Aluminum Alloy Repair

Safety Precautions

Precautions for Ensuring Safety:

1. Although aluminum is non-toxic, it is lightweight, so fine particles of metal given off by sanding operations tend to float in the air. It is therefore vital that operators protect their lungs and eyes from this dust.

2. Small pieces of aluminum alloy are spattered by MIG welding can be projected over considerable distances. It is therefore important to provide protection not only for the welders operators themselves, but also for the surrounding areas.

3. The sparks generated from the arc during inert gas are welding are very bright and may hurt the eyes if viewed directly. A protective shield for the eyes must therefore be worn at all times when welding.

Use of protective gear to ensure safety:

Work overalls with long sleeves, a cap, and safety shoes must be worn at all times. Depending on the job to be done, protective goggles, gloves, ear plugs, and a dust-proof mask should also be worn (see page 2-7).

CAUTION:

- **When aluminum alloys are heated, they melt without changing color.**

  Melting temperature

  Aluminum alloys: Approx. 1184°F (640°C) (depends on alloy)
  Steel plate: Approx. *2732*°F (1500°C)

- **Aluminum alloys can be repaired in virtually the same way as steel sheets, but it is important to have a good grasp of their properties and be thoroughly familiar with their limitations.**

- **Aluminum alloys tend to overheat during sanding. When they overheat, the metal tends to flake and clog the filing surface of the sanding tool. If a tool with a clogged surface is used, it will leave scratches and marks on the base metal.**

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. Inert gas is passed through the torch, an arc is formed between the electrode and the base metal, and welding takes place when the heat 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 heat at the welding point, the thermal effects extend to the surrounding area and the strength of the aluminum alloy is reduced. Neither must gas welding be used for brazing since 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.

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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 2-10 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.**

