



Cylinder Head Bolt Torque Procedure

Quick Training Guide – QT114B

All Toyota engines use torque-to-yield bolts for critical fastener applications, such as to fasten the cylinder head to the cylinder block. Not following the Repair Manual instructions and failure to use sound shop practices can result in damaged threads, warped mating surfaces, and cylinder head gasket leakage. This QTG will explain how torqueing fasteners works and how torque-to-yield bolts function, as well as providing proper shop procedures and outlining the proper torque sequence.



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Torque

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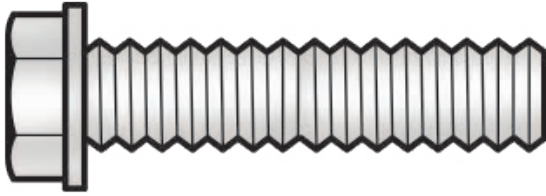
Inspecting Bolts

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Overview

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Conventional bolts stretch when they are torqued to specification and then return to their original length when they are removed.



However, there are factors that can reduce the clamping force generated by a fastener (bolt or nut).

- Dirty threads
- Damaged threads
- Insufficient lubrication

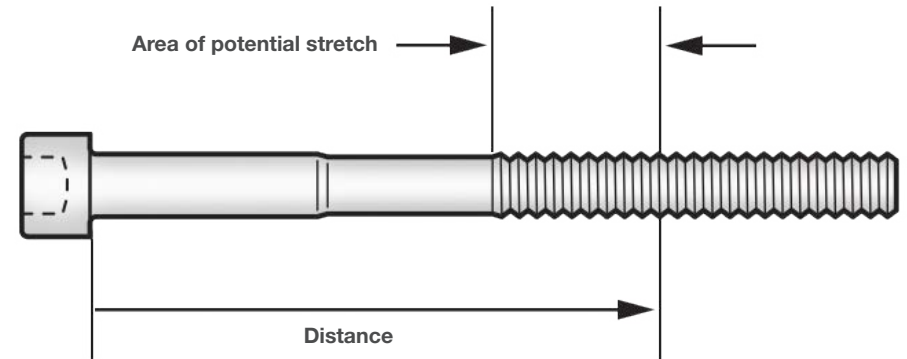
These factors can result in uneven torque from each fastener.



Torque-to-yield bolts are used in critical applications, such as cylinder heads and rod caps.

- These applications demand consistent and equal torque distribution.

Torque-to-yield fasteners stretch a little with each use and will not return to their original length when removed, so, they have to be inspected before re-use.



Also, there are specific tightening procedures and sequences that must be followed for torque-to-yield bolts to work properly.

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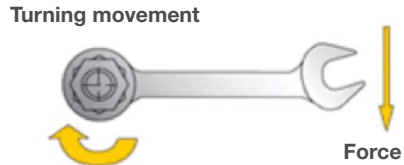
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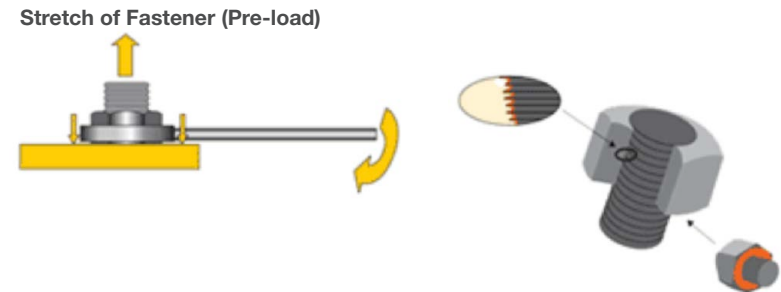
Torque

What is Torque? Torque is a measure of how much force is acting on an object which causes that object to rotate.



What is Torque Tightening? Torque tightening is the application of preload to a fastener by the turning of the fastener's nut.

Friction points should always be lubricated when using the torque tightening method

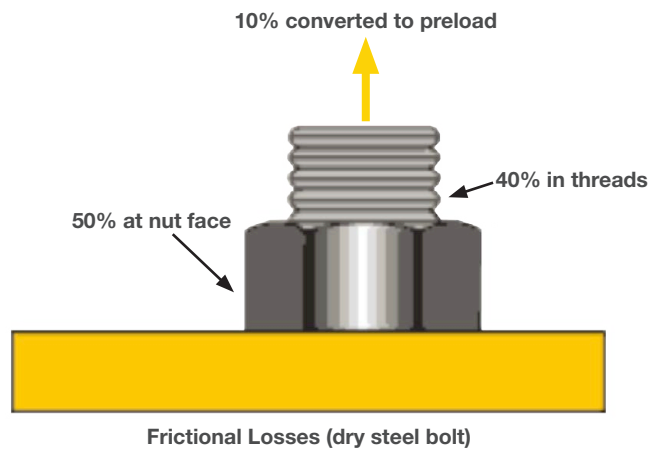


Torque is measured in:

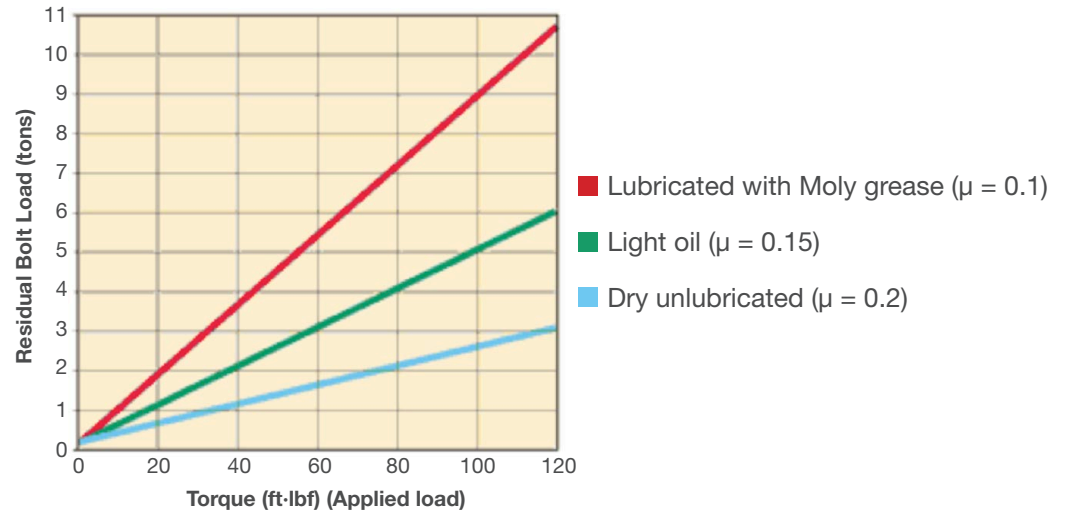
- ft·lbf (foot pounds force), in·lbf (inch pounds force) and N·m (newton meters)

How much torque is actually converted to clamping force? These illustrations detail the losses of clamping force due to friction.

Frictional Losses



Lubrication Reduces Friction



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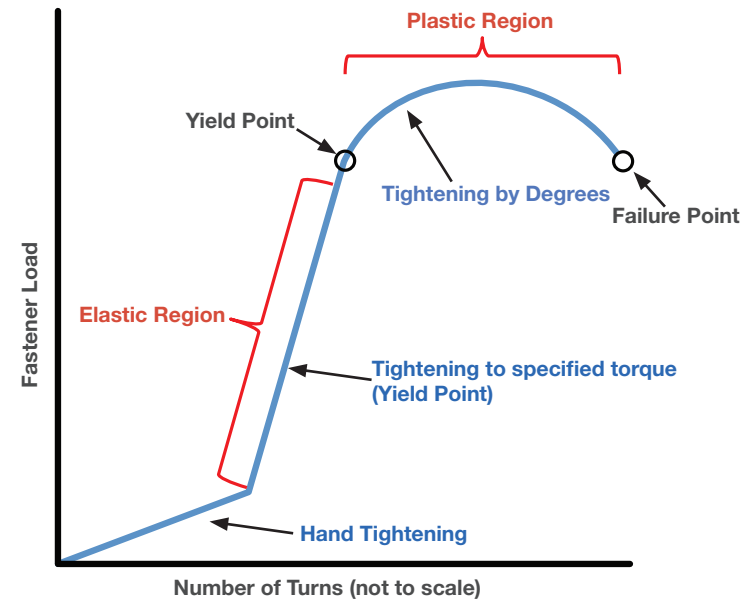
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Torque-to-yield Bolts

Torque-to-yield bolts have plastic regions that are calibrated to a factory-specified yield point. When properly installed, as the bolts stretch they provide equal torque.

