ALUMINIUM

Welding of Aluminium

Aluminium is a light, ductile, readily worked metal, with good thermal and electrical properties. It has a tenacious oxide film on the surface that gives it good corrosion resistance. It is also the most abundant metal on earth.

Aluminium alloys may be sub-divided into two main groups – cast alloys and wrought alloys. Wrought materials also come in a wide variety of product forms.

Wrought alloys are further sub-divided into heat treatable and non-heat treatable alloys.

Heat treatable alloys are based on aluminium-copper, aluminium-silicon-magnesium and aluminium-zinc-magnesium alloy systems. They can develop high strength by solution treatment followed by age hardening at elevated temperatures.

Non-heat treatable alloys include pure aluminium, and those based on aluminium-manganese, aluminium-silicon, and aluminium-magnesium. They can be strengthened only by cold work.

Types

Cast Alloys

Aluminium alloy castings may be produced in sand moulds, in metal moulds, and by gravity or pressure die-casting. The castings possess rigidity and good corrosion resistance, with strength and ductility generally of secondary importance.

Alloying elements frequently used in aluminium castings are copper, silicon, magnesium, zinc, iron, manganese and nickel. Cast alloys are of two main types:

- Those which rely solely on alloying for their properties, such as AlMg and AlSi alloys
- Those for which heat treatment can be used to enhance properties, like the AlCu alloys.

As yet, there is no agreed international standard numbering system for castings. Each country uses its own identification method. In the UK, casting alloys are prefixed by the letters 'LM', followed by a one or two digit number; in the US, casting alloys are given a two or three digit number, some prefixed with a letter. Similar systems are also used in South Africa.

Many aluminium casting alloys are based on the AlSi or AlCu systems. The AlSi system has good fluidity and can be used for intricately shaped cast sections. Silicon reduces hot shortness and the tendency for castings to crack on solidification. These alloys have good corrosion properties and often have copper as a second element to enhance their strength.

There are only a few AlMg casting alloys, for while they have good corrosion properties in marine environments, and good strength, they are somewhat more difficult to cast than AlSi alloys.

Wrought Alloys

Wrought alloys consist of cast material that has been worked by processes such as forging, extrusion, drawing, or rolling, thereby improving the homogeneity and enhancing the mechanical properties of the material. This renders many forms of wrought alloys more suitable for welded construction.

Wrought alloys may be:

- Hot or cold rolled, to produce plate, sheet, strip or foil
- Extruded, to give bars, sections or tube
- Drawn, to make wire, bolts, screws, rivets or tube
- Forged, to give a variety of shapes.

Wrought aluminium alloys are of two main types:

- Heat treatable (those that can be strengthened by heat treatment)
- Non-heat treatable (those that can only be strengthened by cold working).

Wrought aluminium alloys are also further classified into groups according to the main alloying element or elements. Each group, or 'series', has a four-digit designation conferred by the International Standards Organisation (ISO). The first number relates to the main alloying element(s), the second number to the alloy modification (zero being the original alloy) and the next two numbers indicate the order in which the alloys were developed and subsequent variations. A letter following the four-digit number indicates a national variation in composition. For instance, alloy 1200A is a compositional variation of alloy 1200.

Wrought aluminium alloys, in numerical series order, are described briefly below. Some of the alloys in each series, and their approximate compositions, are given in tables in each section. Elements are only quoted if included as a deliberate addition, with a minimum requirement, or as a maximum and minimum range in specifications. Other elements may be present as impurities with a maximum limit.

Mechanical Properties

Aluminium is ductile and malleable, enabling it to be manufactured in many different forms by such methods as hot rolling, cold rolling, extrusion, forging, drawing, stamping, spinning, pressing or bending.

Aluminium has good toughness, even down to cryogenic temperatures (below -100°C), because no ductile to brittle phase transition takes place, even with rapid cooling.

