

# 2

## Preparation of Work

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2

Preparation  
of Work

# Preparation of Work

## Outline of Body Repair

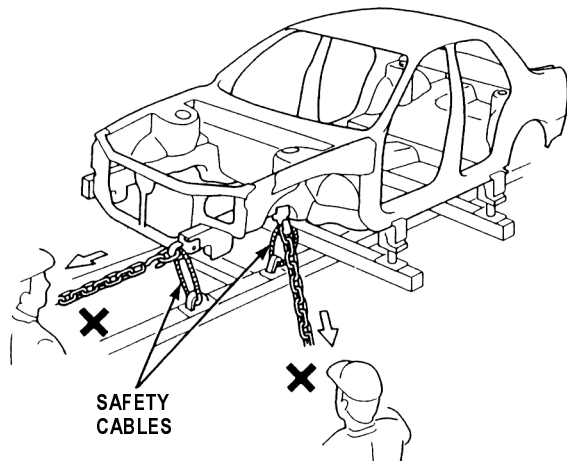
The contents described in this section are the basic processes of repair procedures needed to cut and replace welded parts. Reshape the light damage to the outer panel with patty after corrections by the washer, welder, hammer and dolly.

The table below shows information for this model.

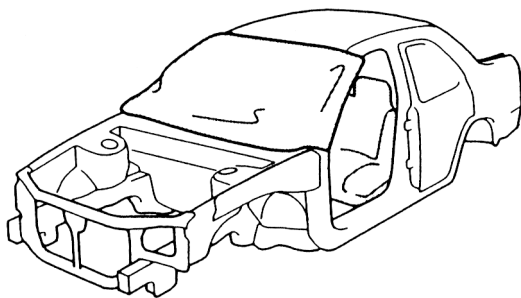
Processes	Repair Procedures	Information	Reference
	<ul style="list-style-type: none"><li>• Accurate inspection of Damaged Parts. (Visual)</li><li>• Measurement</li></ul>	<ul style="list-style-type: none"><li>• Wheelbase</li><li>• Wheel Alignment</li><li>• Body Dimensional Drawings</li></ul>	<a href="#">(see section 1)</a> <a href="#">(see section 1)</a> <a href="#">(see section 4)</a>
Reshape	<ol style="list-style-type: none"><li>1. Remove any related parts.</li><li>2. Attach the frame straightener to the body.</li><li>3. Pull out and straighten the damaged areas.</li><li>4. Check the original position.</li></ol>	<ul style="list-style-type: none"><li>• Body Dimensional Drawings</li></ul>	Shop Manual <a href="#">(see section 1)</a>  <a href="#">(see section 4)</a>
Replacement	<ol style="list-style-type: none"><li>1. Cut off and separate the damaged area.</li><li>2. Straighten any related part.</li><li>3. Check the repair part installation and alignment with the body.</li><li>4. Clean and degrease to the welded surfaces.</li><li>5. Weld in the repair part.</li><li>6. Finish the welded areas.</li></ol>	<ul style="list-style-type: none"><li>• Mass Production Body Welding Diagram</li><li>• Removal</li><li>• Body Dimensional Drawings</li><li>• Installation</li></ul>	<a href="#">(see section 3)</a> <a href="#">(see section 3)</a> <a href="#">(see section 4)</a> <a href="#">(see section 3)</a>
Rust Prevention	<ol style="list-style-type: none"><li>1. Apply the sealer.</li><li>2. Apply the undercoating.</li><li>3. Apply anti-rust agent to the inside of the outer panel and frames.</li></ol>	<ul style="list-style-type: none"><li>• Cross Section of Body and Sealants.</li><li>• Soft Chipping Guard Primer Coating Diagram</li><li>• PVC Coating Diagram</li><li>• Area to be Covered by Antirust Agents</li></ul>	<a href="#">(see section 5)</a>
Paint	Apply the paint.		<a href="#">(see section 6)</a>
Installation and Inspection	<ol style="list-style-type: none"><li>1. Adjust the hood, door, tailgate.</li><li>2. Measure the wheel alignment.</li><li>3. Clean the body.</li><li>4. Install related parts.</li></ol>		Shop Manual

