Aluminium

Aluminium Welding

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 temperature.

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

Aluminium and aluminium alloys can be divided into two main groups that refer to the form in which they are used. These are 'cast alloys' and 'wrought alloys'. Each of these two groups may then be further sub-divided into alloy type by composition.

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 Al-Mg and Al-Si alloys
- Those for which heat-treatment can be used to enhance properties, like the Al-Cu 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 Australia and New Zealand.

Many aluminium casting alloys are based on the Al-Si or Al-Cu systems. The Al-Si 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 Al-Mg casting alloys, for while they have good corrosion properties in marine environments, and good strength, they are somewhat more difficult to cast than Al-Si 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 Al-Mn and Al-Mg, 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 Al-Cu, Al-Mg-Si and Al-Zn-Mg, 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

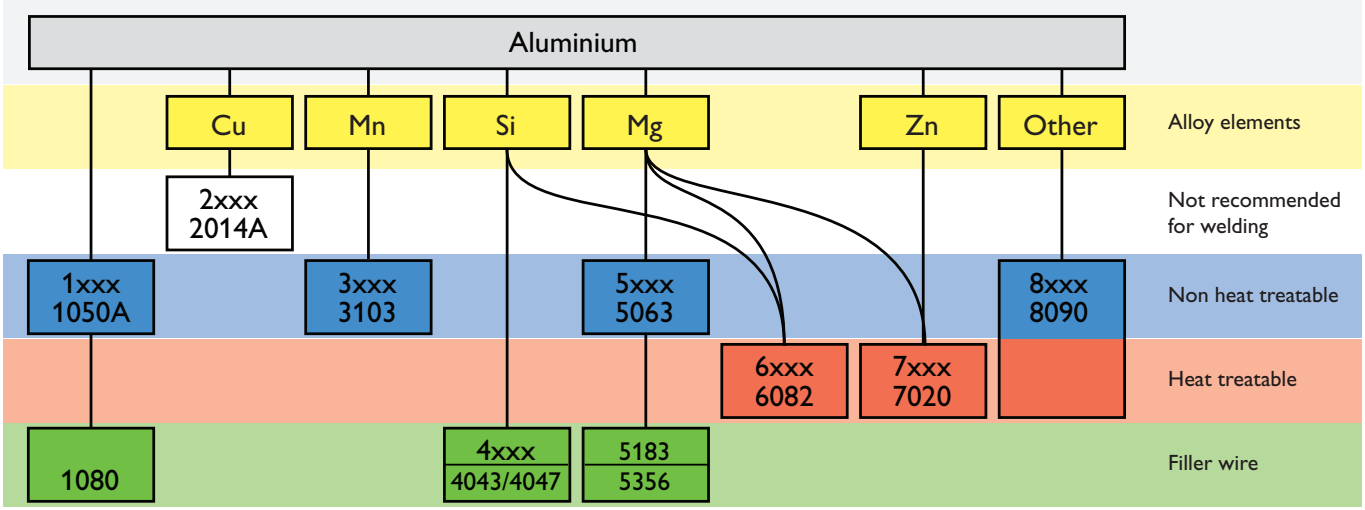
Aluminium and many of its alloys can be readily welded, most frequently using inert gas shielded processes, such as MIG and TIG. MMA is still used occasionally, particularly for site repair work, but it is difficult to obtain good quality welds with the consumables available.

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 BOC 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 Ar-CO_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



WARNING Welding can give rise to electric shock, excessive noise, eye and skin burns due to the arc rays, and a potential health hazard if you breathe in the emitted fumes and gases. Read all the manufacturer's instructions to achieve the correct welding conditions and ask your employer for the Materials Safety Data Sheets. Refer to www.boc.com.au or www.boc.co.nz

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 Al-Si and Al-Mg, may be welded with appropriate filler metals.

Welding Wrought Alloys

A brief resume 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 Al-Si or Al-Mg filler metals for some applications. They may be welded using all main processes, including MIG, TIG, MMA, gas welding and brazing, 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 Al-Si 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.