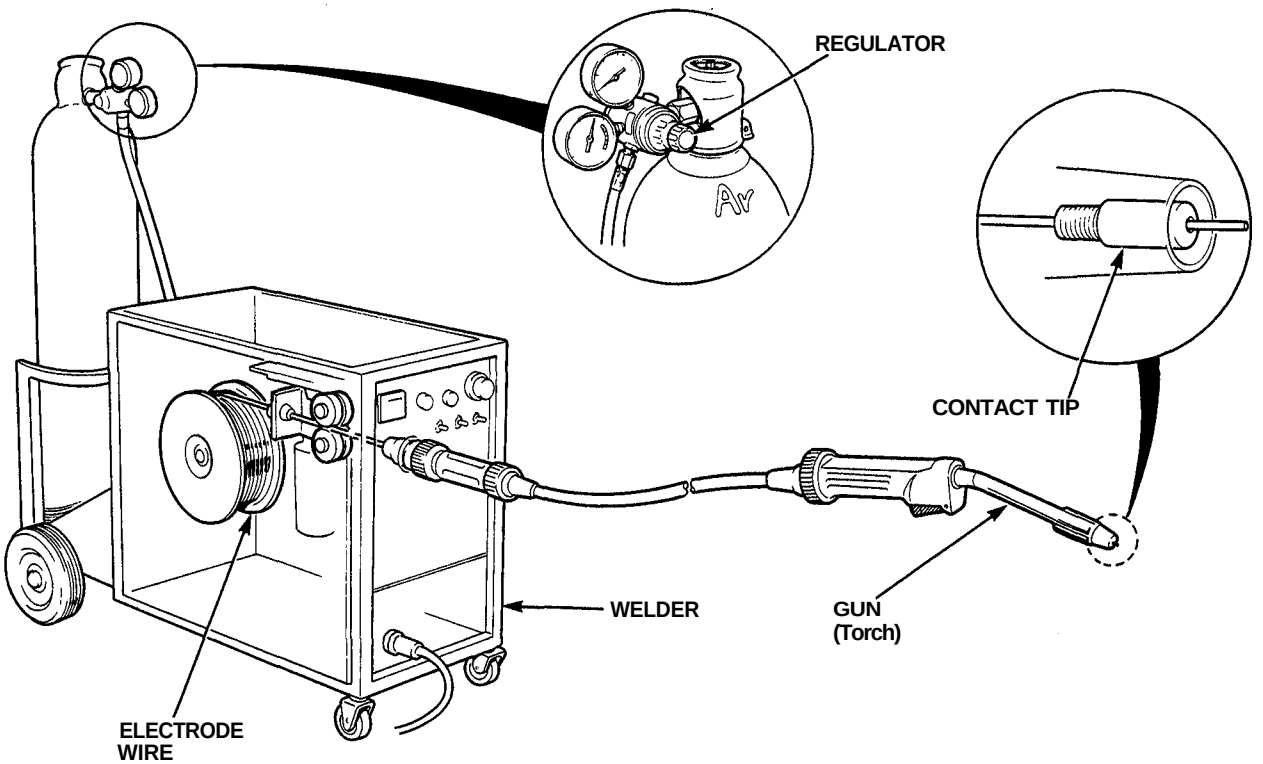
Welders

Performance of Welders:

1. Output current: Approx. 200 A at maximum output
2. Electrode wire diameter: Approx. 0.8~1.2 mm (0.031 ~0.05 in) (A5356WY)
3. Shielding Gas: 100% Argon

- It is an added convenience if the welder can be set to seam, stitch and spot modes.
- A welder which can be used for both aluminum alloy MIG welding and steel plate carbon dioxide gas arc welding simply by changing some parts is economical and efficient.

NOTE: Follow the manufacturers' instruction.



Conditions:

Material thickness unit: mm (in)	Electrode wire diameter unit: mm (in)	Electrode wire speed (A)	Welding voltage (V)	Volume 100% argon (L/min)
1.6 (0.06)	0.8 (0.031)	50~70	10.0~11.0	15.0
2.0 (0.08)	0.9~1.0 (0.035~0.04)	60~110	12.0~15.0	15.0
2.5 (0.1)	0.9~1.2 (0.035~0.05)	80~120	13.0~16.0	17.0
3.0 (0.12)	0.9~1.2 (0.035~0.05)	100~140	15.0~18.0	20.0
5.0 (0.2)	0.9~1.2 (0.035~0.05)	120~170	17.0~20.0	20.0

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Filler Metals

When "filler metal" is mentioned in this text, it refers to welding rods for TIG welding and to electrode wire for MIG welding.

The selection of the filler metal affects the following items relating to the state of the welded joints:

a) Flaws in joints (bead cracks)

b) Strength of joints

c) Toughness of joints (tenacity)

d) Resistance of joints to corrosion

[A5356WY] is the filler metal best suited to aluminum alloys in the 5000 and 6000 series which are used for HONDA aluminum alloy bodies.

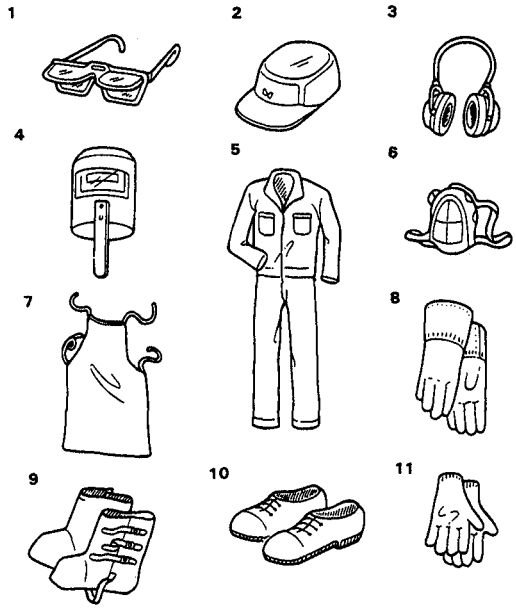
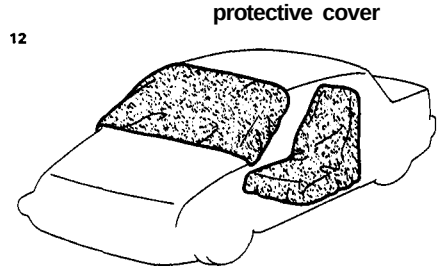
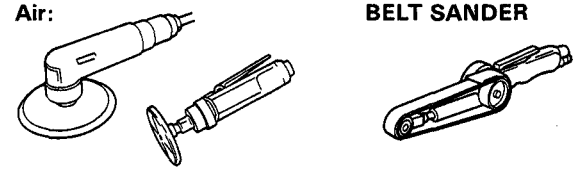
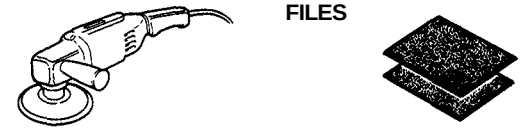
Filler metal storage