## General Safety Precaution

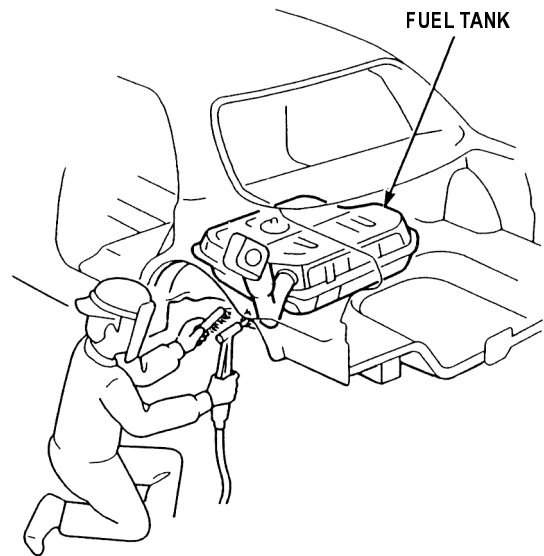
- Disconnect the battery to reduce the possibility of damage caused by electrical shorts.
- Check for fuel leaks and repair as necessary.
- Use standard safety equipment when spraying paint, welding, cutting, sanding, or grinding (see page 2-12).
- Always attach a safety cable when using a hydraulic ram or a frame straightening table; do not stand in direct line of the chains used on such equipment.



- Cover the exterior parts and the interior parts with a fireproof cover and protect the vehicle when welding.
- Do not damage the passenger compartment parts when you heat the undercoat of the welded flange with a torch.

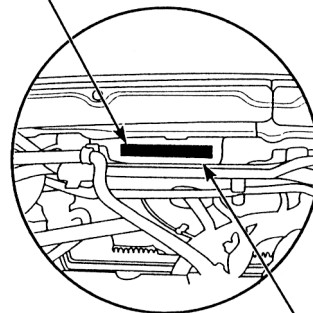


- Remove the fuel tank and/or fuel lines if welding equipment is to be used near the fuel system.



- The vehicle identification number is stamped on the dashboard upper panel and is registered with local authorities. If the dashboard upper panel must be replaced because of damage, check with local authorities first.

VEHICLE IDENTIFICATION  
NUMBER (VIN)



DASHBOARD UPPER

# Preparation of Work

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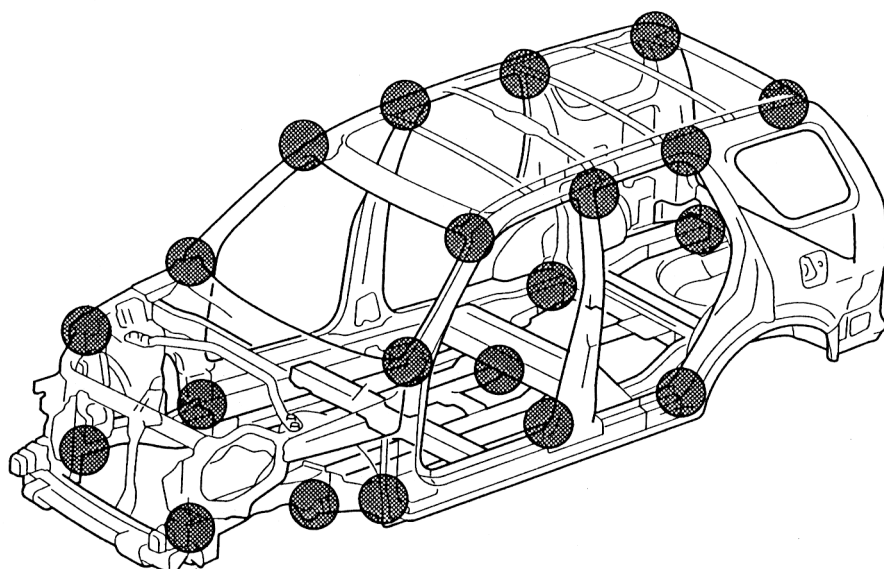
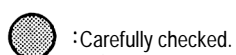
## Accurate Inspection of Damaged Parts (Visual)

### Description

Most monocoque bodies are composed as a single unit by welding together pressed parts made of steel plates, which come in a variety of different shapes and sizes. Each part is responsible for displaying a certain strength and durability in order that it may play its role in meeting the functions of the body.

Damage to the exterior of the body can be visually inspected, but where there has been external impact, it is necessary to inspect the extent of the damage. In some cases, the deformation may have spread beyond the actual areas that were in the collision so the deformation must be closely inspected.