Although the strength of pure aluminium is low compared with steel and other common engineering materials, it can be improved by cold working or by alloying with different elements, and these alloys can be further improved with heat treatment or cold working. The elements most commonly used to form alloys with aluminium are copper, magnesium, silicon, manganese and zinc, singly or in combinations.

Alloying with these elements can strengthen aluminium by one of two mechanisms:

- Strength may be increased by the presence of alloying elements that become entrapped in solid solution within the aluminium by a process called solid solution hardening. Alloys that are solid solution hardened can be cold worked

to further increase strength and this is called work hardening. Work hardening the material involves cold rolling, extrusion, pressing, drawing, etc. and the strength achieved depends on the amount of cold work applied, and may be described as the 'temper' of the alloy. Alloys of this type include AlMn and AlMg, and they are known as non-heat treatable alloys.

- The properties of some aluminium alloys may be improved by heat treatment, a process in which precipitation of constituents held in solid solution is allowed to take place by holding at a suitable temperature. The process is usually described as ageing or age hardening. If age hardening takes place at room temperature, it is referred to as natural ageing. But if elevated temperatures are used, this is called artificial ageing. Alloys of this type include AlCu, AlMgSi and AlZnMg, which are known as heat treatable alloys.

Welding

Although, at first sight, it appears to be a relatively simple alloy system to weld, compared with steel, because no solid state phase change occurs, there are several important factors influencing the weldability of aluminium and its alloys. There are some general factors covering all alloys and some individual alloy characteristics, the latter making some alloys more difficult to weld than others.

The main factors to be considered and dealt with in detail in welding aluminium are:

- The presence of a tenacious, refractory, surface oxide film, which, if not removed before welding, can cause lack of fusion or porosity
- The high solubility of hydrogen in liquid aluminium which, compared with its solubility in solid aluminium, can lead to porosity in weld metal
- The tendency for some alloys, notably 2XXX, 6XXX and 7XXX series alloys, to suffer hot cracking or HAZ liquation cracking
- The reduction in mechanical properties that occurs across the weld zone when aluminium alloys are welded.

Welding Processes

Aluminium and many of its alloys can be readily welded, most frequently using inert gas shielded processes, such as MIG and TIG. MMA is still used occasionally, particularly for site repair work, but it is difficult to obtain good quality welds with the consumables available.

MIG welding of aluminium is always carried out with a completely inert gas shield, traditionally argon, but now increasingly helium-argon mixtures, such as the Afrox Alushield® range, which help to increase penetration and to reduce the incidence of porosity.

It must be remembered that aluminium and its alloys must not be MIG welded using active gases like carbon dioxide, or $ArCO_2$ mixtures, since these will lead to severe oxidation and failure to produce a weld.

TIG welding must also be carried out using inert gas shield, argon or argon-helium mixtures, not only to prevent oxidation of the weld, but also to prevent the tungsten electrode being consumed.

High power density processes, like laser and electron beam, and the more recently developed friction stir welding process, are also suitable for welding all alloys. Brazing and resistance welding techniques are applicable to some alloys.

The submerged arc and flux cored wire processes are not used for welding aluminium alloy systems.