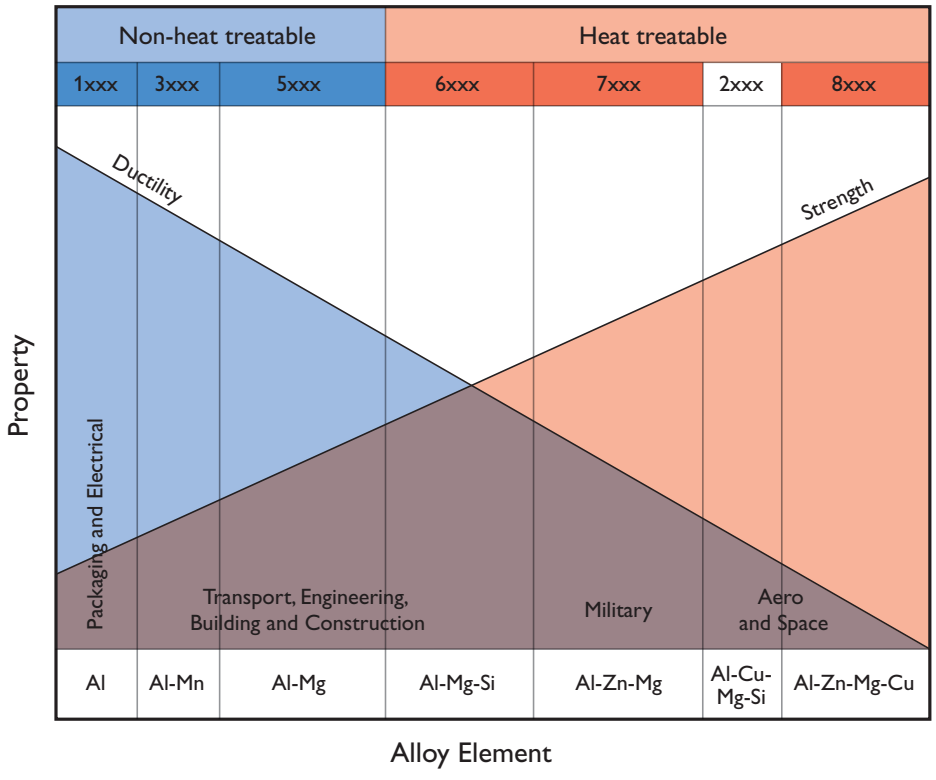
MIG and TIG are the most frequently used welding processes for these alloys, and they tend not to respond well to MMA or to gas welding and brazing.

6XXX series: Magnesium and Silicon as Main Alloying Elements

These alloys can 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,



WARNING Welding can give rise to electric shock, excessive noise, eye and skin burns due to the arc rays, and a potential health hazard if you breathe in the emitted fumes and gases. Read all the manufacturer's instructions to achieve the correct welding conditions and ask your employer for the Materials Safety Data Sheets. Refer to www.boc.com.au or www.boc.co.nz

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 (Al-Si-Mg) 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, 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.

BOC Aluminium MIG Wire 1080

Welding characteristics

Triple shaved for smoother feeding and consistent contact.

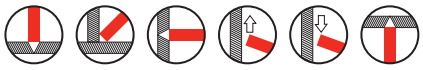
Applications

For welding of 99.9% pure aluminium.

Recommended shielding gases
Welding Grade Argon
Alushield® Light
Alushield® Heavy

Classifications
AS 2717.2 No equivalent
AWS/ASTM A5.10 No equivalent
DIN 1732 SG.Al Mg 4.5 Mn Werks. 3.3548 BS 2901 Pt.4 5183

Welding positions



Mechanical properties – all weld metal	
	Typical as welded
Yield strength (Rm)	22
Tensile strength (MPa)	60
Elongation (%)	40

Chemical composition, wt% – all weld metal							
	Si	Fe	Cu	Mn	Mg	Zn	Ti
Min.							
Typical	<0.15	<0.15	<0.02	<0.02	<0.02	<0.06	<0.02
Max.							

