

# Fastener Answers to Common Questions

## Part 2



by Guy Avellon

Part 1 answered questions about fastener reuse and torque values. Part 2 will cover other areas so that soon, most common fastener questions can be found together. This is because many times we may be at a loss to find the answer, especially a printed answer. Many manufacturers make good products but do not know all of the applications where they are used and may not be able to provide exact answers. The same applies to distributors who may lack the technical expertise to help the customer with basic questions. This series will help all.

### Can I Use Several Flat Washers as a Spacer?

**Yes, but there are a few conditions:**

First, the flat washers must be made of a hardened steel to ASTM F436 specifications. Secondly, the SAE dimensional size of hardened flat washer is preferable due to its closer tolerance inside diameter being able to provide a greater contact surface area for the nut and / or bolt head to seat upon. However, USS dimensioned hardened flat washers may be used against the joint surface as long as the last washer that is against the turned nut or bolt head is of the hardened SAE or F436 dimensions.



## Screw is small, responsibility is big.



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Next, there is a limit on how many washers may be used. Tests were conducted on various fastener dimensions and lengths using a tension testing device to determine how much relaxation would occur if using washers as spacers for a hydrogen embrittlement test. It was found that six flat washers (6) would be the maximum limit before there was excessive relaxation. Four (4) washers were found to be optimum without incurring too much relaxation. However, once tightened, the same tightening torque must be reapplied 60-90 seconds after tightening to allow for the stack to relax. If this is a multiple fastener application in a joint connection, then the torque must be applied in a criss-cross pattern and in increments; such as 70%, 90%, 100%, then 105% of the torque value. This will assure even clamp load with minimal relaxation.

### Can I Use Different Fastener Grades in the Same Connection if I Torque Them All the Same?

**No.**

For example; consider a connection that had a combination of SAE Grade 5 and Grade 8 fasteners, or Class 8.8 and Class 10.9 fasteners, and all the fasteners were torqued to the same torque recommended for the Grade 5. There are many engineers who will argue that since the modulus of elasticity is the same for both the Grade 5 and Grade 8 fasteners, they should both produce the same clamp load. The first part is true; the modulus of elasticity is the same for both steel fasteners. If you stretch the fasteners the same amount in tension, they will produce the same clamp load.

But this is not what happens in reality. The Grade 8 will produce less clamping force than the Grade 5. However, we are not tightening the fasteners by tension; we are tightening them by torque. This changes everything because torque is a function of friction. Because the Grade 8 is much stronger and harder than the Grade 5, it will take more force to cause the Grade 8 to stretch the same distance as the Grade 5. The friction of torque will limit the amount of effort applied to stretch the Grade 8. The same friction is felt with either a torque wrench or the elbow; the force will 'feel' the same applying it to either the Grade 5 or Grade 8 fastener. Therefore, if the fastener is not stretched the same, it will not produce the same clamp load as the other fasteners and the connection is compromised.

Conversely, if the torque for the Grade 8 was applied to the Grade 5, the Grade 5 is either at or beyond its proof load and has been weakened, also compromising the safety of the connection. Therefore, make sure that all of the fasteners in the same joint connection are of the same strength grade.

### Can an SAE Fastener be Used in Place of an ASTM Structural Fastener and Vice-versa?

**Yes, but there are application limitations.**

This question has been asked many times from companies who primarily use ASTM standards and fasteners but want to use SAE fasteners for maintenance because they are less expensive. Sales personnel who don't supply structural fasteners recognize that their customer has a need for the SAE fasteners but are unsure.



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First, there must be an agreement with the user that they acknowledge their buying the SAE fasteners for maintenance use and that the fasteners should be kept separate away from the ASTM fasteners. This is especially true with the ASTM A193-B7 fasteners as these are designated for high temperature usages that SAE fastener grades are not capable of handling.

Secondly, dimensions are different between the two specifications. The ASTM structural bolts (A325 and A490) have a larger head, with increased dimensions across the flats, as they are used many times without a flat washer. Consequently, the matching nuts are also larger across the flats. The structural bolts also have a shorter thread length to assure the full diameter shank is within the shear plane of the connection and not the weaker threads. Therefore, SAE fasteners may be subject to shear if used in a structural application.

Structural bolts begin with nominal diameters of 1/2" and M12. The ASTM A354-BD is directly equivalent to the SAE Grade 8 fastener from 1/4" to 2 1/2" in diameter. An exception for the A354-BD is that all fasteners are made from alloy steels and proof load testing is a requirement in addition to the standard tests. Additionally, the ASTM structural bolts are only made in diameters up to and including 1 1/2" and M36.

Therefore, the SAE style of fastener may be used in any type of application other than structural erections or high temperature boilers and pressure vessels. The assemblies would never pass ASME code inspections. The ASTM fasteners may be used in any other application but may cost more than the standard commodity SAE fastener.

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Be aware of the environmental exposure. The A325 bolts are supplied with a heavy hot dip galvanized coating or a mechanical zinc coating. The A490 bolts are never electro-plated or hot dip galvanized. Dip and spin coatings and mechanical galvanizing processes have been approved. Both structural fasteners are installed into their yield points to attain 100% of their clamp load. This high stress load would exacerbate hydrogen embrittlement of a high strength electroplated fastener.

### Can a Fastener be Reused If It Has been Stretched into Yield?

Most of us do not have to even think twice on this one, regardless if the fastener material is ferrous or non-ferrous; No. However, I'm sure it would do just fine holding a license plate onto a vehicle. Yet there was one person who went beyond this question and asked if there was a computer model that would predict the failure point for x-number of times reusing the fasteners beyond yield. The application was in a nuclear power plant. This is the time to walk away from any more discussions. □