Welding Casting Alloys

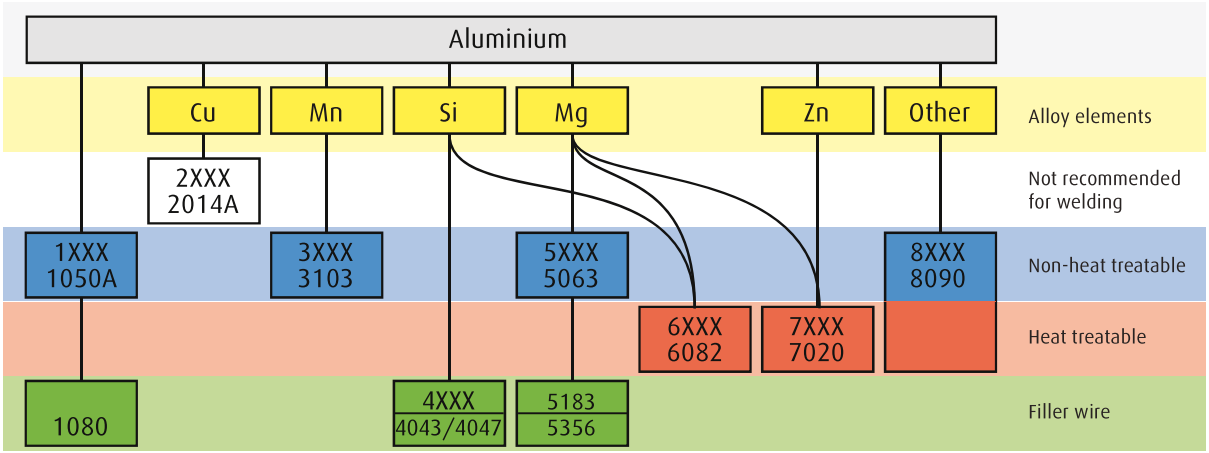
Aluminium castings find limited use in welded construction, principally because of their low ductility and high porosity content, but re-instatement and repair of castings by welding is often required. Many casting alloys, notably those containing copper, are not recommended for welding as they are very crack sensitive. Pure aluminium, and alloys based on AlSi and AlMg, may be welded with appropriate filler metals.

Welding Wrought Alloys

A brief résumé of the welding characteristics of each group of alloys is given below.

1XXX series: Non-alloyed aluminium

The 1XXX alloys are readily welded using filler metals of matching composition. It is also possible to use AlSi or AlMg filler metals for some applications. They may be welded using all main processes, including MIG, TIG, MMA, gas welding and brazing as well as resistance and friction welding methods.



2XXX series: Copper as main alloying element

These alloys are virtually unweldable because the formation of aluminium-copper intermetallics in weld metal renders them brittle. They tend to crack if attempts are made to weld them using fusion welding processes, although the use of Al-12% Si filler may sometimes give reasonable results. Non-fusion techniques, such as friction welding and friction stir welding may give some success.

3XXX series: Manganese as main alloying element

The 3XXX series alloys are weldable alloys, welded with matching filler metals, but are welded infrequently, the main joining method being brazing. Furnace brazing and gas torch brazing are suitable methods.

4XXX series: Silicon as main alloying element

These alloys are weldable by all processes using AlSi filler metals where appropriate. However, as stated before, a major use for these alloys is as welding wire containing 5% Si or 12% Si.

5XXX series: Magnesium as main alloying element

Alloys with magnesium contents under about 3%, such as 5251 and 5454, are susceptible to cracking and it is usual to use higher magnesium fillers to overcome this tendency. Alloys with more than 4,5% Mg are readily welded.

MIG and TIG are the most frequently used welding processes for these alloys. They tend not to respond well to MMA or to gas welding and brazing.

6XXX series: Magnesium and silicon as main alloying elements

These alloys should be welded with care, since, with less than 1% Si and 1% Mg, they have a tendency to crack in the HAZ by a mechanism called liquation cracking, if high heat inputs are used. To avoid weld metal cracking, they require a MIG or TIG filler metal containing 5% Mg or 5% Si to be used. Care must be taken not to mix the two filler compositions or cracking will result.

7XXX series: Zinc as main alloying element

The series includes both weldable and unweldable grades, although even the weldable alloys are prone to suffer HAZ liquation cracking. It is usual to use filler metals containing zinc and magnesium, although it is possible to use Al-5,5% Mg fillers in some instances. MIG and TIG tend to be the main processes used on these alloys.

