Welding Methods

1. MIG (metal inert gas arc) welding

This type of welding uses consumable electrodes, with electrode wire serving as the electrode. Inert gas is passed through the torch and welding takes place when an arc is formed between the electrode wire and the base metal. The electrode wire is supplied automatically.

Although it is dependent on the proficiency of the welder himself, the minimum thickness of weldable aluminum alloy sheets has been 1.6 mm (0.06 in.). In most cases the sheets used have been over 3 mm (0.1 in.) thick. More recently, welders have been developed for handling sheets with a thickness of 1 mm (0.04 in.) or less.

2. TIG (tungsten inert gas arc) welding

This type of welding uses non-consumable electrodes, with tungsten rods serving as the electrodes. Inter gas is passed through the torch, an arc is formed between the electrode and the base metal, and welding takes place when the heart from the arc melts the base metal and hand-held welding rod. The minimum thickness of aluminum alloy sheets which can be welded is about 0.6 mm (0.02 in.), although this method is not suited to heat-treated alloys because there are many thermal effects.

3. Carbon dioxide gas arc welding (metal active gas arc welding)

In place of the high-cost inert gas, carbon dioxide gas or carbon dioxide gas mixed with argon gas is employed as the shielding gas in the metal active gas arc welders often used today in body shops. Carbon dioxide gas is not an inert gas in the full sense of the term so these welders are known by the acronym of "MAG" (metal active gas), rather than "MIG."

4. Gas (oxygen, acetylene) welding

Welding or brazing work must not be undertaken using these gases.
Since it is hard to concentrate the heart at the welding point, the thermal effects extend to the surrounding area and the strength of the aluminum alloy is reduced. Gas welding cannot be used for brazing since the joint strength is too low.

NOTE: Gas welders are used for heating work when aluminum alloys are shaped. (It is necessary to control the upper limit temperature.)

5. Spot welding

Aluminum alloys cannot be welded using the conventional spot welders which are used in body shops.

The capabilities of spot welders for steel plate are not sufficient for aluminum alloys which have high thermal conductivity. No matter how long the welding current is allowed to run, the heat escapes to the surrounding areas and the base metal does not melt, making welding impossible. It requires a very high current of several tens of thousands of amperes and high pressure to spot-weld an aluminum alloy.

(cont'd)

Aluminum Alloy Repair

Welding Methods (cont'd)

Comparison of spot welding for aluminum alloys and steel plate (one example)

Material	Thickness	Current (A)
Steel sheeting	1.2 mm (0.05 in.)	Approx.9300
Aluminum alloy	1.2 mm (0.05 in.)	Approx.26,000

NOTE:

- Welding conditions may induce changes in the spot welding current given in the comparison above.
- See page 2-20 for the re-bonding procedure applied when spot-welds on an aluminum alloy body are repaired. MIG welding is used.
- A person proficient at carbon dioxide gas arc welding who has an adequate understanding of the properties of aluminum alloys will be able to master the technique after practicing for a short while. Practice is important for increasing one's competence.

⚠ CAUTION

- **Aluminum alloys melt without changing color when heated.**
- **It is difficult to judge the melting point when an alloy is heated.**
- **Aluminum alloys have a coefficient of thermal expansion which is approximately double that of steel plate and a coefficient of contraction during solidification which is approximately 1.5 times higher. They are therefore subject to strain more easily and welding cracks (bead cracks and crater cracks) develop.**
- **Cleaning the welding location greatly affects results.**
  Although the oxide film is destroyed by the cleaning action, it is important for all dirt to be removed, along with any oil and grease, prior to the welding.
- **Tools used for welding aluminum alloys must be kept completely separate from those used for steel plate.**
- **Use a stainless steel wire brush.**
- **Use sanding tools which have been reserved especially for use only with aluminum alloys. If the same tools are used for steel plate as well, iron deposits will remain on the surface of the aluminum alloy and contaminate welds.**
- **Inert gas arc welding is a gas-shielded method and is therefore unfit for working in areas exposed to wind or breezes. It is important that the flow of the inert gas is not disturbed.**