Inert gas welding of aluminum alloys

Process engineering and selection of shielding gases

The right inert gas for the right process

A variety of processes are available for aluminum treatment. The range of shielding gases is correspondingly wide.

TIG welding

For better removal of the oxide coating, TIG welding is carried out using alternating current. In addition to classic argon and the argon-helium mixes, the more advanced dual and triple gas mixes Aluline N and Aluline He N are available as shielding gases. The nitrogen content of Aluline N stabilizes and concentrates the arc and improves the penetration properties. The TIG DC mode with a negative electrode is relatively seldom used. Here, helium or a high helium content shielding gas is employed.

MIG welding

In most cases, pulse technology is to be recommended. This means that thinner sheets can be welded while, at the same time, increasing the protection against pore formation. Spatters are also reduced. The range of gases is similar to that for TIG welding. The admixture of nitrogen in the Aluline N series has proven beneficial. With increasing sheet thickness, the helium content should be raised accordingly.

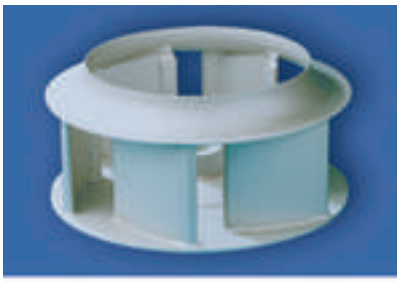
Special techniques

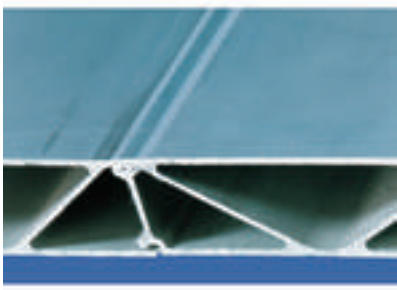
Plasma welding with a positive electrode is a variety of TIG welding, usually applied in automated systems. The Plasma-MIG process, that combines plasma process with MIG welding, is also normally used with fully automation. Thick sheets can be welded in one position with very high quality in this mode. In the dual wire MIG technique, two wire electrodes, usually with two separate power sources, are mounted together in one torch. This is used, by preference, for the welding of long seams on level components or on circumferential welds.

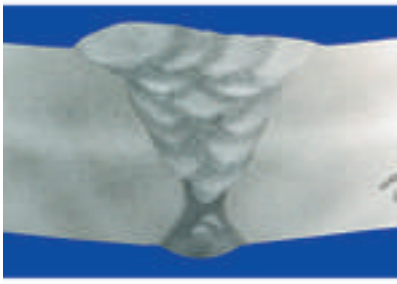
Shielding gases for TIG and MIG welding

	Group acc. ISO 14175	Composition as a percentage by volume Ar	He	N_2
Welding Argon	I1	100	-	-
Helium 4.6	I2	-	100	-
Aluline He15	I3	85	15	-
Aluline He30	I3	70	30	-
Aluline He50	I3	50	50	-
Aluline He70	I3	30	70	-
Aluline He90	I3	10	90	-
Aluline N	Z	Balance	-	0,015
Aluline He15 N	Z	Balance	15	0,015
Aluline He30 N	Z	Balance	30	0,015
Aluline He50 N	Z	Balance	50	0,015

Practical Notes







Main applications

Aluminum offers a lot of advantages as a construction material. It is light, very strong, resistant to corrosion and easily to reshape. Rail vehicle construction is a classic area of application and this has now been joined by automobile production. There are also many other fields of application, such as the bicycle industry, ventilator fans, machines, containers and shipbuilding. Aluminum alloys are also used in building construction.

What is special about aluminum?

The high melting point of aluminum's oxide coating makes positive-polarity welding (MIG) or AC welding (TIG) necessary. The flow characteristics are very different from those of steel. Because of the high thermal conductivity, attention must be paid to safe edge penetration. Aluminum is sensitive to hydrogen porosity, so care must be taken with the storage of welding-Filler metals, the cleanliness of the weld edge and the reliability of the shielding gas feed.

TIG or MIG welding?

TIG stands out primarily for its high process reliability, MIG for high performance. The TIG process can be optimized by variation of the alternating current parameters. MIG welding is also increasingly used for tasks with high quality requirements. Here, the pulse technology is an essential precondition. High demands on the wire feed system are met by four-roller drives, push-pull systems and a Teflon core.

Base materials

The alloying elements and the manufacturing process determine the characteristics of materials. A distinction is made between non-hardenable and hardenable alloys (DIN EN 573). For use as non-hardenable materials, AlMg alloys with high natural hardness are preferred. In vehicle construction, hardenable alloys of classes AlZnMg or AlMgSi are mainly used. Some cast alloys are only partial suitable for welding because of their tendency to pore formation.

Filler materials

Aluminum is predominantly welded to itself or to similar materials. In order to avoid cracking, AlMg or AlMgMn Filler materials are also used for the hardenable materials. AlSi Filler materials exhibit lower hardness, but have very favorable welding properties. Important criteria are also the corrosion resistance and subsequent surface treatment. Wire electrodes of 1.2 mm and 1.6 mm diameter are mainly used.

Edge preparation and preheating

Absolute cleanliness is necessary for aluminum welding. For work on the weld edges, milling is to be preferred to grinding. Particularly in the case of TIG welding, the lower edges of the seam should be slightly chamfered. In general, from a sheet thickness of approx. 8 mm, preheating (80 °C to 150 °C) is recommended.

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