Packing and welding data

Dia. (mm)	Current (A)	Voltage (V)	Weight/ spool (kg)	Part No.
0.8	70–110	16–18	5.0	S970850
0.9	90–130	17–19	6.0	S970960
1.0	100–140	17–19	6.0	S971060
1.2	120–150	24–29	6.0	S971260
1.6	200–320	25–33	6.0	S971660

BOC Aluminium MIG Wire 4043

Welding characteristics

- Excellent flow characteristics and penetration
- Excellent crack resistance
- Triple shaved for smoother feeding and consistent contact

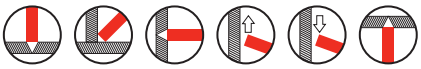
Applications

- Used to weld alloys with a maximum of 2% alloying elements and for castings containing up to 7% Si
- Many general construction and automotive applications

Recommended shielding gases
Welding Grade Argon
Alushield® Light
Alushield® Heavy

Classifications
AS 2717.2 E4043
AWS/ASTM A5.10 ER4043
DIN 1732, SG.AL SI.5 Werks. 3.2245
BS 2901 Pt.4 4043 A

Welding positions



Mechanical properties – all weld metal	
	Typical as welded
Yield strength (Rm)	40
Tensile strength (MPa)	120
Elongation (%)	8

Chemical composition, wt% – all weld metal							
	Si	Fe	Cu	Mn	Mg	Zn	Ti
Min.	4.5						
Typical		<0.40	<0.05	<0.05	<0.05	<.010	<0.015
Max.	5.5						

Packing and welding data

Dia. (mm)	Current (A)	Voltage (V)	Weight/ spool (kg)	Part No.
0.8	70–110	16–18	0.5	S430805
0.8	70–110	16–18	5.0	S430850
0.9	90–130	17–19	0.5	S430905
0.9	90–130	17–19	6.0	S430960
1.0	100–140	17–19	0.5	S431005
1.0	100–140	17–19	6.0	S431060
1.2	150–250	20–25	0.5	S431205
1.2	150–250	20–25	6.0	S431260
1.6	200–350	23–28	6.0	S431660

BOC Aluminium MIG Wire 4047

Welding characteristics

- Good mechanical properties
- Excellent corrosion resistance
- Low melting point ensures reduction in parent metal distortion
- Triple shaved for smoother feeding and consistent contact

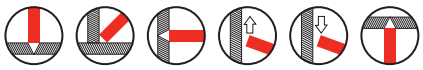
Applications

- General purpose welding of aluminium sheets, extrusions and castings
- Many general construction and automotive applications

Recommended shielding gases
Welding Grade Argon
Alushield® Light
Alushield® Heavy

Classifications
AS 2717.2 E4047
AWS/ASTM A5.10 ER4047
DIN 1732SG.AL Si.12 Werks. 3.2585
BS 2901 Pt.4 4047 A

Welding positions



Mechanical properties – all weld metal	
	Typical as welded
Yield strength (Rm)	60
Tensile strength (MPa)	130
Elongation (%)	5
Melting Range	573–585°C

Chemical composition, wt% – all weld metal							
	Si	Fe	Cu	Mn	Mg	Zn	Ti
Min.	11.0						
Typical		<0.50	<0.05	<0.15	<0.05	<0.10	<0.15
Max.	13.0						

Packing and welding data

Dia. (mm)	Current (A)	Voltage (V)	Weight/ spool (kg)	Part No.
1.0	100–140	17–19	6.0	S471060
1.2	120–150	24–29	6.0	S471260

BOC Aluminium MIG Wire 5183

Welding characteristics

- High strength
- Triple shaved for smoother feeding and consistent contact

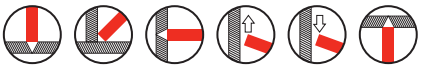
Applications

- Where high strength and resistance to sea water are required
- Applications in ship building, offshore, cryogenic equipment, railway constructions and automotive

Recommended shielding gases
Welding Grade Argon
Alushield® Light
Alushield® Heavy

Classifications
AS 2717.2, E5183
AWS/ASTM A5.10, ER5183
DIN 1732, SG.Al Mg 4.5 Mn Werks. 3.3548
BS 2901 Pt.4 5183

Welding positions



Mechanical properties – all weld metal	
	Typical as welded
Yield strength (Rm)	125
Tensile strength (MPa)	275
Elongation (%)	17

Approvals	
Lloyds Register of Shipping	D O BF 5083 0 and F S NA
American Bureau of Shipping	AWS A5.10–92
Det Norske Veritas	AlMg4.5Mn/I1
BV	

Chemical composition, wt% – all weld metal							
	Si	Fe	Cu	Mn	Mg	Zn	Ti
Min.				0.60	4.3		0.07
Typical	<0.25	<0.40	<0.05			<0.25	
Max.				1.0	5.2		0.15

