

Cylinder-head Bolts and Cylinder-head Installation

Tips and Practical Information No. 2

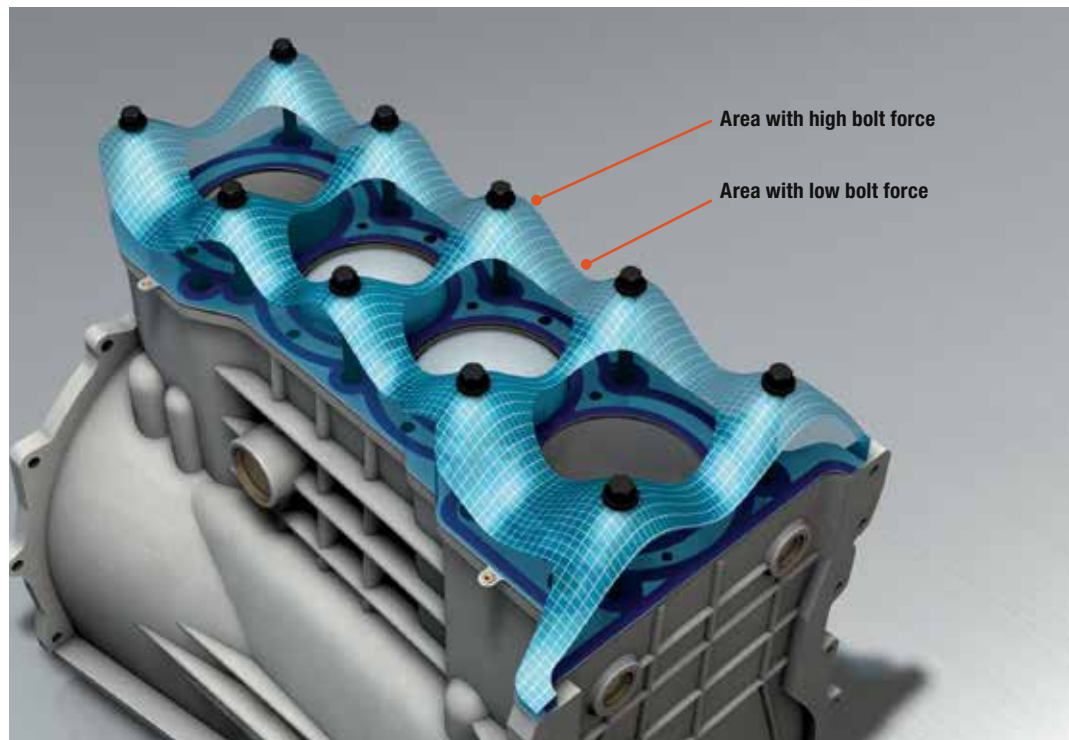
Cylinder-head Bolts – Strong Joints for Perfect Sealing

Connecting Element

Cylinder-head bolts are the connecting elements between engine block, cylinder-head gasket, and cylinder head. The bolt tightening force is an important factor for the mutual sealing of combustion chamber, lubricant and coolant channels, and the ambient air. A task that must be performed perfectly with cold or extremely hot engines, at negative and high positive pressures.

Surface Pressure

When tightening (torquing) the cylinder-head bolts, the bolt force generates the so-called surface pressure, which is essential for achieving a perfect seal. Hereby, and in combination with the applied torquing method, the bolts have a strong effect on surface pressure quality.



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When torquing the cylinder-head bolts, the bolt force generates a surface pressure, which is essential for achieving a perfect seal.

Surface pressure describes the force per unit of contact surface area between two components, e.g. between cylinder head and head gasket, or engine block and head gasket. As opposed to the clamping force, surface pressure is not constant across the entire contact area.



Special Bolts for Higher Bolt Forces

Innovative Development Needs No Retorquing

For economic reasons, engine builders developed head gaskets in the 80s that do not require retorquing. The assembly of cylinder heads without having to retorque the head bolts represented a technical innovation for series production. Similarly, when replacing a head gasket, torquing in several steps was no longer necessary.