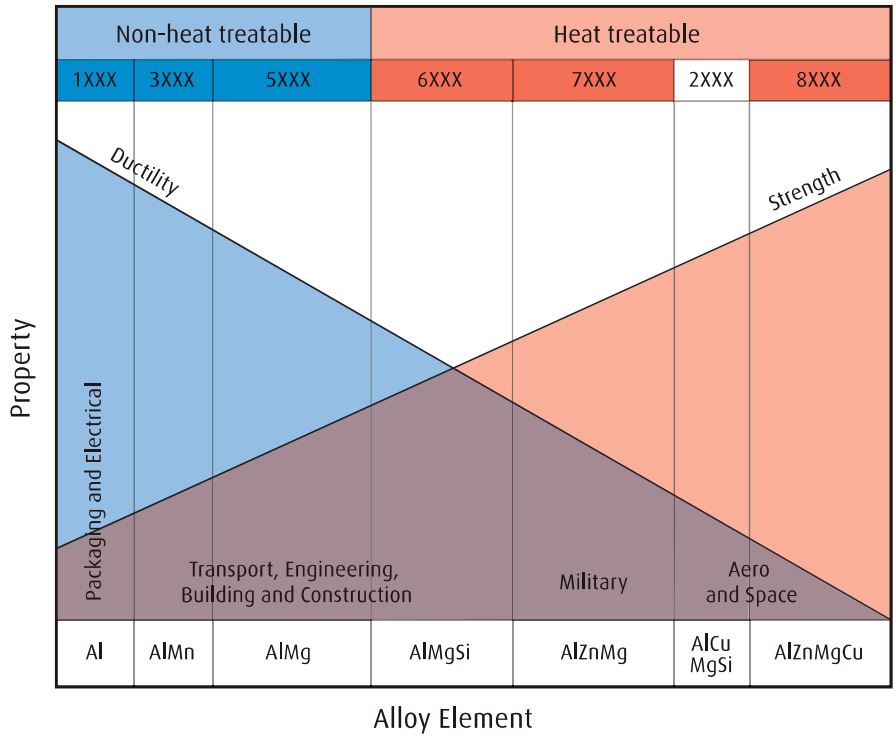
8XXX series: Miscellaneous alloys

Most of the alloys in this series are not commonly welded, and some are not weldable. However, there have been developments in aluminium-lithium alloys for aerospace applications that have led to weldable grades becoming available.

Cutting

Cutting processes that use an electric arc in a stream of inert gas may be used to cut all aluminium alloys. The cut surfaces are generally quite smooth and clean, but the plate retains narrow, melted and partially melted zones which, with heat treatable alloys, may lead to intergranular cracking. Corrosion properties may also be adversely affected in the immediate HAZ of the cut. It is, therefore, advisable to trim back by about 3 mm from the cut surface to give a sound welding surface, free from possible stress raisers.

It should be noted that some standards call for levels of up to 6 mm to be removed after cutting.



Relevant standards should be consulted to establish requirements.

Cutting Processes

There are several different thermal processes for cutting aluminium and its alloys, but the most frequently used is plasma cutting, with laser cutting also finding some applications.

For most industrial fabricators today, plasma cutting is probably the first choice as a cutting technique for aluminium from 3 mm to 50 mm and above in thickness. Plasma cutting gives a smooth cut surface, free from major contamination, but should be trimmed prior to welding, as described above.

Preheating of Aluminium and Aluminium Alloys

When to Preheat

Preheat is needed when there is a risk that, if a welding operation is carried out 'cold', an unsound weld could be produced. While it is not possible here to cover all eventualities, there are certain guidelines that can be followed in making the decision as to whether to preheat or not, and these are outlined here, categorised for convenience, by alloy type.

Aluminium Alloys

Aluminium alloys have a high thermal conductivity and preheat is used to provide additional heat to the weld area in order to help ensure full fusion of the weld. Application of preheat is also used to drive off any moisture in the surface oxide. Preheating may not be necessary when welding thin sheet, but becomes increasingly important as thickness, and therefore thermal conduction away from the weld, increases.

How Much Preheat to Apply

The actual preheat temperature required for a specific welding operation depends not only on the material or materials being welded, but also on the combined thickness of the joint, the heat input from the welding process being used and the amount of restraint imposed upon the components. There are no hard and fast rules regarding how much preheat to apply, but there are many publications available that give helpful guidance. These publications include national and international standards or codes of practice, guides from steel and aluminium alloy producers, and from consumable manufacturers. Some guidelines are included here and, as in the previous section, categorised for convenience by alloy type.