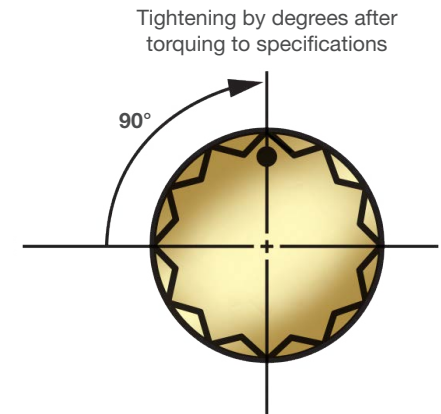
On Toyota vehicles, these bolts are torqued to a lower level to run down and align the fastener, then a series of measured turns are used to tighten the fastener to the desired level. As turns are used instead of a fixed torque value, any extra friction of the fastener is less important. This procedure allows the amount of stretch (clamping force) to be uniform from bolt-to-bolt across the component.

These bolts can be re-used, but there are specific inspection procedures in the Repair Manual to ensure that they are suitable for re-use. The specifications vary by model, so it is essential that the correct Repair Manual is used for reference.



Elastic Region: In this area, the bolt deforms but returns to its original shape and length when the load is removed.

Plastic Region: In this area, the bolt is permanently deformed. After several tightenings, the deformation accumulates until the bolt reaches its failure point.



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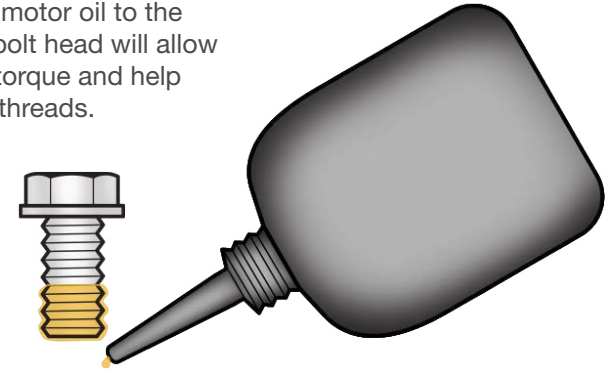
Proper practices in the shop will result in even torque distribution and less chance of deformation and cylinder head gasket leaks.

Visually inspect the bolt and bore threads to check for damage or dirt. It may be necessary to clean out the bore threads with a finish tap (NOT A STARTER TAP).

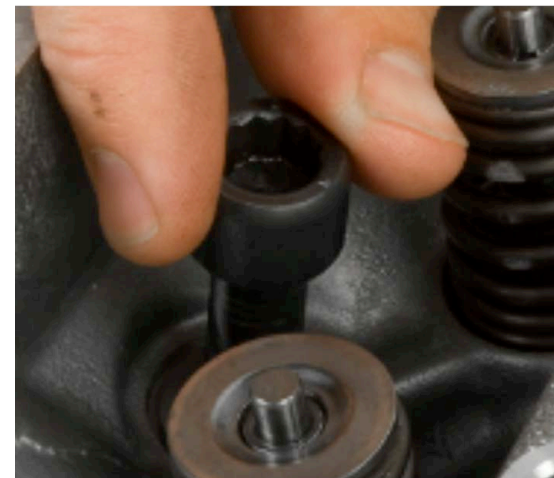


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A light coating of clean motor oil to the threads and under the bolt head will allow for even application of torque and help prevent damage to the threads.



A good test for excess resistance is to see if a lightly oiled bolt can be easily screwed all the way in and out of the bore with only your fingertips. If there is excess resistance there may be something wrong with the bolt or bore threads.



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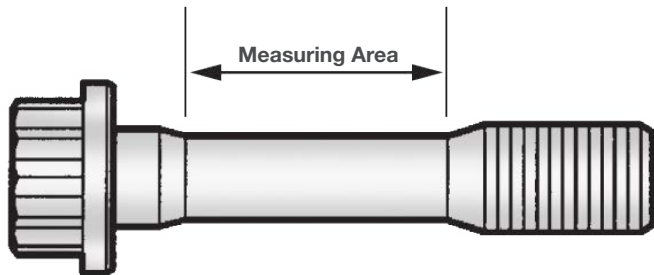
Inspecting Torque-to-yield Bolts

The fastening torque applied to torque-to-yeild bolts causes them to stretch.

Connecting Rod Bolts

For connecting rod bolts, inspect for stretching by measuring the diameter of the bolt in the prescribed area. Also visually inspect the bolt outside of the measurement area for places that may appear deformed or stretched.

