Technical Report #24

Cylinder Head Bolts with Angular Tightening

Informe Técnico

Purpose

Characteristics, features and usage of cylinder head bolts with angular tightening.

Introduction

Along the years the cylinder head bolts have changed both in design and properties, to suit the needs, increasingly demanding engines today. High performance mechanicals, where internal pressure in the combustion chamber are increasingly higher, led to the need to develop cylinder head sealed ever more complex and efficient, which makes the cylinder head bolts to have a very important role in the repair of the vehicle.

The main function of the cylinder head bolt is to apply the clamping force evenly across the different engine parts involved, usually cylinder block and head, with a capacity to hold it steady ensuring proper sealing of liquids and gases in the cylinder head gasket, withstanding temperature variations, vibrations and positional changes which occur in the engine during operation.

Actually the use of cylinder head bolts with angular tightening is the most common; they can adapt perfectly to the specifications of modern engines manufacturers.

Characteristics of Angular Tightening.

In contrast to the bolts which have torque tightening only, in cylinder head bolts with angular tightening, the elastic limit of the material is exceeded, so it suffers permanent deformation even after disassembly, for that reason it is very important not to reused bolts with angular tightening.

Torque Tightening

The torque tightening bolt only Works in the elastic zone, which means that the deformations suffered are reversible after cessation of the clamping force. They can be fitted again after verifying its health.

In this type of tightening, friction has a significant effect, besides the high frictional forces on the head and thread can experiment slight variations from one bolt to the other during assembly. This results in significant variations in the uniformity across the clamping head.

While working in this area, a small dilatation, and therefore stretching of the bolt caused by the difference in the initial torque (highly influenced by friction) and the proper engine operation, involve loss of much of the clamping forces (1). Besides fiber gaskets normally used with these screws reduce in thickness, so it is essential to come back to the workshop to give the retightening to the cylinder head bolts.

Angular Tightening

In bolts with angular tightening the elastic zone of the material is exceeded, so that its deformation is permanent. DO NOT REUSE.

In this type of tightening is applied a small initial torque to the bolts (Kpm) continuing tightening by degrees so that all bolts are tightened similarly without any influence of the friction in the end result, which leads to greater uniformity in the cylinder head and block sealing.

Once tightened, the bolts are working in the plastic zone of the material and then the expansions suffered by the bolts in the main tightening or during operation of the engine, imply a very small variation in the final closing force exerted by the bolt (2). Thus, the retightening is unnecessary and therefore avoid back to the workshop for that operation with the savings in cost that this entails.

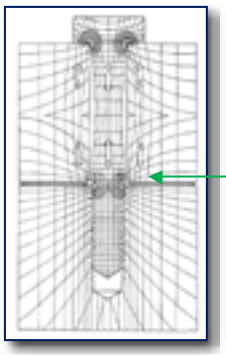
Angular tightening; procedure.

For correct operation of the bolt, and therefore suitable cylinder head closure, is necessary to apply the torque procedure as accurately as possible, paying special attention to properly follow the order, stages and tightening specified by the manufacturer, information that AJUSA incorporates into the head gaskets for customers.

When fitting the cylinder head bolts, a correct tightening is the way to ensure a perfect seal between the block and head and prevent leakage in the cylinder head gasket.

While torque tighten is applied by a torque wrench, in angular tighten is necessary to use the goniometer tool.

The bolt looseness involves insufficient clamping forces and therefore loss of liquids and gases in the cylinder head gasket, while if this is excessive the bolt will go too far trough the plastic zone it become to the breakage. In the same way, reuse cylinder head bolts with angular tighten can cause failure of the seal in the cylinder head and the bolt broken even suddenly before completing tightening.



An over-tighten or reusing the bolts, may lead to an incorrect sealing of the cylinder head gasket or even the bolt breakage in the area where tensions are critical.