

ACL TECH TALK

ALUMINIUM CYLINDER HEADS

Care should be taken when straightening aluminium cylinder heads. The manufacturers of these components recommend against the practice because of the residual stresses generated and the risk of softening. However, aluminium cylinder heads are expensive to replace and as a result numerous straightening techniques have been developed and are in use in the reconditioning industry.

The following comments are intended to point out that a straightened cylinder head may never be as good as a new one and that the risk of problems developing later, particularly in relation to gasket sealing, are greater.

The process of straightening involves the application of heat, whether in an oven or by flame, and under no circumstances should the temperature be high enough to cause annealing (ie. permanent softening) of the aluminium alloy.

The aluminium alloys used in cylinder heads will anneal at 662 F (350° C), but considerable softening begins at around 554-590 F (290-310° C) depending on the alloy and the time that the head is held at that temperature.

When using temperature sensitive crayons, excessive temperatures may be experienced due to the delay in the response of the crayon, or to uneven heating of the head. It is recommended that cylinder heads are not heated beyond 482 F (250° C) when straightening.

If annealing has occurred in an aluminium cylinder head, the material strength is reduced and it becomes more ductile. There could be some permanent thickness change in the areas underneath the head studs or some penetration of the washer into the softened and more ductile head material. This effect will be increased when the engine heats up due to the greater expansion of the aluminium head compared to the steel studs.

Any thickness change which occurs in a softened aluminium cylinder head will reduce the clamping pressure on the gasket. The achievement of correct clamping pressure on the gasket is critical to its performance and any loss could lead to a lack of sealing and failure of the gasket. At this point, it is no use being critical of the gasket, it is the condition of the aluminium cylinder head which caused the failure.

The behaviour of aluminium cylinder heads in an overheating situation will differ, however in either case overheating (whether on the engine or when straightening) will reduce hardness and strength. As a guide, any used aluminium head which has hardness lower than 65 Brinell is likely to have been permanently softened by overheating.

Cylinder heads are made in a variety of aluminium alloys and may be either gravity or low pressure die cast. The heat treatment applied to the casting varies according to the alloy used and results required. It is not possible to generalise on the hardness achieved in manufacture. For example, some aluminium heads are solution heat treated and aged to a hardness of 110-120 Brinell, while others are stabilised only (ie. oven aged) as the removable core is burnt out and these have a hardness of around 80-90 Brinell.

The above implies that anyone straightening an aluminium cylinder head should have equipment for measuring hardness.

REMINDER

- * An aluminium alloy cylinder head which has been distorted by overheating in a vehicle may be unfit for further service.
- * Overheating during straightening causes a permanent change to the material's properties.
- * Re-use of an aluminium head which has been overheated during straightening may lead to gasket failure.