This objective was only achievable through optimum matching of all

the components involved. A tight, compound joint of engine block, cylinder-head gasket, cylinder head, and head bolts.

Stretch Bolts

Bolts that are tightened beyond their elastic limit (yield point) into the plastic region ensure high and uniform bolt clamping forces. An important prerequisite for reliable sealed joints without retorquing. In this respect, stretch bolts offer decisive advantages over rolled shank bolts. By reducing its shaft diameter, the bolt is able to respond elastically to dynamic sealing gap movements, i.e. adaptation is greatly improved.

Torque-angle Method

In the first step, the bolt is snugged down to the cylinder head by means of a pretorque. With the second step, the so-called torque or tightening angle, the bolt is tightened into the plastic region, i.e. beyond its elastic range.

Using the torque-angle method, the variations in bolt clamping force lie in a range of $\pm 10\%$. Using the simple torquing method with several steps, the variations will be within $\pm 30\%$ of the calculated bolt clamping force. The reasons for this lie in the dispersion range of torque values and the overall coefficient of friction, i.e. the friction occurring under the bolt head and in the threads.

Stretch bolts are designed so that they can be elongated beyond their elastic limit into the plastic region without problems. When a specific tightening torque has been reached, the bolts are turned further through a defined angle, which pre-loads them into the plastic region. Consequently, no retorquing is necessary.



◀ *Advantage of stretch bolt: As opposed to a rolled shank bolt, it can be tightened beyond its elastic limit (yield point) into the plastic region – a guarantee for high and uniform bolt clamping forces.*

Safety with New Bolts

With the torque-angle method, the head bolts are elongated plastically, i.e. permanently. After disassembly, they are clearly longer than new bolts. During the engine's warm-up period, the bolt is stretched even more. This applies in particular for all-aluminium and bi-metal engines, as the two materials have different thermal expansion rates.

In the worst case, a bolt that is reused can break, or it can «bottom» in the threaded hole of the engine block and cause damage. For safety reasons, cylinder-head bolts should therefore always be used only once.

You Can Trust the Dana Specialists

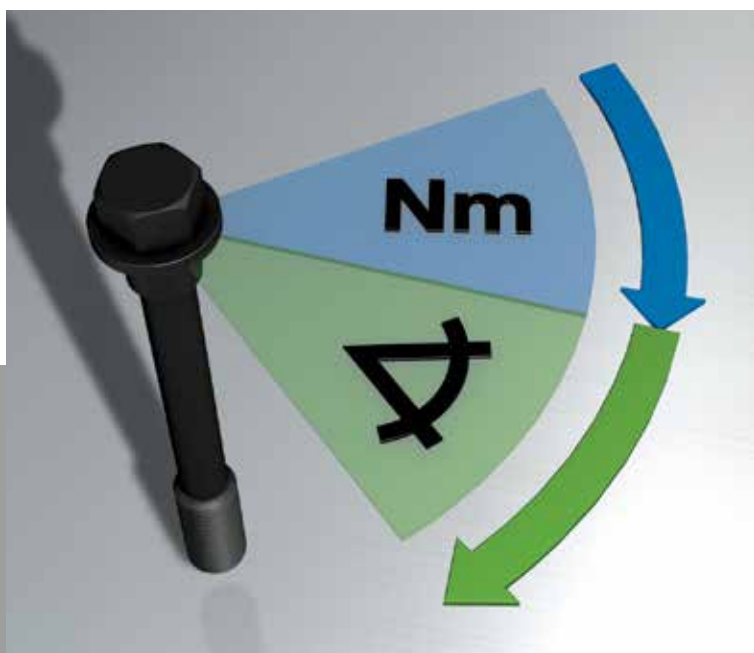
Cylinder-head bolts guarantee a secure and releasable joint. However, this does not mean that the same bolt can be reused for the same application. When reassembling a cylinder head, always make sure to use new head bolts. The result will be a high sealing pressure for a reliable and tight joint.

Make sure to use head bolts exclusively from quality manufacturers. Victor Reinz cylinder-head bolts comply with all manufacturer specifications, and are matched perfectly to our head gasket sets. Of course, the torquing guidelines are always supplied.