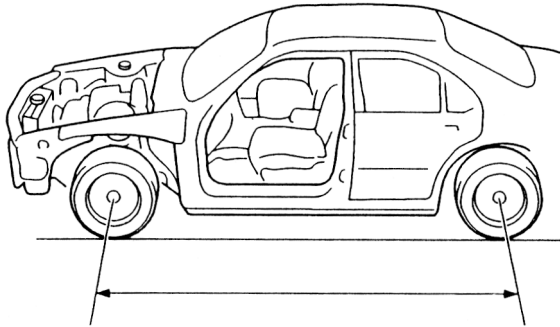
Distortion to the vehicle, bends, inclines and gaps between parts should be thoroughly checked. Also, check for paint peeling at welded areas, corners and the sealing coat.



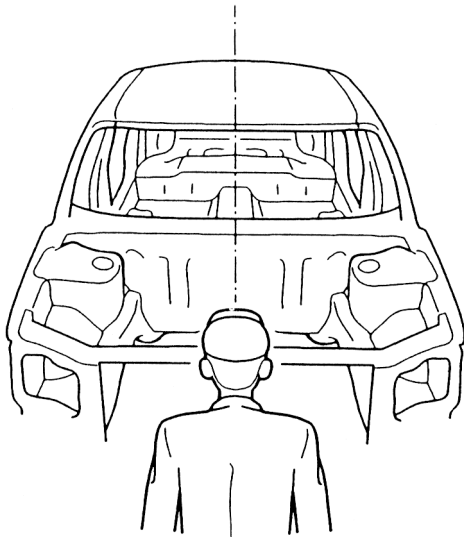
## Measurement

Whenever possible, make judgements and conclusions based on measurements.

- Measure the wheel alignment to prevent uneven tyre wear or incorrect steering wheel alignment.
- If there are any deviations, use a tram-tracking gauge and measure the body parts.

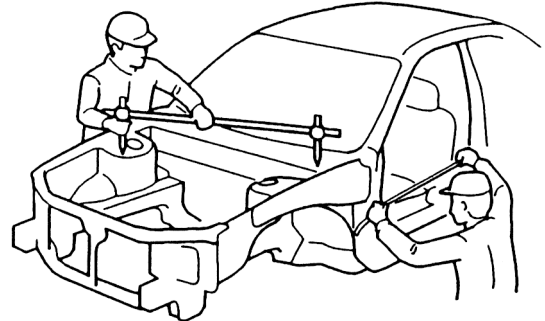


- If there is any twisting to the body, measure with a frame centering gauge.

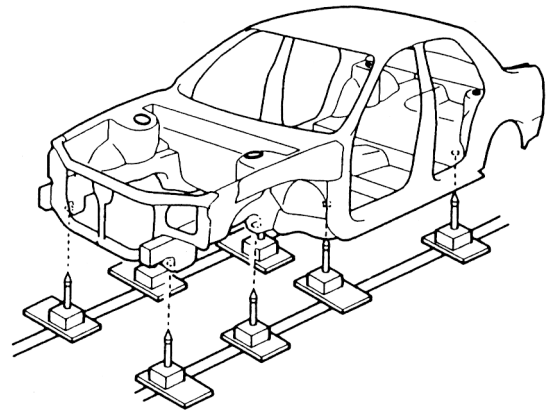


- To measure body dimensions, use a universal tram gauge and convex tool.

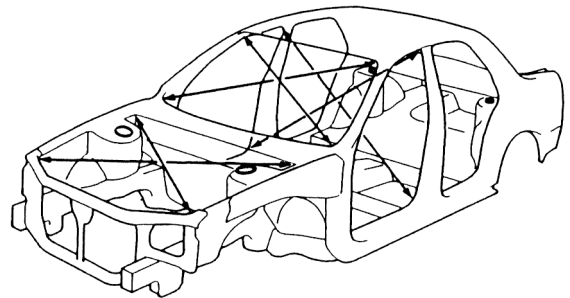
Body Measuring Dimension/Opening Repair Chart:



Frame Repair Chart:



Diagonal measurement:



