

Fastener Answers to Common Customer Questions Part 3

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Part 1 answered questions regarding Fastener Reuse and Torque Values while Part 2 answered some common questions about using different grades that are not found in any printed form. Being in print and subject to peer review helps validate the answers when providing them to customers, besides being a handy reference source.

When performing plant maintenance or repairing a machine, do I need to replace what was removed with the same style or grade of fastener?

Absolutely!

If for no other reason: liability from overall failure.

Liability plays an important part when making repairs, especially in public facilities where someone may become injured. These would include contract maintenance, structural repairs, lift trucks, auto shops, manufacturing plants, etc. The intent is to facilitate repairs so the parts perform exactly as if they were new from the manufacturer.

The same style can be the difference between a socket head cap screw and a hex head cap screw; a lock nut and a heavy hex nut; a flat washer and a lock washer, etc.

Critical applications generally employ higher strength fasteners, such as the SAE Grade 8 or metric Property Class 10.9. However, when using socket head cap screws, there are three different strength levels: 12.9, 10.9 and 8.8. These PC markings are clearly stamped on the product, but personnel need to know there is a difference and to look for the markings. In Part 1 it was discussed that different strengths of fasteners will produce different clamp loads even when torqued the same.

The same length of fastener can be critical as the manufacturer may have designed the joint to use a fastener with shorter threads for a shear application. The same fastener will fail in an application where there are dynamic loads where the additional thread length is needed to absorb shock and cyclic vibration loads.

Style can also mean finish. Never mix a plated product with a non-plated product. Even with applied torque, the clamp loads will be greatly different due to the many friction variables created with the different surface finishes.

Nut styles can vary from hex, heavy hex, thick hex, locking and flange type. Each one of these has a specific purpose and it is not advisable to introduce any one of these into a multiple bolt connection where this would be the only one of its type.

Lock nuts are usually coated with a supplemental lubricant to avoid the friction from the thread displacement of the nut. These lubricants will drastically lower the torque values of normally printed 'dry' torque values to the extent that assembly with a 'dry' torque will cause the fastener to either strip its threads or be severely stretched into yield.

Plant maintenance is very critical as they are governed by certain codes. Boiler and Pressure Vessel Code applications are related to the ASME (American Society of Mechanical Engineers) Specification SA-193 in Section II. The ASTM (American Society for Testing and Materials) lists the bolting specifications in the Standard A 193 / A 193M and A 194 / A194M for nuts.

The B7 bolts and other special non-ferrous alloy fasteners that were originally specified are expensive but cannot be substituted for any other material for these applications. It is important that good communication exists between the maintenance personnel and the Purchasing Department to avoid substitution.

As the A 193 / A194M Standards suggest, there are many different types of nut materials, treatments and strength requirements to match their fastener counterpart. The same applies to SAE and metric ISO fasteners. Be sure the nut matches the fastener in material and strength by the markings required on all of the products.

My equipment did not come with a lock washer, should I add one to the connection?

No.

A good rule of thumb to follow is: if the equipment was not manufactured with a specific component part, never add anything other than Original Equipment designated parts to the connection. The same is true for lock washers: don't add a lock washer to the connection if it did not initially come with the assembly.

This is not to say that lock washers do not have a use or play a part in maintenance. However, we must go back to 'liability'. Again, the dynamics of a connection may be changed from the addition of something which was not originally specified. The SAE has intentionally removed lock washers from their 1980 Book of Standards. Therefore, with all specifications for automotive, heavy machinery and off-road equipment, there are no lock washers ever used with these equipment, especially with the Grade 8 or 10.9 fasteners. Instead, through hardened, heat treated flat washers are used with the critical, high strength fasteners, while other types of locking fasteners are used in non-critical assemblies.

Originally, the specified hardness for lock washers was in the range of 51-55 Rc. Due to their high hardness, these lock washers were highly susceptible to metal fatigue even if the clamped joint lost enough preload to cause the lock washers to spring open slightly to produce a counter force against the fastener to prevent loosening.



Picture 1

Picture 1 is an example of one of the early hard lock washers that failed in metal fatigue.

Many lock washers were plated, but this also presented problems with susceptibility to hydrogen embrittlement. Even though the SAE dropped the specifications from their Handbook, dimensions, specifications and testing methods were still found in the IFI (Industrial Fasteners Institute) Handbook which referenced the ANSI/ASME B18.21.1 standard. During the mid-1990s, the hardness requirements were lowered to 45 Rc in an attempt to avoid the problems previously encountered.



Picture 2

However, at times, the combination of a lower hardness and assembly using the same techniques, have caused the lock washers to actually spread open and become flattened, as illustrated in Picture 2. A high speed assembly tool was used on this lock washer.

used without a flat washer. However, due to the increased loads produced by the A490 bolts, these joint applications will usually require an ASTM F436 hardened flat washer.

Regular steels: flat washers should be used to prevent embedment of the nut or bolt head into the softer joint material. Flat washers are also used to protect the surface of the clamped materials and will provide consistent clamp loading with properly tightened fasteners.

Metric 10.9 and 12.9, as well as SAE grade 8 fasteners, are always matched with a hardened steel flat washer. Many times, these flat washers are not marked. When the joint is disassembled and the flat washer does not exhibit signs of dishing or wear, they are hardened steel. Many times, these hardened flat washers may be reused without any consequences. But if they are to be replaced, they must always be replaced with the same type and not to confuse the hardened flat washers with common soft, wrought flat washers which will lose clamp load in high load applications. ■

Do I need to use a flat washer?

Yes and No.

Here again it depends on the application. Most answers are generic, while others depend greatly upon the joint materials and application.

Structural steels: while the ASTM A325 and A490 structural bolts have wider heads, the A325 is frequently



Heat treatment, carburizing, tempering after quenching, annealing, tempering and precipitation hardening for various mechanical components.



**CONTINUOUS MESH
BELT TYPE
HEAT-TREATMENT FURNACE**

Energy saving



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