

TORQUE TO YIELD HEAD BOLTS

LET'S CLARIFY THE ISSUES

There is a lot of controversy about torque to yield head bolts, also known as angle torque or stretch bolts. I would like to clarify some issues regarding these types of bolts in this bulletin.

FIRST SOME HISTORY

Torque to yield (TTY) head bolts are extensively used in modern design engines predominantly for cylinder heads but also main bearing caps, rod bolts, etc. TTY head bolts offer a number of advantages for the engine manufacturer, which include flexibility in cylinder head design as this type of clamping style requires less head bolts and there is also a reduction in component costs. Another advantage for the manufacturer is controlled cylinder head clamping torque.

HOW DO THEY WORK?

When the TTY head bolts are tightened they undergo two main phases. First is the *elastic phase*, which is a state whereby the bolt will stretch under tension but will return to its original dimensions when the axial loading is released. If this loading is increased the bolt will reach its *plastic phase*. The plastic phase is the state whereby the bolt has stretched past its *yield point* and will not return to its original dimensions or state, when the loading is released. If the bolt loading is increased even further the bolt will reach its *shear point* and the bolt material wastes and breaks.

CAN TTY HEAD BOLTS BE REUSED?

Simple and clear, the answer is NO. Due to the very nature of their design these bolts do wear out and cannot be reused. Unlike a conventional bolt the TTY bolts are tightened beyond their yield point into the plastic phase and will not return to their original dimensions when the tension is released. If these types of bolts are to be used a second time or any subsequent times thereafter, the already permanently stretched bolts will stretch even further and rapidly lose clamping load, which could ultimately lead to head gasket failure. The end user will ultimately have to pay for the extra cost of new bolts, but this is a relatively inexpensive form of insurance against head gasket failure.

HOW ARE TTY HEAD BOLTS FITTED?

Torque to yield head bolts require a different torque procedure than a conventional head bolt. These bolts will require a numerical initial torque setting, sometimes called a pre-load, followed by one or more angle settings. Care must be taken that the correct procedure is adhered to and an accurate angle gauge is used to ensure correct and even bolt loading. As with conventional head bolts a good thread and under bolt head lubricant is still important. Lubricants reduce the amount of friction between the fastener and the surface it contacts while being tightened. A quality thread lubricant will convert more of the torque to more usable clamping force instead of having it lost to friction.

IN SUMMARY

Do NOT reuse torque to yield head bolts. It is imperative that new bolts are fitted following cylinder head gasket replacement.