Proper storage of filler metals is important for best welding results.

NOTE:

- Store filler metals where they will not become dirty or scratched and where they will be free from contact with oils and greases.
- Use clean gloves when handling filler metals. Seal them in airtight vinyl bags, and store at a constant temperature in a location where they will be dry at all times. Before sealing the electrode wire, make sure that it is wound properly on its spool.
- Take steps to ensure that the seal cover is not opened until actual use.

Examples of Repair Tools

Item	Work	Tools, equipment used
Protective equipment	Operator protection	**1. Protective goggles** **2. Cap** **3. Earplug** **4. Shield for eyes** **5. Overalls with long sleeves** **6. Dust-proof mask** **7. Protective apron** **8. Welding gloves** **9. Foot protectors** **10. Safety shoes** **11. Work gloves** **12. Spattering guard** 
	Vehicle body protection	**Heat-resistant protective cover** 
Processing tools	Edge preparation	**DISC GRINDER, DISC SANDER.** **Air:** **BELT SANDER**  **Electric:** **SANDPAPER, FILES** 

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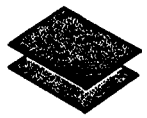
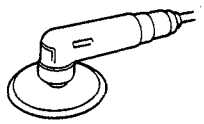
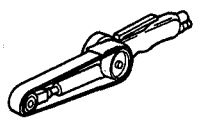
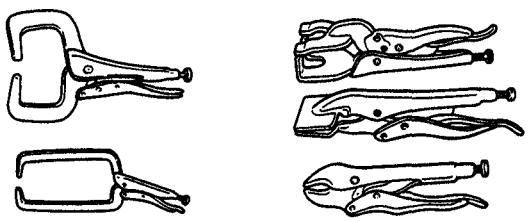
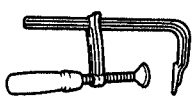
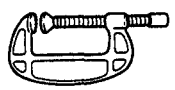
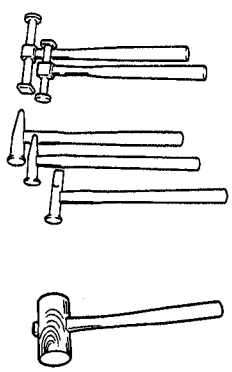
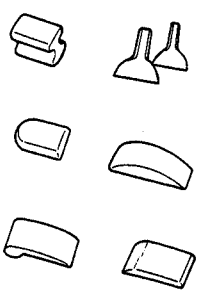
Aluminum Alloy Repair

Examples of Repair Tools (cont'd)

Item	Work	Tools, equipment used
Processing tools	Plug hole drilling	**DRILLING BLADE, DRILL, SPOT CUTTER**  **ROTARY CUTTER**  **PUNCH** 
Sanding tools	Cleaning	**STAINLESS STEEL WIRE BRUSH**  **SANDPAPER**  **DISC SANDER**  **BELT SANDER** 
	Finishing	Disc grinder. Disc sander. Belt sander. Sandpaper.
Fixing tools	Base metal fixing	**VISE-GRIPS**  **SCREW CLAMP**  **SQUILL VISES** 
Shaping tools	Skin panel shaping	**HAMMERS**  **DOLLIES/CHISELS** 

NOTE: Use a stainless steel wire brush and sanding tools reserved especially for aluminum alloys. Do not use the same tools for steel sheet.