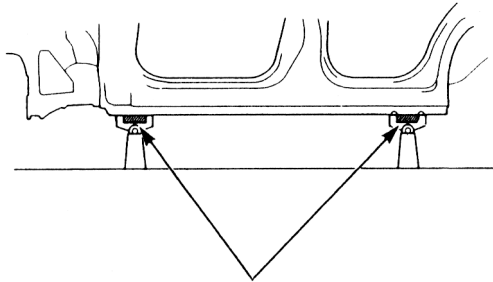
# Preparation of Work

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## Reshaping

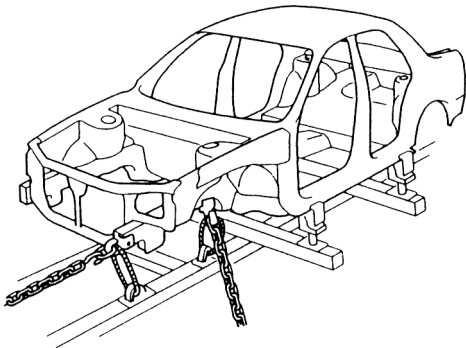
### Correction of the Damaged Area

1. Remove any related parts.  
NOTE: See the Shop Manual.
2. Connect the frame straightener to the vehicle body.
  - The side sill is flangeless to allow reshaping by pulling it out.
  - Use the horizontal pinch welds for anchoring the vehicle.

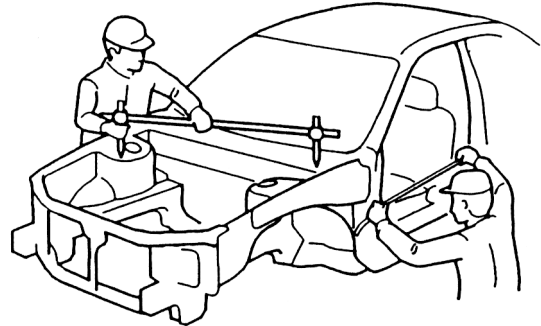


**SUPPORT POINTS**  
(Jack-up stiffener)

3. Pull out and straighten damaged areas.  
Apply load to the damaged section and pull on it until the section is almost restored to its original shape. Do not pull out more than necessary.



4. Check that the part of the body is more or less restored to its original shapes. Check the original positions using the body dimensional drawings.



# Replacement

## Removal

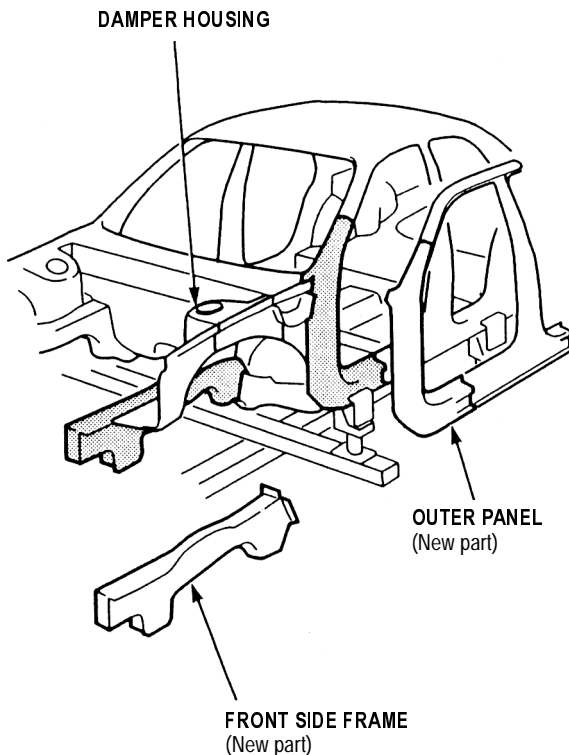
1. Decide whether to replace all the affected parts or whether to cut the weld joint parts and replace them.

NOTE: When cutting the parts off, take special care that you do not damage adjacent parts on the vehicle.

Setting Condition for Replacement Parts Joint Sections:

- Make sure that you can perform straightening work after welding.
- Make sure that the locations will not be susceptible to distortion caused by other parts.
- Make sure that there are few removable parts and that the location allows for safe welding.
- Make sure that the joints are short and that paint repair can be performed easily.
- Make sure that locations are such that the joints can be finished in a way that will not affect the outward appearance.
- Make sure that the locations do not hinder the removing and attaching of parts.

Parts which influence wheel alignment such as damper housing and the side frames must be examined using the frame repair charts.



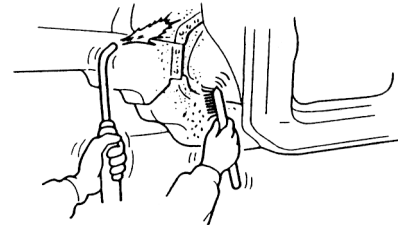
2. Peel off the undercoat.



### CAUTION



Be careful not to burn the fittings inside the passenger compartment when heating.