TIP FROM THE EXPERTS

With the torque-angle tightening method, the head bolts are elongated permanently. Therefore, cylinder head bolts should only be used once for safety reasons.

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Torque-angle method using pre-torque and tightening angle.

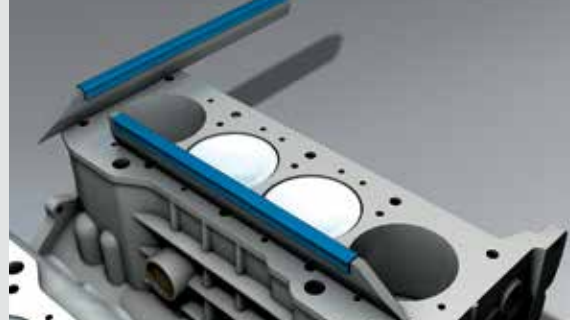


Practical Tips: Preparation and Cylinder-head Installation

The first steps ...



1. Carefully clean the sealing surfaces of engine block and cylinder head – dirt and gasket remnants on the surfaces are a frequent source of trouble.



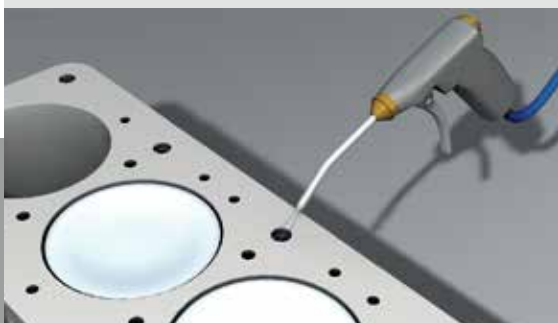
2. Use a straightedge to check the surface flatness; longitudinally and transversely.



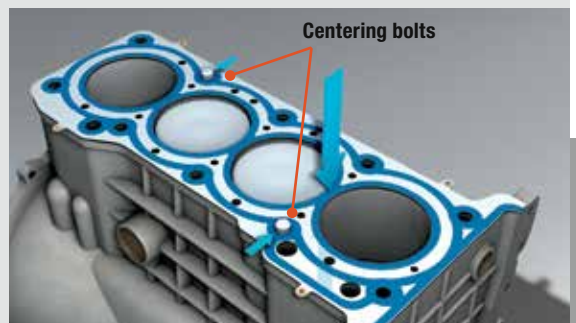
3. Remove any gouging, component distortions, grooves or scores, e.g. by surface grinding in a specialist workshop.



4. Observe the minimum dimensions of engine block and cylinder head according to the manufacturer's specifications, as well as the specified head gasket thickness.



5. Clean the bolt hole threads, and remove any contamination, oil and water, e.g. with a blast of compressed air.



6. Position the head gasket accurately on the engine block. Do not use any additional sealing compounds, grease or oil.

Replacing the Cylinder-head Bolts

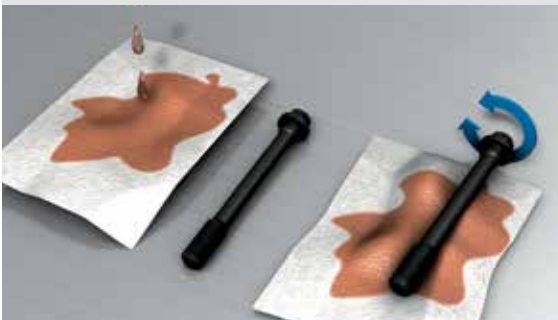
... the next steps



- 7.** Fit the cylinder head, and take care not to damage the head gasket during assembly.



- 8.** Always use new head bolts.



- 9.** Lightly lubricate the bolt thread and the bottom of the bolt head by applying a small quantity of oil to a rag and rotating the bolt in the oily rag.



- 10.** If the manufacturer specifies the use of a washer, lightly lubricate both sides.



- 11.** Always follow the manufacturer's instructions regarding the tightening sequence for the head bolts – the instructions are not only different according to manufacturer, but can also vary depending on engine type.



- 12.** Only use approved and recommended anti-freeze agents and corrosion inhibitors.



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