

Dr. Fastener:

Avoiding Fastener Failures

Fastener Selection and Use

by Guy Avellon

Many times fastener failures begin when the product is ordered. Sometimes the incorrect fastener product is ordered for the job through miscommunication from the requesting party to the purchasing personnel and even to the distributor. Then, once the fastener products are ordered, there are many ways fasteners can be misused. The following are suggestions of what to look for and what to avoid when selecting a fastener product and their installation.

Fastener Selection:

1. Always be sure the order is correct. If there is a question, ask.

- This seems basic but maintenance personnel and engineers use jargon and descriptions not easily recognizable on a Purchasing Order to non-technical personnel.

2. If the order includes one Grade or Class of fastener and a different Grade or Class of nut that is the same size, ask and reconfirm.

- Inaccuracies may happen at the procurement level where an incorrect product was bought, due to lack of specification or price differences.
- Problems may occur at the maintenance level where many types of products are stored and may be mixed when excess product is returned.

4. Make sure that all of the fasteners and nuts in a multiple connection are the same grade or Property Class.

5. Bolt lengths should be long enough to accommodate a flat washer under the head and under the nut when applicable.

- There only need to be at least two bolt threads sticking out of a tightened nut. Any more threads than two are useless and increase the stresses on the threads in the joint.
- The end of the bolt should never be flush with the nut opening as the first thread of the nut is incomplete.

6. Always use a hardened SAE or ASTM F436 flat washer under the nut and bolt head with any fastener whose strength is an SAE Grade 5 or ISO Class 8.8, A325 or stronger.

7. USS flat washers should only be used on sheet metal, plastics or any compressible materials.

- The USS flat washer does not increase the load bearing surface any more than an SAE washer does on a steel joint.
- The only fastener products that will increase the load bearing surface area is a flanged head bolt and nut because it is an integral part of the fastener.



8. Fine threads (UNF) will produce 10% more clamp load than a coarse threaded fastener.

- This is due to the differences in stress area; there is more metal with the UNF.
- The shallow helix angle makes fine threads less susceptible to loosening from vibration.

9. Never mix nut and bolt finishes in a multiple bolt connection.

- That is, non-plated with plated or with different types of coatings.
- Especially do not mix plated fasteners/nuts with hot dipped galvanized products where the nuts may be overtapped.

10. A lock washer will not prevent loss of preload.

- If the clamp load is not significantly higher than the external service load, nothing will prevent loosening and loss of preload.

11. If the assembly did not come with a lock washer as OEM, Never put one on the fastener.

- Reread above.

12. No locking device will ever prevent loss of preload.

- Nothing will guarantee against loss if the joint materials, fastener components and installation torque are not compatible.

13. Metal prevailing torque lock nuts are reusable, nylon insert nuts are not. Choose the metal nuts if you expect frequent maintenance.

- Prevailing torque lock nuts have a lubricant applied which reduces thread friction.
- A nylon nut is like a standard nut, it has dry threads which promote an increase in friction and an increase in torque.
- The nylon will also provide less drag with each reuse due to wear.

14. Any locking device will not always adequately perform in every application.

- Lock washers are good for sheet metal and small screws, not 1-1/2" (38 mm) bolts.
- Thread locking chemicals do not act alike, read the labels.

15. Thread locking chemicals are good for low impact and low vibration loads.

- Never rely on any locking device to stop loosening or loss of preload.
- Preload must be sufficient to overcome predictive service loads.

Fastener Installation:

1. Any fastener made can and will fail if not properly installed.

- There are hundreds of variables to consider that will cause loss of clamp load.

2. Each joint is unique.

- What you do for one joint may not be good for another.

3. Impact wrenches are NOT for installing fasteners. EVER.

- They have too much uncontrolled initial impact torque.
- If they must be used, perform a controlled test on a non-critical joint.

4. Uniform tightening is more important than torque.

- If one side is tighter than the other, loosening occurs.

5. Tightening technique affects the connection more than torque.

- How compressible is the joint?
- Were incremental torques used along with a torque pattern?

6. Never apply full torque to a fastener during initial tightening, especially with multiple fasteners in a single joint connection.

- The first fastener will become tighter, and then it loosens as the rest are tightened.

7. Tighten in torque increments. If it is a critical connection, retighten the fastener after two minutes and again after a load has been applied.

- This is due to the normal compression set of the materials, joint and fastener.
- There is no such thing as a non-compressible gasket. Every material relaxes, every material is compressible.

8. Torquing the head of the fastener takes more torque than tightening the nut.

- A torsional twist is applied to the body of the fastener instead of stretching the threaded section which dissipated the torsion more. When turning the head stops, the fastener 'unwinds' itself and therefore loses both stretch and clamp load.
- This effect is reduced if the fastener is lubricated.

9. Use incremental loading when tightening multiple fasteners in the same joint as well as using a criss-cross pattern.

- This produces an evenly loaded joint connection.



10. Clamp load must always exceed the service load.

- If not, the joint will either loosen or fail from metal fatigue.

11. Torque is a function of friction and only evaluates torsional friction; keep all surfaces consistent.

- Torquing a 'dry' fastener and a 'lubricated' fastener with the same torque will result in the dry fastener having a much lower clamp load than the other.

12. The only time a torque wrench is accurate is when the fastener is lubricated.

- This is because friction is kept at a constant, not a variable.

13. A lubricated fastener will take less torque than dry to achieve the same clamp load.

- Lubricants reduce friction, so it takes less torque (friction) to tighten.

14. All metal prevailing torque lock nuts take less torque to tighten than a standard hex nut.

- All of these products are coated with a wax finish to reduce the prevailing torque drag friction caused by the locking feature.
- These products are reusable at least five (5) times.

15. Never tighten a lubricated fastener without using the proper torque value for that lubricant.

- Some lubricants are more 'slippery' than others. All types are different.
- Too high a torque with a very efficient lubricant will cause the fastener to be stretched into yield (UNC) or to strip threads (UNF).

16. A lubricated fastener will not vibrate loose any more than a dry fastener if the proper torque has been applied.

- A lubricated fastener can produce greater and more consistent clamp loads than non-lubricated fasteners. Naturally, if the clamp load is higher, it is more resistant to vibrational loosening.

17. Keep procedures consistent.

18. Never use torque as an 'audit' to check for joint preload: there are too many variables and it is inaccurate.

- Variables include overcoming rust, paint or embedment. It is not a true indicator.

19. If the tightening motion has stopped below the desired torque value, tightening may continue safely forwards, never backwards.

- Loosening a nut will create extra friction between the threads affecting torque, which will be less than desired and can never be regained.

20. The faster the nut and/or bolt are tightened, the greater the joint relaxation.

- The increase in speed causes more joint compression, hence the relaxation. It is an elastic rebound effect.

21. Torque is not affected by socket extensions.

22. Torque is affected by handle length extensions.

23. Tapped holes, such as engine blocks, are considered 'wet' torques by OEM.

24. Never reuse a bolt in a critical application.

- There may be stress cracks that are not visible.

25. Never reuse a nut.

- Nuts have a finite life.
- Damaged internal threads are common but not always visible.

26. If one fastener fails in a multiple fastener assembly, replace the adjacent fasteners.

- The loads have shifted and are forcing the adjacent fasteners to absorb greater loads which will lead to their failure as well.

27. If more than one fastener fails in a multiple fastener assembly, replace all of the fasteners.

28. Keep it clean.

29. Keep it tight.

30. Keep an eye on it.

31. Fasteners are the least expensive commodity product holding everything together. ■

When in Doubt, Throw it Out!

