

## BOLTING STANDARDS UPDATE

A look at recent additions and updates to industry standards for structural bolts.

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**MSC ASKED A HANDFUL OF BOLTING EXPERTS** to comment on recent changes in fastener standards and how they will affect the steel industry. Here's what we found.

### ASTM A307

**Lindsay:** One recent change that will have a significant impact on the construction fastener industry is the 2007 elimination of the grade C designation within the ASTM A307 specification. ASTM A307 is the standard specification for low-carbon steel construction fasteners. Until recently, A307 had three grades: A, B, and C. Grade A covers bolts for general applications, grade B covers heavy hex bolts and studs for cast iron flanges, and grade C covered unheaded threaded rods, either bent or straight, intended for structural anchorage purposes. Last year's elimination of A307 grade C is the result of a virtually identical specification: F1554 grade 36. Developed in 1994, this specification replaces A307 grade C. It has taken structural engineers many years to become familiar with the F1554 specification, but now as F1554 grade 36 has become more commonplace, ASTM didn't see the need to have two specifications that covered the same item and thus eliminated the grade C designation of ASTM A307.

Although A307 grade C and F1554 grade 36 are virtually identical, there are some subtle yet very important differences. The ASTM F1554 specification was introduced in 1994 and covers anchor rods<sup>†</sup> designed to anchor structural supports to concrete foundations. There are three grades—36, 55, and 105—with the grade corresponding to the minimum yield strength of the anchor rod. F1554 grade 36 is manufactured from low-carbon steel

just like ASTM A307 grade C was. But in addition to being a bent or straight anchor rod, it can also be a headed bolt that is embedded in concrete and used for anchoring purposes.

There are also some important differences with regard to mechanical values of both specifications, with F1554 grade 36 possessing more stringent requirements than ASTM A307 grade C. Most commercially available all-thread rod that meets ASTM A307 and is used for anchor rods will not meet ASTM F1554 grade 36.

Additionally, imported hex bolts that meet A307 and are commonly embedded in concrete and used as anchor rods will also not meet F1554 grade 36. However, many fastener distributors, and even some manufacturers who do not have a thorough understanding of the differences between ASTM A307 grade C and F1554 grade 36, continue to provide A307 bolts, believing they will cross-certify to ASTM F1554 grade 36, which is simply not the case in most instances. This practice, which has become commonplace in our industry, is exposing contractors to a significant amount of liability, since contractors rely on fastener companies to have a thorough comprehension of the ASTM specifications and provide products that meet all requirements of the ASTM F1554 grade 36 specification. This is also a continued source of frustration for Portland Bolt, since we routinely compete against companies substituting less expensive and readily available imported items that simply do not meet the requirements of ASTM F1554 grade 36.

### ASTM A490

**Hamilton:** The ASTM A490 specification was just revised in the online version in February of this year. This -08a revision



An ASTM A325 bolt.

Nucor Fastener

allows ASTM F1136 Grade 3 to be applied to A490 bolts. This is the first coating that has been allowed by the ASTM standard to be pre-applied to A490 bolts prior to installation, so this is a big change in the standard since its creation in 1964. The evaluation and subsequent determination of acceptability of the coating was the result of hydrogen embrittlement research that is currently being supported at McGill University by the RCSC, IFI, CIFI, AESF, Ifastgroupe, the U.S. Navy, Nucor Fastener, and the Boeing Company.

The concept of using any type of electroplating process on A490 structural bolts without having conducted a finish/coating qualification testing process, as outlined in IFI-144 and per the McGill University research project to qualify the ASTM F1136 coating, would be in violation of ASTM A490 (per Section 4.3, Protective Coatings). Consult your fastener manufacturer for further information or to put you in touch with a finish/coating expert if you have specific questions regarding the ASTM F1136 finish/coating.

**Lindsay:** Hot-dip galvanizing does not affect the strength of the ASTM A490 bolt.

<sup>†</sup>Editor's Note: The title of ASTM F1554 is *Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength*. Even though the standard refers to "anchor bolts," AISC uses the term "anchor rods" when referring to materials used to anchor structural supports to concrete foundations—even if those materials have the same appearance as headed bolts. The reason for the distinction is to discourage the inadvertent (and incorrect) application of structural bolt installation and pre-tensioning requirements to foundation connections.

The problem with galvanizing or plating A490 bolts is the potential for hydrogen embrittlement. This scenario may occur when atomic hydrogen is absorbed by the steel during the acid pickling process that takes place prior to galvanizing or plating. This embrittlement can potentially lead to the loss or partial loss of ductility in the steel and consequently result in the premature failure of the fastener in the field.

Common practice in the industry is to bake bolts after plating to reduce the potential embrittlement, but ASTM does not recommend this procedure and simply states that A490 bolts should not be galvanized or electroplated.

A better option to reduce corrosion on an A490 bolt, besides painting them after installation, is to order an ASTM A490 Type 3 in lieu of a standard A490 (Type 1) bolt. The Type 3 version of this specification uses weathering steel, which is naturally corrosion-resistant. The result is a high-strength structural bolt with the same

mechanical properties as a Type 1, but with corrosion-resistant properties.

**Pfeifer:** Following extensive research, conducted according to the IFI-144 test method, the DACROMET finish (the brand name for the finish applied per ASTM F1136) has been added to the A490 specification as an approved finish. At this time, DACROMET is the only finish permitted on A490 bolts. The DACROMET process is non-electrolytic and it is applied via dip-spin or spray application method.

#### **ASTM F2280**

**Hamilton:** ASTM F2280 is also a relatively new standard for twist-off tension-controlled bolt assemblies, having been first approved in 2006. The current revision of the standard is 2008. This standard is the corresponding ASTM A490-strength version of the twist-off tension control assembly, similar to ASTM F1852 (ASTM A325-strength version) that has been around for several years without an

official ASTM standard. Dimensions are covered by the same ASME B18.2.6 standard that defines dimensional requirements for the A325, A490, and F1852 standards. This ensures the user of dimensional uniformity by standard and allows the user to choose their preferred installation method without having to worry if the body length and thread lengths will be different between the hex and tension-controlled products they purchase. **MSC**

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