. This, in turn, made achieving the requisite pretension difficult. The footnotes to the table clearly prohibited the use of multiple thicknesses of standard thickness ASTM F436 washers.

While the provision has been in place for many years, conditions demanding them are not frequent. Therefore, the hardened, thick washers and hardened plates/bars have not always been readily available. Recognizing the difficulty of obtaining these washers, the RCSC has added alternatives to $\frac{5}{16}$ " hardened washers, hardened plate washers and hardened bars. In connections with long-slotted holes in the outer ply and using ASTM A490 bolts, the revised bolt spec will permit an ASTM F436 washer of

standard thickness with a $\frac{3}{8}$ " structural grade plate washer. It will also permit an ASTM F436 washer with a structural grade $\frac{3}{8}$ "-thick continuous bar. Connections with oversized or short-slotted holes in the outer ply using ASTM A490 bolts can now use either ASTM F436 hardened washers $\frac{5}{16}$ "-thick, as before, or a $\frac{3}{8}$ "-thick plate washer and an ordinary thickness ASTM F436 washer. A form of the revised table appears below.

Where ASTM A490 bolts are pretensioned in connections and the connected material has yield strength less than 40 ksi (usually ASTM A36), the existing bolt spec requires washers under the head and nut to prevent galling of the connected material. The requirement for the washer under the head is waived when twist-off bolts with bearing diameters under the head equal to or greater than the diameter of an ASTM F436 washer are used. Recent research indicates that this exception is also valid for all twist-off bolts with a bearing circle diameter meeting the requirements of ASTM F1852. (Schnupp, K.O., and T.M. Murray,

Table 6.1 Washer Requirements for Bolted Joints with Oversized and Slotted Holes in the Outer Ply

ASTM Designation	Nominal Bolt Diameter, d_b , in.	Hole Type in Outer Ply		
		Oversized	Short-Slotted	Long-Slotted
A325 or F1852	$\frac{1}{2} - 1\frac{1}{2}$	ASTM F436 ^a		$\frac{5}{16}$ "-thick plate washer or continuous bar ^{b, c}
A490	≤ 1	ASTM F436 ^a		$\frac{5}{16}$ "-thick plate washer or continuous bar ^{b, c}
	> 1	ASTM F436 with $\frac{5}{16}$ " thickness ^{b, d}		ASTM F436 washer with either a $\frac{3}{8}$ "-thick structural grade plate washer or continuous bar ^b

^a This requirement shall not apply to heads of round head tension-control bolt assemblies meeting the requirements in Section 2.7 and providing a bearing circle diameter meeting the requirements of ASTM F1852.

^b Multiple washers with a combined thickness of $\frac{5}{16}$ " or larger do not satisfy this requirement.

^c The plate washer or bar shall be of structural-grade steel material but need not be hardened.

^d Alternatively, a $\frac{3}{8}$ "-thick plate washer and an ordinary thickness F436 washer may be used. The plate washer need not be hardened.

“Effects of Head Size on the Performance of Twist-Off Bolts,” Virginia Polytechnic Institute and State University, CC/VTI-ST 03/09, July 2003.) In other words, twist-off bolts with the smaller head diameter may be used without a washer under the head.

Further changes are under consideration by RCSC, particularly with regard to slip critical design strength, the use of bolts with welds, the treatment of thick fills in slip-critical connections and the nominal strength of a bolt in shear with threads included in the shear plane. RCSC’s current revisions to the bolt spec, however, will not change the number or size of bolts required in a connection if it was designed properly using the provisions of the 2000 edition. Nevertheless, the exception to the washer requirements may make life a little easier for fabricators and erectors. ★

Tom Schlafly is director of research for the American Institute of Steel Construction, Inc., and is also a member of the RCSC.