Packing and welding data

Dia. (mm)	Current (A)	Voltage (V)	Weight/spool (kg)	Part No.
0.8	70–110	16–18	5.0	S510850
0.9	90–130	17–19	6.0	S510960
1.0	100–140	17–19	6.0	S511060
1.2	120–150	24–29	6.0	S511260

BOC Aluminium MIG Wire 5356

Welding characteristics

- Excellent corrosion resistance and high strength
- Triple shaved for smoother feeding and consistent contact

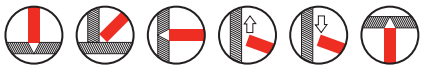
Applications

- Used to weld aluminium magnesium base metal alloys with a maximum of 5% Mg. Suitable for a wide range of 3XXX, 5XXX, 6XXX and 5XX series
- Applications in ship building, storage tanks, railways and the car industry

Classifications
AS 2717.2 E5356
AWS/ASTM A5.10 ER5356
DIN 1732 SG.AL Mg 5
BS 2901 Pt.4 5356

Approvals	
Lloyds Register of Shipping	D O BF 5083-OandF S NA
American Bureau of Shipping	AWS A5.10.92
Det Norske Veritas	AlMg5/11
BV	

Welding positions



Recommended shielding gases
Alushield® Light
Alushield® Heavy
Welding Grade Argon

Mechanical properties – all weld metal	
	Typical as welded
Yield strength (Rm)	110
Tensile strength (MPa)	240
Elongation (%)	17

Chemical composition, wt% – all weld metal							
	Si	Fe	Cu	Mn	Mg	Zn	Ti
Min.				0.10	4.5		0.07
Typical	<0.25	<0.40	<0.05			<0.10	
Max.				0.30	5.6		0.15

Packing and welding data

Dia. (mm)	Current (A)	Voltage (V)	Weight/spool (kg)	Part No.
0.8	50–150	14–21	0.5	S530805
0.8	50–150	14–21	5.0	S530850
0.9	80–180	16–22	0.5	S530905
0.9	80–180	16–22	2.0	S530920
0.9	80–180	16–22	6.0	S530960
1.0	110–220	17–23	0.5	S531005
1.0	110–220	17–23	2.0	S531020
1.0	110–220	17–23	6.0	S531060
1.2	150–250	20–25	0.5	S531205
1.2	150–250	20–25	2.0	S531220
1.2	150–250	20–25	6.0	S531260

Autocraft AL1100

- A high purity aluminium wire for the GMA welding of selected wrought aluminium alloys
- Recommended for the joining of selected high purity 1XXX series aluminium alloys used extensively in electrical and chemical industry applications

Classifications
AS/NZS 2717.2: E1100 AWS/ASME-SFA A5.10: ER1100

Typical all weld metal mechanical properties	
Single 'V' butt weld with 1060 Aluminium (reduced section tensile specimen)	
	Welding grade Argon
0.2% Proof stress	34.5 MPa
Tensile strength	69.0 MPa
Elongation (in 2 inches)	29%

Wire analysis limits		
Si: 0.06%	Fe: 0.06%	Cu: 0.005%
Mn: 0.01%	Mg: 0.01%	Zn: 0.03%
Ti: 0.01%	Total others: 0.01%	Al: 99.88% min

* Single values are maximum allowable, unless otherwise stated.

Recommended shielding gas
Alushield® Light
Alushield® Heavy
Welding Grade Argon

Packaging and operating data						
Dia. (mm)	Voltage (V)	Wire feed speed (m/min)	Current range (A)	Pack type	Pack weight (kg)	Part No.
1.6	23–28	5.0–9.5	200–350	Spool	7.0	722218
2.0	25–31	53.0–7.5	250–400	Spool	7.0	723218

Autocraft AL4043

- An aluminium -5% silicon wire for GMA welding of selected wrought and cast aluminium alloys
- For the repair welding of aluminium alloy castings (mainly 4XX and 6XX series)
- For welding selected wrought (1XXX, 5XXX and 6XXX series) aluminium alloys