3. Remove the damaged parts.



### WARNING

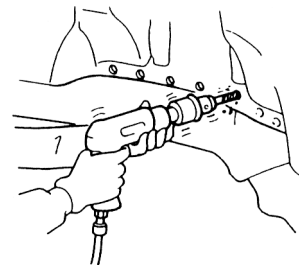


To prevent eye injury, wear goggles or safety glasses whenever sanding, cutting or grinding.

- Center punch around the spot weld imprints on the welded flange and drill holes using the spot cutter.

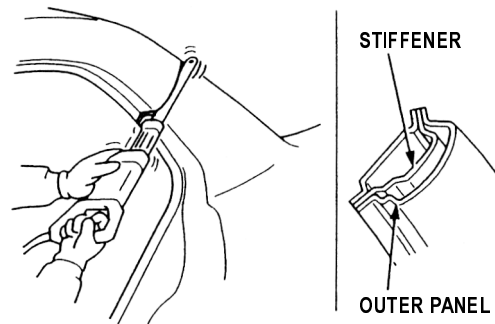
NOTE: Make a drill hole so that the installation of the repair parts may become easy.

- Remove the MIG weld flange with a disc sander.
- Pry off the welded flange with a chisel.



- Cut off the outer panel with an airsaw.

NOTE: Be careful not to cut the inner section.



(cont'd)

# Preparation of Work

## Replacement (cont'd)

### Installation

1. Straighten any damaged parts.



#### WARNING



To prevent eye injury and burns when welding, wear an approved welding helmet, gloves and safety shoes.

- Fill any holes by MIG welding and even out with a hammer and dolly.

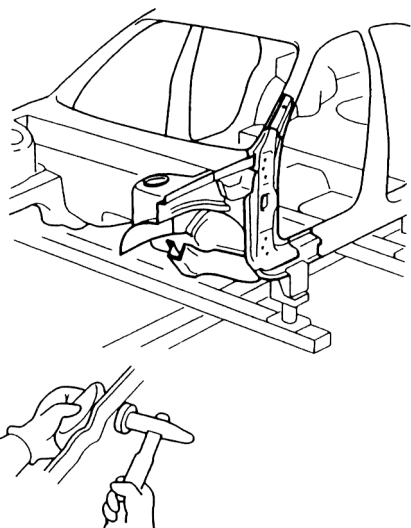


#### WARNING



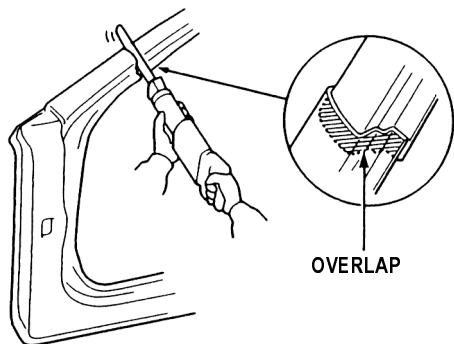
To prevent eye injury, wear goggles or safety glasses whenever sanding, cutting or grinding.

- Level and finish the burns on the welding flanges with a disc sander or belt sander.

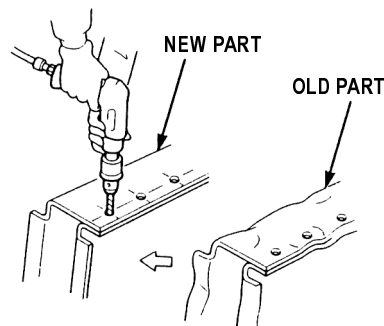


2. Preparations of new parts.

- Cut the new outer panel so it will overlap by 20~30 mm (0.8~1.2 in.) to the panel of the body side.



- The part where new parts cannot weld the spot welding make holes for the plug welding.
- Make holes to the size which corresponds to the thickness of the welded plate (see page 2-19).
- The position and the point by which holes are made, refer to the old parts or Mass Production Body Welding Diagram (see section 3).



3. Apply rust prevention processing on welded surface.



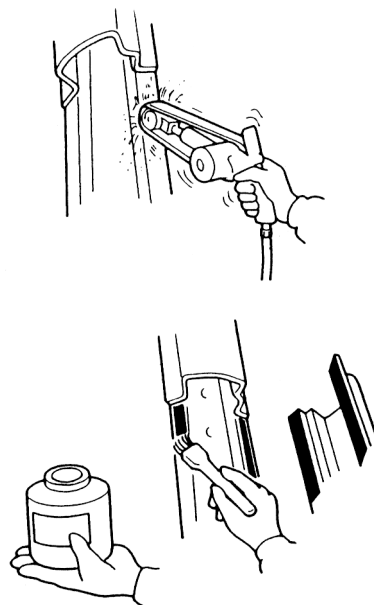
#### WARNING



To prevent eye injury, wear goggles or safety glasses whenever sanding.