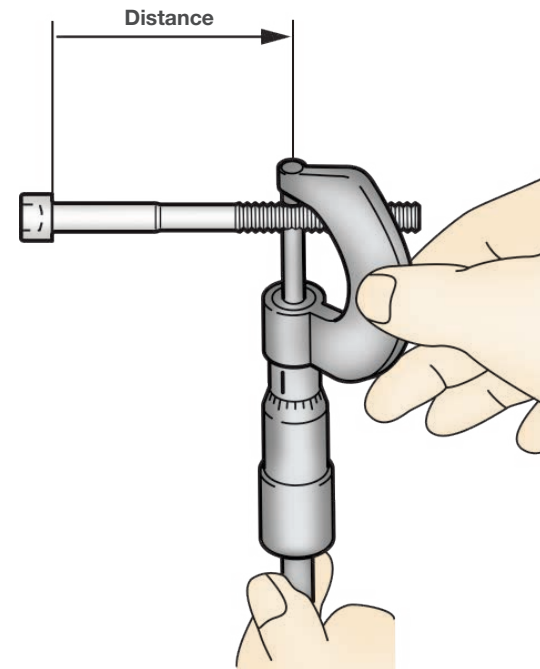
Using a micrometer, measure the thread diameter at the measuring area specified in the Repair Manual.



If the bolt does not meet specifications, replace it.

Cylinder Head Bolts

For cylinder head bolts, inspect for stretching by measuring the diameter of the threads in the prescribed area. Also visually inspect the bolt outside of the measurement area for places that may appear deformed or stretched.



Using a micrometer, measure the thread diameter at the measuring area specified in the Repair Manual.

If the bolt does not meet specifications, replace it.

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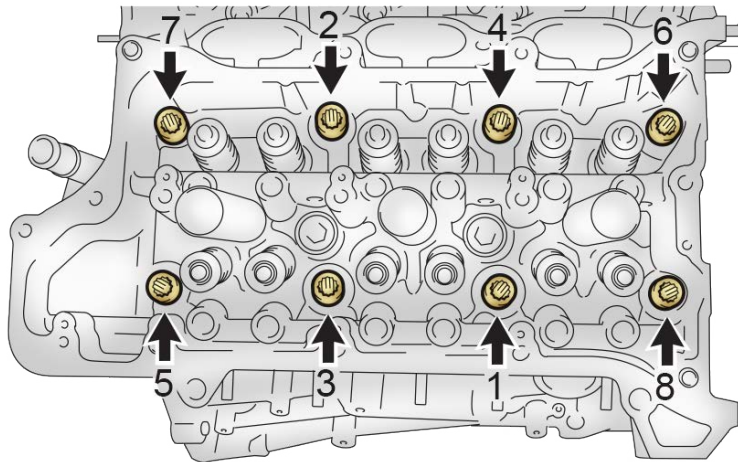
Torque Sequence

Torque Sequence

When Installing A Cylinder Head

1. Apply a light coat of engine oil to the threads and under the heads of the cylinder head bolts.
2. In the sequence given in the Repair Manual, install and uniformly tighten the cylinder head bolts with the plate washers in 3 progressive steps.

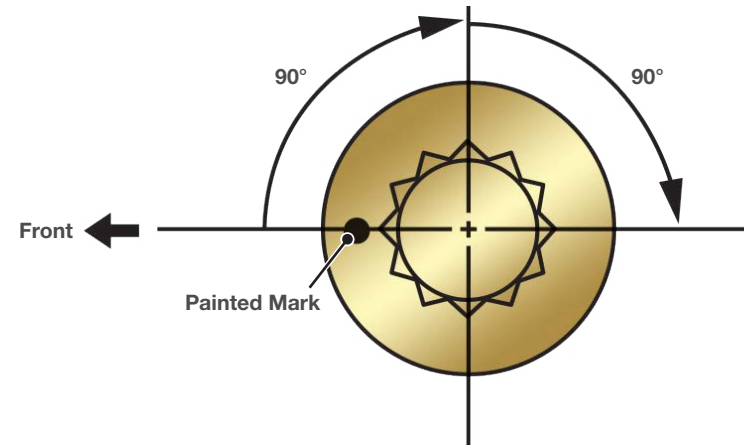
DO NOT short cut step 2. The cylinder head is the roof of the cylinder block and when in operation is under extreme pressure. The torque sequence is divided into three steps to ensure the cylinder head is tightened evenly. This ensures the cylinder head gasket is compressed evenly as well.



Most cylinder head bolts require a 10 mm bi-hexagon (also called a triple square or XZN) socket.

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3. After torquing the cylinder head bolts:
 - Mark each cylinder head bolt with paint as shown in the illustration
 - Tighten the cylinder head bolts another 90° in the original tightening sequence
 - Tighten the cylinder head bolts again an additional 90° in the original tightening sequence



The 90 degree turns in addition to the torque provides the stretch tension. This stretch or spring tension from the bolts keeps the bolts from working loose over time.