Aluminium Alloys

As a rule, aluminium alloys are only preheated to temperatures between 80°C and 120°C. Certain heat treatable aluminium alloys (AlSiMg) are sensitive to HAZ liquation cracking, if overheated, and preheat must be carefully controlled within this range. With less sensitive alloys, preheat may be increased up to a maximum of 180 - 200°C. Remember that aluminium alloys have relatively low melting points and care must be taken to avoid overheating, which can result in poor weld quality and cracking in some alloys.

Aluminium and Aluminium Alloys

Base Metal	1060, 1100, (1050), 3003	3004	5005, 5050	5052	5083	5086	5154, 5354	5454	5456	6005, 6061	7005	356,0 443,0
1060, 1100, (1050), 3003	1100 (1050) b, e	4043 d, e	4043 d, e	4043 d, e	5356 b, d	5356 b, d	4043 d, e	4043 d, e	5356 b, d	4043 e	5356 b, d	4043 e
3004		4043 d, e	4043 d, e	4043 d, e	5356 d	5356 d	5356 a	5356 a	5356 d	4043 d, e	5356 b, e	4043 e
5005, 5050			4043 d, e	4043 d, e	5356 d	5356 d	5356 a	5356 a	5356 d	4043 d, e	5356 b, d	4043 e
5052				5356 a, b	5356 d	5356 d	5356 a	5356 a	5356 d	5356 a, b	5356 a	4043 a, e
5083					5183 d	5356 d	5356 d	5356 d	5183 d	5356 d	5183 d	5356 b, d
5086						5356 d	5356 d	5356 d	5356 d	5356 d	5356 d	5356 b, d
5154, 5254							5356 a	5356 a	5356 a	5356 a	5356 d	4043 a
5454								5554 b, d	5356 d	5356 a, b	5356 a	4043 a, e
5456									5556 d	5356 d	5556 d	5356 b, d
6005, 6061, 6063, 6351										4043 a, e	5356 a, b	4043 a, e
7005											5356 d	4043 a, e
356,0 443,0												4043 c, e

Notes

1 The filler metal shown for each combination of base metals is that most commonly used. However, the specific filler metal depends on usage and type of joint and, in a number of cases, acceptable alternatives are recommended (footnotes a to c)
2 Filler metals conform to requirements of AWS specification A5.10-80
3 Exposure to specific chemicals or a sustained high temperature (over 150°F) may limit the choice of the metals. Filler alloys 5183, 5356, 5556 and 5654 should not be used in sustained elevated-temperature service

a 5813, 5356, 5554, 5556 and 5654 may be used. In some cases they provide: improved colour match after anodising treatment, higher weld ductility and higher weld strength. 5554 is suitable for elevated-temperature service. Castings welded with these filler metals should not be subjected to post weld artificial ageing
b 4043 may be used for some applications
c Filler metal with the same analysis as the base metal is sometimes used
d 5183, 5356 or 5556 may be used
e 4047 may be used for some applications

Aluminium Electrodes

Afrox Alumoid

Afrox Alumoid is a 12% silicon aluminium arc welding electrode with exclusive self-lifting slag. It is designed for arc welding wrought and cast aluminium alloys, alloyed with copper, silicon and magnesium. Also excellent for joining dissimilar grades of aluminium. Can also be used as a torch brazing alloy.