Classifications
AS/NZS 2717.2: E4043 AWS/ASME-SFA A5.10: ER4043

Typical all weld metal mechanical properties		
Single 'V' butt weld with 6061-T6 Aluminium (reduced section tensile specimen) using welding grade Argon: Postweld heat		
	As welded	Treated and aged
0.2% Proof stress	124 MPa	276 MPa
Tensile strength	186 MPa	303 MPa
Elongation (in 2 inches)	8%	5%

Wire analysis limits		
Single values are maximum allowable, unless otherwise stated		
Si: 4.5–6.0%	Fe: 0.80%	Cu: 0.30%
Mn: 0.05%	Mg: 0.05%	Zn: 0.10%
Ti: 0.20%	Total others: 0.15%	Al: Balance

Recommended shielding gas
Alushield® Light
Alushield® Heavy
Welding Grade Argon

Packaging and operating data						
Dia. (mm)	Voltage (V)	Wire feed speed (m/min)	Current range (A)	Pack type	Pack weight (kg)	Part No.
1.2	20–25	5.5–12.0	150–250	Spool	7.0	722237
1.6	23–28	5.0–9.5	200–350	Spool	7.0	722238

Autocraft AL5356

- An aluminium -5% magnesium wire for the GMA welding of a wide range of wrought and cast aluminium alloys containing magnesium

Classifications
AS/NZS 2717.2: E5356 AWS/ASME-SFA A5.10: ER5356

Typical all weld metal mechanical properties	
Single 'V' butt weld with 5086 Aluminium (reduced section tensile specimen)	
	Welding grade Argon
0.2% Proof stress	130 MPa
Tensile strength	269 MPa
Elongation (in 2 inches)	17%

Wire analysis limits		
Single values are maximum allowable, unless otherwise stated		
Si: 0.25%	Fe: 0.40%	Cu: 0.10%
Mn: 0.05–0.2%	Mg: 4.5–5.5%	Cr: 0.05–0.20%
Zn: 0.10%	Ti: 0.06–0.20%	
Total others: 0.15%	Al: Balance	

Recommended shielding gas
Alushield® Light
Alushield® Heavy
Welding Grade Argon

Packaging and operating data

Dia. (mm)	Voltage (V)	Wire feed speed (m/min)	Current range (A)	Pack type	Pack weight (kg)	Part No.
0.8	14–21	6.0–20.0	50–150	Mini Spool – Pack of 4	4 x 0.5	721221
0.9	16–22	6.0–17.5	80–180	Spool	7.0	722226
1.0	17–23	6.0–16.5	110–220	Spool	7.0	722224
1.2	20–25	5.5–12.0	150–250	Spool	7.0	722227

GMAW Wire

Superglaze 4043

Popular filler metal chemistry containing silicon to lower melting point and to provide fluidity. Developed for welding of heat treatable base alloys and, more specifically, the 6XXX series alloys. Moderately soft, provides good weld appearance, melting action and penetration. Excellent operating characteristics.

Classifications	AWS ER4043

Size (mm)	Carton (kg)	Part No.
0.9	7.26	ED028395
1.2	7.26	ED028397A
1.6	7.26	ED028398A
2.4	7.26	ED028399

Superglaze 5183

Magnesium based alloy providing outstanding strength, making this chemistry an excellent candidate for structural applications such as marine, storage or rail cars.

Classifications	AWS ER5183

Size (mm)	Carton (kg)	Part No.
0.9	7.26	ED028435
1.2	7.26	ED028437
1.6	7.26	ED028438

Superglaze 5356

5% magnesium alloy, which is the most commonly used. It is suitable for welding most of the 5XXX base materials. The wire exhibits good strength, stiffness and good wire feeding characteristics.

Classifications	AWS ER5356

Size (mm)	Carton (kg)	Part No.
0.9	7.26	ED028385A
1.0	7.26	ED028386A
1.2	7.26	ED028387A
1.6	7.26	ED028388A

Comweld AL1100

- 99.88% pure aluminium alloy rod
- Suitable for gas welding and gas tungsten arc-(GTAW/TIG) welding applications
- Embossed with AS/AWS class '1100'
- For the joining of selected high purity 1XXX series aluminium sheets and plates used extensively in the electrical and chemical industries

