UK Aluminium Industry Fact Sheet 9

Aluminium Extrusions
Introduction

The versatility of aluminium as a metal is complemented by the versatility of the extrusion process. Other metals can be extruded but few with the ease of aluminium and its alloys. Aluminium's high strength-to-weight ratio, and its ability to be extruded into any shape – no matter how complex, with tight tolerances, make it an ideal material for design applications which require maximum versatility from a cross-sectional area. Aluminium extrusions are also highly cost effective since they need virtually no machining or maintenance.

The Process

Aluminium extrusions are produced by heating aluminium billets to approximately 500°C and extruding or forcing the hot metal through a steel die. As the extruded section emerges it is cooled and cut to the desired length. Heat treatment is then used to optimise the material's inherent mechanical properties. Computer aided design and manufacture is used to reduce design time, improve tolerances, and control each stage of the process more accurately. In addition to the normal mill condition, the various finishes which can be applied to the extrusions for protection and improved appearance are: natural silver or colour anodized film, plus a full range of colours in polyester powder coatings and electrophoretic white/bronze acrylic paint.

The benefits are:

Less fabrication and machining: there is greater design potential because intricate shapes may be extruded, reducing the need to manufacture component parts for future assembly. Some shapes achievable by extrusion are unattainable by any other process.

Low prototype costs: the cost of tooling aluminium extrusions is low compared to that of roll forming, casting, forging and moulding of competing materials.

Great structural efficiency: optimum structural efficiency is possible, as, by using extrusions, metal can be placed where it adds strength and omitted where it is not needed.

Less weight: extruded aluminium is lightweight yet strong and durable. Differences in properties between aluminium and competing materials can result in aluminium structures being ½ the weight of equivalent structures made from other heavy materials that are not so readily fabricated.

A wide range of attractive, corrosive-resistant finishes: can be achieved through powder or electrophoretic coating; designers can specify virtually any colour they wish. Natural silver or colour anodized films are also available.

Less maintenance: aluminium is a naturally durable metal and the surface finishing described above further enhances durability.

The Products

The range of alloys available in the form of extrusions offers a choice to suit most applications. The versatility of the extrusion process, coupled with the ideal properties of aluminium alloys of lightness, strength, corrosion resistance and formability means that aluminium extrusions are widely used in architecture, transport and general engineering. The aluminium spaceframe of vehicles such as the Audi A8 car is possible thanks to aluminium extrusions. Very complex, tight tolerance aluminium extrusions enable window and door sections to be fabricated into windows and doors with painted or anodized finishes that are long lasting, with good thermal properties.

Aluminium alloys fall into two basic categories: non heat treatable, whose strength can be improved in some form by work hardening; and heat treatable, which offer the highest strength but generally have lower formability ratings. Where ductility is important, heat treatable alloys can be fabricated
at an intermediate stage and finally heat treated to obtain maximum strength.

All alloys suffer loss of strength during welding to a varying degree dependent on their initial condition, particularly in the area adjacent to the weld. It is sometimes possible to restore the properties by further heat treatment, but this can create problems due to distortion. Alloy 5083 is particularly suitable for welding since it offers the highest strength after welding of any other standard alloy. This, and its resistance to sea water make it very suitable for marine applications.

Machining characteristics also tend to improve with increasing strength and if a free machining alloy is required for use on automatic lathes, then alloy 2011, which includes small lead and bismuth additions, is the ideal choice. Other specialised alloys include 1350 and 6101A for electrical applications, where low resistivity is the important feature and alloy 6463 for chemical brightening purposes.

Probably the best combination of medium strength, good surface finish and corrosion resistance, with excellent anodizing properties, is provided by the Al-Mg-Si alloys of the 6060, 6063 and 6082 types with tensile strengths in the range 190 to 310 MPa, which account for the very large tonnages supplied by the aluminium extrusion industry. Alloys 2014A, 7020 and 7075 with tensile strengths ranging from 470 to 570 MPa are used for high strength applications. The following table gives a selection of alloys with characteristics and typical applications.

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<th>Alloy Designation</th>
<th>Characteristics</th>
<th>Typical Applications</th>
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| 6060 (No former BS designation) | Intricate sections  
Medium strength  
Good surface finish  
Good corrosion resistance | Construction  
Consumer products  
General engineering |
| 6063 (Former BS designation HE9) | Intricate sections  
Medium strength  
Good surface finish  
Good corrosion resistance | Construction  
Consumer products  
General engineering |
| 6082 (Former BS designation HE30) | Medium/high strength  
Good corrosion resistance | Transport  
Scaffolding  
Bridges  
General engineering |
| 6005 (No former BS designation) | Very good corrosion resistance  
Good weldability  
Medium strength  
Good extrudability | Transport  
Structural engineering  
Precision engineering |
| 2618 (No former BS designation) | High strength | Engine components  
Piston rings  
Compressor blades |
| 5083 (Former BS designation N8) | Excellent corrosion resistance  
Excellent weldability  
Medium strength | Specialised applications, e.g.:  
Highly stressed marine structures  
Pressure vessels  
Cryogenic applications |
| 7020 (Former BS designation H17) | High strength  
Good weldability  
Elevated temperature forming | Specialised applications, e.g.:  
High strength welded structures |

Extrusions for general engineering purposes are produced to BS E 755 Parts 1-9.

More information on extrusion is available from http://www.powerofaluminium.com/html/extrusion

For details of UK Extruders please visit http://www.alfed.org.uk/assocs.asp?action=display&ident=1

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