Classifications		
AWS	A5.3	E4047
DIN	1732	EL-AlSi12

Typical Chemical Analysis (All weld metal)			
% Manganese	0,04	**% Copper**	0,23
% Aluminium	Bal.	**% Magnesium**	0,04
% Silicon	11,8	**% Zinc**	0,08
% Iron	0,8		

Typical Mechanical Properties (All weld metal in the as welded condition)	
0,2% Proof Stress	180 MPa
Tensile Strength	300 MPa
% Elongation	7

Packing Data				
Diameter (mm)	**Electrode Length (mm)**	**Current (A)**	**Pack Mass (kg)**	**Item Number**
2,5	350	50 - 80	Sleeve	W072112
3,25	350	70 - 120	Sleeve	W072113
2,5	350	50 - 80	2,0	W076112
3,25	350	70 - 120	2,0	W076113
4,0	350	110 - 150	2,0	W076114

Aluminium MIG & TIG Wires

Afrox Filmax 1050
Afrox TIG 1050

Afrox Filmax 1050 and Afrox TIG 1050 are high quality, commercially pure aluminium wires having a maximum of 0,5% alloying elements. Afrox MIG 1050 is suitable for spray arc and pulsed arc transfer using high purity argon on thin sections or an argon-helium mixture (Alushield®). For MIG welding, gas flow rates of 15 - 20 ℓ/min should be used on thicknesses greater than 4 mm. Afrox TIG 1050 should be used with a zirconiated tungsten electrode with pure argon or Alushield® at flow rates of 10 - 15 ℓ/min. For oxy-acetylene gas welding, a neutral flame should be used with aluminium welding flux (Item Number W001777).

Applications

The wire is recommended for welding unalloyed aluminium products, i.e. aluminium alloy types 1050, 1070, 1200 and equivalents. Applications in electronic, electrical and construction industries; equipment and containers for food, chemical, brewing and atomic energy industries and decorative assemblies in architecture and transport.

Classifications		
AWS	A5.10	Nearest equivalent ER1100
EN	18273	Al 1200 (A199,0)

Typical Chemical Analysis (Wire analysis)			
% Silicon	0,3 max	**% Magnesium**	0,05 max
% Iron	0,4 max	**% Zinc**	0,07 max
% Copper	0,05 max	**% Titanium**	0,05 max
% Manganese	0,05 max	**% Aluminium**	99,5 min

Typical Mechanical Properties (All weld metal in the as welded condition)	
0,2% Proof Stress	20 MPa
Tensile Strength	65 MPa
% Elongation on 4d	35

Packing Data

MIG			TIG			
Diameter (mm)	**Pack Mass (kg)**	**Item Number**	**Diameter (mm)**	**Pack Mass (kg)**	**Consumable Length (mm)**	**Item Number**
1,2	7,0	W033167	1,6	5,0	1 000	W030506
1,6	7,0	W077507	3,2	2,0	1 000	W030508

Recommended shielding gases: Argon or Alushield®

Afrox Filmax 4043
Afrox TIG 4043

Afrox Filmax 4043 and Afrox TIG 4043 are 95% aluminium, 5% silicon welding wires suitable for the welding of heat treatable base alloys, and more specifically, the 6XXX series. It has a lower melting point and more fluidity than the 5XXX series filler alloys and is preferred by welders because of its favourable operating characteristics. The ER4043 wires are also less sensitive to weld cracking with the 6XXX series base alloys. Afrox MIG 4043 is suitable for spray arc and pulsed arc transfer using high purity argon on thin sections or an argon-helium mixture (Alushield®) as a shielding gas on thicker sections. Flow rates of 15 - 20 ℓ/min should be used. Afrox TIG 4043 should be used with a zirconiated tungsten electrode with pure argon or an argon-helium mixture (Alushield®) for thick sections, at flow rates of 10 - 15 ℓ/min. For oxy-acetylene gas welding, a neutral flame should be used with aluminium welding flux (Item Number W001777).

Applications

Applications in the construction and automotive industry.

Materials to be Welded

Afrox Filmax 4043 and TIG 4043 wires are used to weld most aluminium alloys containing up to 7% silicon and can be used for welding wrought to cast aluminium materials, such as: BS 1470-1475 HE19, HE15, HE20 and HE30 material BS 1490 LM2 and LM6 castings Aluminium alloys (AAA).6061, 6062, 5052, 5154, 3003, 2024, 1050 and 1100 (after anodising, welding will be of a dark grey colour).

