Refinishing of the Cylinder Block and Head

When an engine blows a head gasket, replacing the gasket may cure the problem – initially. Regardless of what might have caused the head gasket to fail, two things must always be checked when replacing a head gasket - flatness and surface finish of the cylinder block and head. If either mating surface is out-of-flat or is too rough to seal properly, the replacement head gasket may be doomed to a short service life.

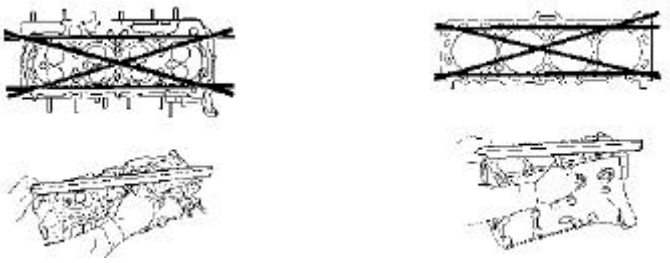
Distortion

A gaskets ability to create and maintain a seal is directly related to the condition of the surfaces upon which it is required to perform. Distortion on either surface, damage such as corrosion, deep scratches, gouges, pitting, excessive surface roughness and or waviness will all reduce the gaskets performance. In short, a poor surface will produce a poor seal. It is therefore very important when replacing a gasket to inspect the condition of both surfaces to ensure both are within acceptable limits. Of equal importance is to check that the cylinder head has not developed any cracks or has not softened particularly on the sealing surface and the head bolt bearing surfaces. While the following refers to cylinder blocks and cylinder heads the basic principles should be applied to all surfaces where a gasket is required to create a seal.

Distortion relates to the total values of the cylinder head and the cylinder block. To measure just the cylinder head or just the block in isolation produces an incomplete result that may be outside the recommended specification. Total maximum distortion values for cylinder heads and blocks combined are shown below:

	Length	Width
3 cylinder & V6 engines	0.076mm (0.003”)	0.051mm (0.002”)
4 cylinder & V8 engines	0.102mm (0.004”)	0.051mm (0.002”)
Straight 6 cylinder engines	0.152mm (0.006”)	0.051mm (0.002”)

Using a good straight edge and feeler gauge check both the cylinder head and block for warpage and flatness as shown:



Both the cylinder head and block surfaces should also be checked for waviness. Undulations or waves across the sealing surface should not exceed a maximum height of 0.01mm (0.0005”) for wave peaks between 0.76mm (0.030”) and 2.54mm (0.100”) apart. Wave peaks with a spacing greater than 2.54mm (0.100”) the wave height should exceed a maximum of 0.02mm (0.0008“). There should be no wave peaks with a spacing of less than 0.76mm (0.030”) and there should be no sudden irregularities on the sealing surface that exceeds 0.025mm (0.001”) or any out of flat of plus or minus 0.025mm (0.001”) across a 76.2mm (3.000”) section in any direction.

Surface Finish

If a surface finish is too rough or coarse the gasket can not fully conform to the irregularities. Combustion gases and engine fluids can not be properly sealed. In the past the prevailing theory was if the surface finish was too smooth, friction between the surface and the gasket is reduced allowing the gasket to move and prone to blow out. Due to the improvement to composite materials in recent years current thinking is now that the smoother the finish that can be achieved the better.

Surface finish or perhaps more correctly surface roughness values are normally expressed as roughness average or Ra, either in micrometers or microinches. Ra is the calculated value of the average roughness deviation from the mean roughness height. Another expression commonly used for surface finish is average peak to valley height or Rz, again either in micrometers or microinches. Rz is the average value of individual peak to valley heights in five continuous individual measurement sections. Unfortunately Ra and Rz are not comparable and therefore the value of one cannot be converted to that of the other.

There are two ways to check surface finish. One is to use a comparator gauge which is a flat piece of metal upon which a number of specimens of standard surface finishes have been reproduced. By comparing the appearance and the feel of the machined surface to those of the specimens on the comparator an approximate surface finish can by estimated. The other method is to actually measure the surface finish using a surface roughness tester called a profilometer which drags a diamond tipped stylus across the surface to measure and calculate the surface finish.

The material from which the gasket and the components to be sealed are manufactured have a bearing on the level of required surface finish however the following general specifications are suitable for most petrol and diesel engines whether of aluminium or cast iron construction however due to the rapid changes in technology always check the manufacturers specification.

Conventional Fibre type gaskets
2.00 to 2.50 micrometers Ra (80 to 100 microinches Ra)

Graphite (Carbon Fibre) type gaskets
0.75 to 1.50 micrometers Ra (30 to 60 microinches Ra)

Laminated (Multi Layer) Steel type gaskets - without rubberised coating
less than 0.75 micrometers Ra (less than 30 microinches Ra)

Laminated (Multi Layer) Steel type gaskets - with rubberised coating
less than 0.50 micrometers Ra (less than 20 microinches Ra)