Grain size for sanding/processing tools and jobs performed.

Tool	Disc paper grain size	Job
Disc grinder	A36P (grindstone for grinder)	• Roughing of weld reinforcement areas. • Roughing of V-shaped edge preparation.
Disc sander	#80~#120 (sanding disc)	• Roughing of paint film. • Sanding of aluminum alloy surface (oxide film) • Finishing of weld reinforcement areas. • Finishing of V-shaped edge preparation.
Belt sander	#80 or above	• Sanding of narrow areas.
Stainless steel wire brush		• Sanding of aluminum alloy surface (oxide film)

NOTE:

- Use a low-speed disc grinder or disc sander.
- If a low-speed air-powered disc grinder is not available, attach an air control valve to reduce grinder speed.
- A double-action sander may also be used.

Cleaning-oxide film removal:

Clean the welding locations throughly (both front and back surfaces).

- Use a wax and grease remover to clean off any dirt, oil or grease.
- Use a disc sander and stainless steel wire brush to remove paint and oxide films. Use a #80 sanding disc.

NOTE: Do not allow the sanding disc of the disc sander to become clogged. If the disc sander is pressed excessively hard, it will overheat due to friction and the aluminum alloy will tend to peel off, clogging the disc. The alloy surface will be scraped and scored if a clogged disc is used.

Aluminum Alloy Repair

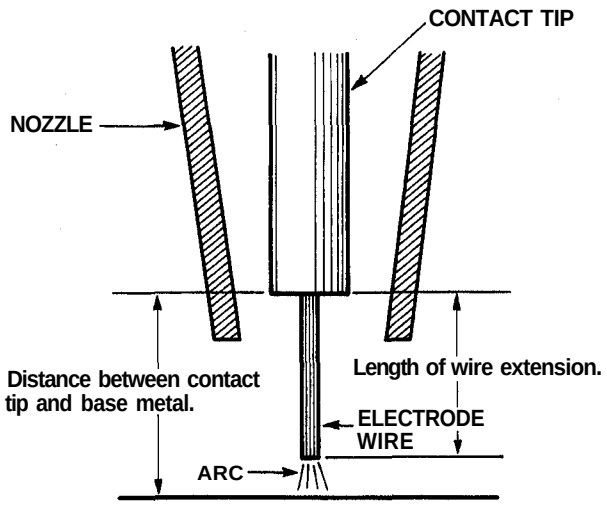
MIG Welding Conditions

MIG welding can be performed under virtually the same conditions as for the carbon dioxide gas arc welding of steel plate mentioned previously. The differences are outlined below.

The factors which affect deposition at the welding location and serve as the welding conditions for carbon dioxide gas arc welding of steel plates are:

- Welding current.
- Welding voltage (automatically adjusted for HTP MAXI MIG),
- Electrode wire speed,
- Distance between contact tip and base metal,
- Gun angle.
- Gun feed speed.
- Volume of shielding gas.

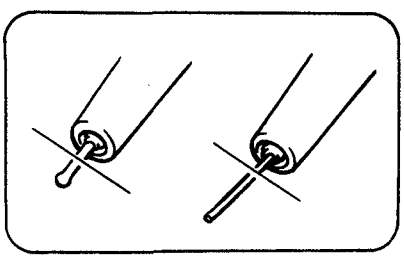
NOTE: Distance between contact tip and base metal: 8~15 mm (0.3~0.6 in).



Arc generation

As with steel-plate welding, an arc is generated and welding starts once the torch switch is thrown.

- Welding startup is impaired if the electrode wire extends too far out or if the end is spherical. In such cases, cut off the end of the wire with a pair of wire cutters.



CAUTION:

- **The torch switch must not be thrown with the electrode wire in contact with the base metal.**
- **When cutting the end of the electrode wire, point the torch downward and cut near ground level to protect the eyes from the cut end.**