Classifications		
AWS	A5.10	ER4043
EN	18273	Al4043 (AlSi5)

Typical Chemical Analysis (Wire analysis)			
% Silicon	4,5 - 5,5	**% Zinc**	0,1 max
% Iron	0,4 max	**% Titanium**	0,15 max
% Copper	0,05 max	**% Beryllium**	0,0008 max
% Manganese	0,05 max	**% Aluminium**	Bal.
% Magnesium	0,05 max		

Typical Mechanical Properties (All weld metal in the as welded condition)	
0,2% Proof Stress	40 MPa
Tensile Strength	120 MPa
% Elongation on 5d	8

Packing Data

MIG			TIG			
Diameter (mm)	**Pack Mass (kg)**	**Item Number**	**Diameter (mm)**	**Pack Mass (kg)**	**Consumable Length (mm)**	**Item Number**
1,0	7,0	W077517	1,6	2,0	1 000	W030511
1,2	7,0	W033183	2,4	2,0	1 000	W077513
-	-	-	3,2	2,0	1 000	W030513

Recommended shielding gases: Argon or Alushield®

Afrox Filmax 4047
Afrox TIG 4047

Afrox Filmax 4047 and Afrox TIG 4047 are 11 - 13% silicon wires, which have a lower melting point and higher fluidity than ER4043 type wires. Used as a substitute for an ER4043 type wire to increase silicon in the weld metal, minimise hot cracking and produce slightly higher fillet weld shear strength. Also suitable for sustained elevated temperature service, i.e. above 65°C. Afrox Filmax 4047 is suitable for spray arc and pulsed arc transfer using high purity argon on thin sections or an argon/helium mixture (Alushield®) on thicker sections. Flow rates of 15 - 20 ℓ/min should be used. Afrox TIG 4047 should be used with a zirconiated tungsten electrode with pure argon or an argon-helium mixture (Alushield®) for thick sections, at flow rates of 15 - 20 ℓ/min. With oxy-acetylene brazing, aluminium brazing flux (Item Numbers W001753 and W001755) should be used.

Applications

For welding, but normally for brazing aluminium sheets, for extrusions and castings. Also for automotive components, body panels, heat exchangers, etc.

Classifications		
AWS	A5.10	ER4047
EN	18273	Al 4047 (AlSi12)

Typical Chemical Analysis (Wire analysis)			
% Silicon	11,0 - 13,0	**% Zinc**	0,1 max
% Iron	0,5 max	**% Titanium**	0,15 max
% Copper	0,05 max	**% Beryllium**	0,0008 max
% Manganese	0,15 max	**% Aluminium**	Bal.
% Magnesium	0,05 max	(After anodising, welding will be of a different colour)	

Typical Mechanical Properties (All weld metal in the as welded condition)	
0,2% Proof Stress	60 MPa
Tensile Strength	130 MPa
% Elongation on 5d	5
% Melting Range	573 - 585°C

Packing Data

MIG			TIG			
Diameter (mm)	**Pack Mass (kg)**	**Item Number**	**Diameter (mm)**	**Pack Mass (kg)**	**Consumable Length (mm)**	**Item Number**
1,0	7,0	W077524	1,6	2,0	1 000	W000850
1,2	7,0	W077525	2,0	2,0	1 000	W077518
1,6	7,0	W077526	3,2	2,0	1 000	W000851

Recommended shielding gases: Argon or Alushield®

Afrox Filmax 5183
Afrox TIG 5183

Afrox Filmax 5183 and Afrox TIG 5183 are 4,7% magnesium, 0,7% manganese wires for the welding of the 5XXX series high magnesium (5%) alloys to themselves or to the heat treatable and 7XXX series alloys that need to meet and exceed tensile strength requirements of 40 000 psi (276 MPa). Afrox Filmax 5183 is suitable for spray arc and pulsed arc transfer using high purity argon on thin sections or an argon-helium mixture (Alushield®) as a shielding gas on thicker sections. Flow rates of 15 - 20 ℓ/min should be used. Afrox TIG 5183 should be used with a zirconiated tungsten electrode with pure argon or an argon-helium mixture (Alushield®) for thick sections, at flow rates of 10 - 15 ℓ/min. For oxy-acetylene gas welding, a neutral flame should be used with aluminium welding flux (Item Number W001777).

