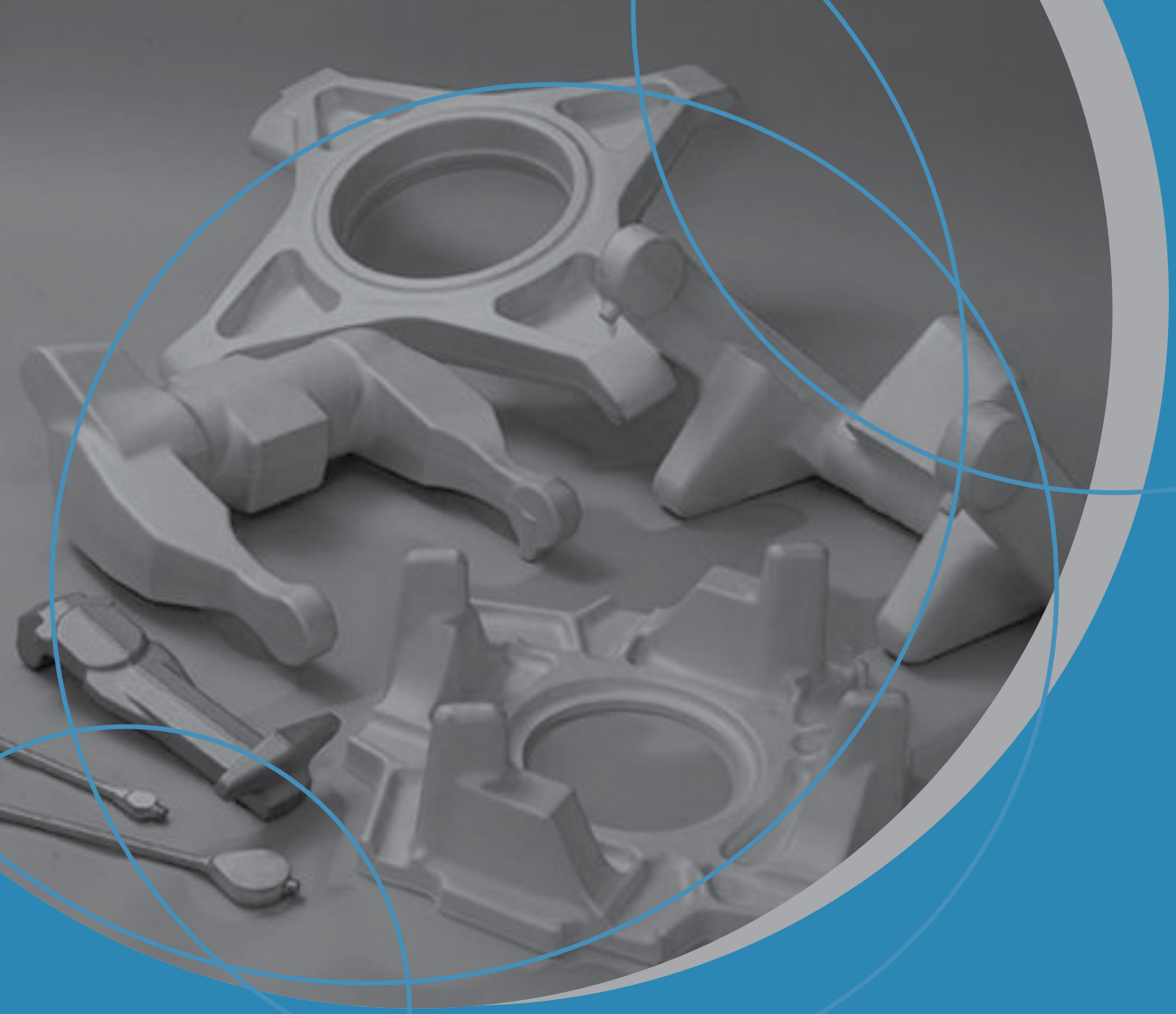

UK Aluminium Industry Fact Sheet 12

Aluminium Forging

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Introduction

The forging of aluminium alloys is the process of converting a uniform blank shape into a final product by hammering the material between shaped or flat dies.

This working process may take place in one stage or several stages. The great majority of aluminium forgings are made in the heat-treatable alloys, but forgings in pure aluminium and in some of the non-heat-treatable alloys find application in certain fields. The technology has now reached an advanced stage of development, and precision forgings are used for many highly stressed parts, such as in aircraft undercarriage gear, internal combustion engines and other power units. Forged components have an advantage of near net shape, minimising further machining.

The Process

Blanks are cut from extruded stock or from ingot and, before forging, are preheated to temperatures in the range of 400° - 500°C, according to the alloy used. In the production of hand forgings the blank is hot worked between flat dies, usually on a pneumatic hammer or a press, care being taken to ensure that the degree of deformation is sufficient to provide adequate breakdown of the original cast microstructure. The rough outline of the component is developed, with the grain flow or fibre of the material in the direction of stressing.

Hand forgings are usually associated with small quantity requirements or prototypes which do not warrant the cost of dies. Since these forged pieces are produced without shaped dies they cannot be subjected to strict dimensional accuracy. The grain flow can be controlled and further machining used to produce final components. Sometimes forged pieces are preferred as an alternative to rolled plate or extruded section for machining stock, ensuring that no cast microstructure has been retained.

Die-forgings, i.e. pressing and drop-forgings or stampings, are usually subjected to open die forgings in the same manner prior to the final operation in dies cut to the final required shape. Simple components may be pressed or stamped directly from extruded stock.

Die forgings are produced using shaped dies, giving a product with a high degree of dimensional consistency which considerably reduces the machining to the finished form. Such forgings have the advantages of good mechanical properties and structural integrity.

The technology of die forming has advanced to produce close-to-form forgings with higher standards of dimensional accuracy. In the non-heat treatable alloys where mechanical properties depend on the degree of cold working it is possible to cold forge.

Hydraulic presses of up to 12,000 tonnes capacity and hammers with tups weighing as much as 20 tonnes are in use for the largest forgings.

The Product

The reasons for using the forging route can be summed up as follows:

1. As an economic means of designing and making a shape. Machining can be eliminated and a high production rate can be achieved. Designs can be produced that eliminate the need for joints and welds.
2. A high strength to weight ratio can be achieved. The act of forging produces a fully wrought structure improving the shock resistance and fatigue resistance.
3. The surface finish is good and the elimination of porosity ensures pressure tightness.

This combination of good mechanical properties, dimensional accuracy and surface finish means that aluminium forgings are used in highly stressed parts where structural integrity is of paramount importance. The alloys commonly used for these highly stressed applications are from the 2000, 6000 and 7000 series. The aerospace industry is a major end user.

Further information about aluminium and aluminium alloys, their production, fabrication and end use can be obtained from:

(1) European Aluminium Association in Brussels
www.eaa.net

(2) International Aluminium Institute in London
www.world-aluminium.org