

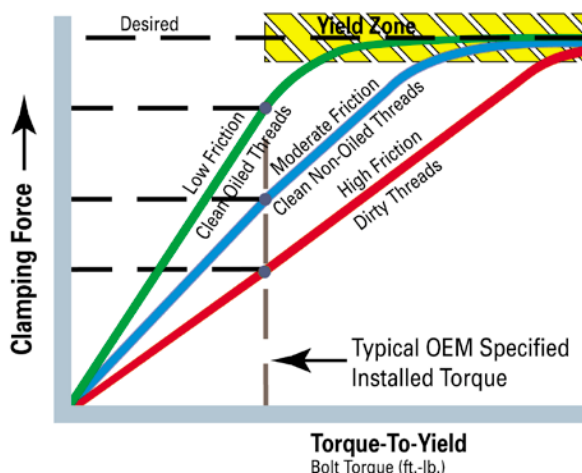
TECBLOG T-T-Y BOLT INSTALLATION

MANY VEHICLE MANUFACTURERS USE TORQUE-TO-YIELD HEAD BOLTS, ESPECIALLY ON ENGINES WITH ALUMINUM HEADS AND/OR IN CONJUNCTION WITH MLS HEAD GASKETS. THEY PROVIDE MORE CONSISTENT CLAMPING LOADS ACROSS THE ENTIRE HEAD-TO-BLOCK MATING SURFACE.

Bolts are elastic by nature, meaning that within their elastic range they'll stretch as load on the bolt increases. As long as the bolt is not stressed beyond its proof load (the maximum load a bolt can withstand and still behave in an elastic manner) it will retract if the torque is relieved. Traditionally, torque specs are calculated to keep fasteners within their elastic range because maximum clamp load is achieved when the bolt reaches its elastic limit or "yield" point.

Typical bolts can be an issue when you use them on aluminum heads and with a gasket that doesn't relax, such as an MLS gasket. The expansion rate of aluminum heads will stretch typical bolts past their yield point and can snap them. Plus, newer engines require high clamping forces (due to increased combustion pressure) that can't be achieved with the smaller diameter bolts normally found in engines. Unfortunately, using a larger diameter bolt is not the answer, as the larger a bolt is, the less it will stretch. Remember bolt stretch is how we get maximum clamping load. So the solution is Torque-To-Yield, or T-T-Y, bolts.

CLAMPING FORCE AT SPECIFIED TORQUE



T-T-Y head bolts are engineered to stretch within a controlled yield zone. Once they reach this zone, they are designed to spring back to provide a more precise level of clamping force. This stretches the bolts into their elastic range, and in some cases, the stretching approaches the bolts' elastic limit, permanently stretching them. Once the yield zone is reached, the clamping force will be more consistent. Getting to the precise yield zone (for maximum clamping force) is accomplished by tightening bolts to a certain torque spec, then turning the bolts an additional number of degrees.

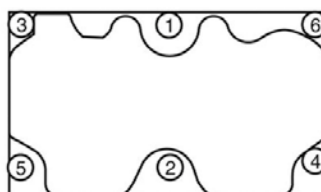
TORQUE-TO-YIELD PROCEDURE

For example, on the Subaru EJ253 2.5L naturally aspirated engine, a torque specification for a single bolt is to tighten to 22 ft/lbs, then 51 ft/lbs, loosen 180 degrees, then loosen another 180 degrees, torque to 31 ft/lbs, turn an additional 80-90 degrees, and finally turn another 40-45 degrees.



TORQUE SPECS

2007
Subaru Impreza 2.5i
2.5L 2457CC H4 99.5mm Bore
SOHC Model EJ253 16 Valve MFI



TORQUE SPECIFICATIONS ARE SHOWN IN FOOT-POUNDS

- 1st Step: 22
- 2nd Step: 51
- 3rd Step: loosen 180 degrees
- 4th Step: loosen 180 degrees
- 5th Step: 31
- 6th Step: turn 80-90 degrees
- 7th Step: turn 40-45 degrees
- 8th Step: Bolts 1-2 turn 40-45 degrees

While a sequence like this is complicated – especially since every head bolt must be tightened this way, and in a particular order – it provides much more consistent clamping force, which creates a better seal.

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HEAD BOLT SETS

Since T-T-Y bolts are designed to stretch, reusing them can cause improper or uneven torque and clamping force. Stretched bolts can damage threads in the engine, especially on aluminum blocks, and since the bolts are weakened, they may break if retorqued. You should always replace the bolts.



ES 72229 Head Bolt set

Before removing T-T-Y head bolts, allow the engine to fully cool. Removing the bolts while the engine is hot can cause cylinder head warpage. T-T-Y bolts should be removed in the reverse order and sequence in which they were installed.

It is very important to follow the proper torquing sequence and specifications when installing T-T-Y head bolts. Always clean the threads where the bolts pass through. Any thread damage, corrosion or rust will create excessive friction, giving you a false torque reading, robbing you of valuable clamping force. Using engine oil, lightly oil the threads and under the heads/washers on T-T-Y bolts unless otherwise specified by the vehicle service manual. Clean, oiled threads prevent binding, allowing for accurate and consistent torquing. Be careful not to over-oil the bolts, especially if they are threading into a blind hole. Too much oil will hydrolock the bolt and give false torque readings.

Any bolts that pass through a water jacket must have a sealer applied to the threads to prevent corrosion and leaks. Fel-Pro head bolt sets are application-specific, so when a head bolt will be in contact with coolant, Fel-Pro provides coated bolts.



ES 71129 Head Bolt set with sealer pre-applied to bolts where necessary