Applications

Applications found in the shipbuilding, railway and automotive industry. Also in marine fabrication and repairs, bicycle frames, cryogenic tanks and other high strength low temperature structural aluminium applications.

Classifications		
AWS	A5.10	ER5183
EN	18273	Al5183 (AlMg4,5,Mn,0,7)

Typical Chemical Analysis (Wire analysis)			
% Silicon	0,25 max	**% Zinc**	0,25 max
% Iron	0,4 max	**% Titanium**	0,07 - 0,15
% Copper	0,05 max	**% Beryllium**	0,0008 max
% Manganese	0,6 - 1,0	**% Aluminium**	Bal.
% Magnesium	4,3 - 5,2	**% Chromium**	0,05 - 0,25

Typical Mechanical Properties (All weld metal in the as welded condition)	
0,2% Proof Stress	275 MPa
Tensile Strength	125 MPa
% Elongation on 5d	17

Packing Data

MIG			TIG			
Diameter (mm)	**Pack Mass (kg)**	**Item Number**	**Diameter (mm)**	**Pack Mass (kg)**	**Consumable Length (mm)**	**Item Number**
1,2	7,0	W033156	3,2	2,0	1 000	W077532
-	-	-	4,0	2,0	1 000	W077533

Recommended shielding gases: Argon or Alushield®

Afrox Filmax 5356
Afrox TIG 5356

Afrox Filmax 5356 and Afrox TIG 5356 are 95% aluminium, 5% magnesium wires for general purpose welding of the 5XXX series alloys when 40 000 psi (276 MPa) is not required. Afrox Filmax 5356 is suitable for spray arc and pulsed arc transfer using high purity argon on thin sections or an argon-helium mixture (Alushield®) as a shielding gas on thicker sections. Flow rates of 15 - 20 ℓ/min should be used. Afrox TIG 5356 should be used with a zirconiated tungsten electrode with pure argon or an argon-helium mixture (Alushield®) for thick sections, at flow rates of 10 - 15 ℓ/min. For oxy-acetylene gas welding, a neutral flame should be used with aluminium welding flux (Item Number W001777).

Applications

Applications found in the construction of ships, bulk container, railway and the automotive industries.

Classifications		
AWS	A5.10	ER5356
EN	18273	Al5356 (AlMg5Cr)

Typical Chemical Analysis (Wire analysis)			
% Silicon	0,25 max	**% Zinc**	0,1 max
% Iron	0,4 max	**% Titanium**	0,07-0,15
% Copper	0,05 max	**% Beryllium**	0,0008 max
% Manganese	0,1 - 0,2	**% Aluminium**	Bal.
% Magnesium	4,5 - 5,6	**% Chromium**	0,1 - 0,3

Typical Mechanical Properties (All weld metal in the as welded condition)	
0,2% Proof Stress	240 MPa
Tensile Strength	125 MPa
% Elongation on 5d	17

Packing Data

MIG			TIG			
Diameter (mm)	Pack Mass (kg)	Item Number	Diameter (mm)	Pack Mass (kg)	Consumable Length (mm)	Item Number
0,8	7,0	W077541	1,6	2,0	1 000	W030522
1,2	0,5	W033153	3,2	2,0	1 000	W030521
1,6	7,0	W033176	-	-	-	-

Aluminium Brazing Flux

Afrox Aluminium Brazing Flux

Afrox Aluminium Brazing Flux is a white flux powder with a low melting point of 550°C recommended for use with Afrox TIG 4047 aluminium brazing alloy. This flux may be used with water to form a paste.

Packing Data	
Container Mass (g)	**Item Number**
500 (jar)	W001753