Classifications
AS/NZS 1167.2: R1100 AWS/ASME-SFA A5.10: R1100

Rod analysis limits		
Single values are maximum allowable, unless otherwise stated		
Si: 0.06%	Fe: 0.06%	Cu: 0.005%
Mn: 0.01%	Mg: 0.01%	Zn: 0.03%
Ti: 0.01%	Others each: 0.01%	Al: 99.88% min

Recommended shielding gases
Welding Grade Argon Alushield® Light

Packaging data				
Rod Size (mm)	Weight (kg), Pack type	Carton (kg)	Approx No. (rods/kg)	Part No.
1.6 x 914	2.5 cardboard	15	30	321600
2.4 x 914	2.5 cardboard	15	30	321601

Comweld AL4043

- Aluminium – 5% silicon alloy rod
- Suitable for gas welding and gas tungsten arc (GTAW/TIG) welding applications
- Embossed with AS/AWS class '4043'
- For the repair welding (fractures and blow holes etc) of selected aluminium alloy castings

Classifications
AS/NZS 1167.2: R4043 AWS/ASME-SFA A5.10: R4043

Rod analysis limits		
Single values are maximum allowable, unless otherwise stated		
Si: 4.5–6.0%	Fe: 0.80%	Cu: 0.30%
Mn: 0.05%	Mg: 0.05%	Zn: 0.10%
Ti: 0.20%	Total others: 0.15%	Al: Balance

Recommended shielding gases
Welding Grade Argon Alushield® Light

Packaging data				
Rod Size (mm)	Weight (kg), Pack type	Carton (kg)	Approx No. (rods/kg)	Part No.
1.6 x 914	2.5 cardboard	15	210	321610
2.4 x 914	2.5 cardboard	15	90	321611
3.2 x 914	2.5 cardboard	15	51	321612

Comweld AL4047

- Aluminium – 10% silicon alloy rod
- Suitable for gas welding and gas tungsten arc (GTAW/TIG) welding applications
- Embossed with AS/AWS class 4047
- Used extensively for the brazing of many types of aluminium alloy sheets, extruded shapes and castings

Classifications
AS/NZS 1167.2: R4047 AWS/ASME-SFA A5.10: R4047 AWS/ASME-SFA A5.8: BAlSi-4

Rod analysis limits		
Single values are maximum allowable, unless otherwise stated		
Si: 11.0–13.0%	Fe: 0.80%	Cu: 0.30%
Mn: 0.15%	Mg: 0.10%	Zn: 0.20%
Total others: 0.15%	Al: Balance	

Recommended shielding gases
Welding Grade Argon Alushield® Light

Packaging data				
Rod Size (mm)	Weight (kg), Pack type	Carton (kg)	Approx No. (rods/kg)	Part No.
1.6 x 914	2.5 cardboard	15	210	321620
1.6 x 914	100 rod Handipack	8 Pks	–	322070
2.4 x 914	2.5 cardboard	15	90	321621
2.4 x 914	50 rod Handipack	8 Pks	–	322071
3.2 x 914	2.5 cardboard	15	51	321622

Comweld AL5356

- Aluminium – 5% magnesium alloy rod
- Suitable for gas welding and gas tungsten Arc (GTAW/TIG) welding applications
- Embossed with AS/AWS class 5356
- Produces intermediate deposit strength and good ductility and corrosion resistance for the welding of a wide range of 3XXX, 5XXX, 6XXX and 5XX aluminium alloys

Classifications
AS/NZS 1167.2: R5356 AWS/ASME-SFA A5.10: R5356

Rod analysis limits		
Single values are maximum allowable, unless otherwise stated.		
Si: 0.25%	Fe: 0.40%	Cu: 0.10%
Mn: 0.05–0.20%	Mg: 4.5–5.5%	Cr: 0.05–0.20%
Zn: 0.10%	Ti: 0.05–0.20%	
Total others: 0.15%	Al: Balance	

Recommended shielding gases
Welding Grade Argon Alushield® Light

Packaging data				
Rod Size (mm)	Weight (kg), Pack type	Carton (kg)	Approx No. (rods/kg)	Part No.
1.6 x 914	2.5 cardboard	15	210	321640
2.4 x 914	2.5 cardboard	15	90	321641
2.4 x 914	40 rod Handipack	8 Pks	–	322078
3.2 x 914	2.5 cardboard	15	51	321642