- Remove the undercoat from both sides of the areas to be spot welded with a sander to expose the steel plate.
- Apply the spot sealer to the welding surface of the new parts and body side.

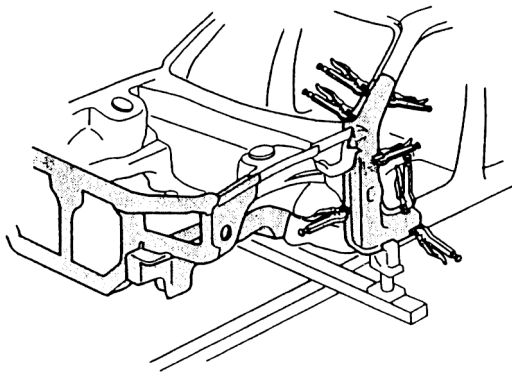
NOTE: Spread the spot sealer coat on the welding surface so that there are no bare areas.



4. Check the tack weld of the new parts.
  - Clamp the new part and check the position of it using the body dimensional drawings (see [section 4](#)).
  - Tack weld the clamped section.

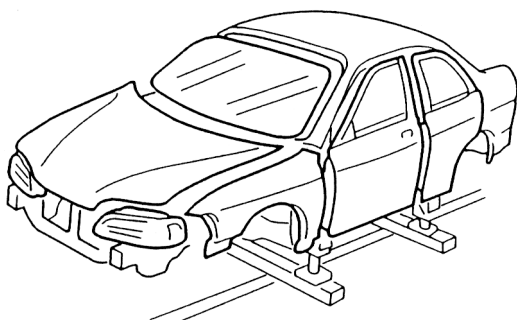
⚠
WARNING
⚠

To prevent eye injury and burns when welding, wear an approved welding helmet, gloves and safety shoes.



5. Check the alignment of the exterior body parts.
  - Temporarily install the exterior body parts, windshield and rear window glass, and check for differences in level and clearances.

NOTE: Check the fit of the front fender, door and the rear fender and make sure the body lines flow smoothly.



6. Main weld the repaired parts.
  - Use proper welding methods (see [page 2-17](#), [page 2-18](#), [page 2-19](#), [page 2-20](#)).

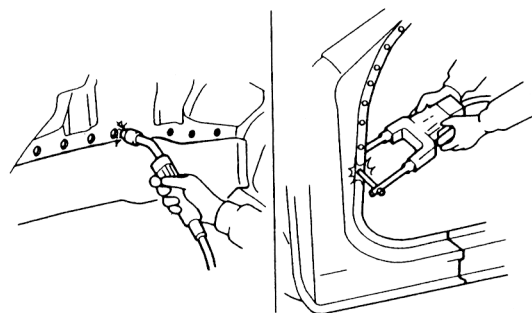
⚠
WARNING
⚠

To prevent eye injury and burns when welding, wear an approved welding helmet, gloves and safety shoes.

- Make 20% to 30% more spot welds than there were holes drilled.
- A new welding position should avoid an old position as much as possible.

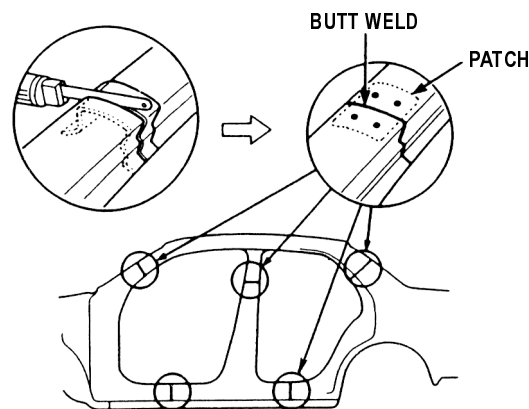
NOTE: If there is not room for spot welds, compensate by using MIG welds.

- The electric continuity property of zinc-plated steel plate is different from ordinary steel plate. When spot welding, increase the current by 10~20%, or increase the resistance welding line.



- Butt weld the front pillar, centre pillar, rear pillar and the wheel arch cut sections of the repaired outer panel.

NOTE: Attach the patches at the cut sections of the outer panel and plug weld them.



(cont'd)

# Preparation of Work

## Replacement (cont'd)

### Installation (cont'd)

7. Finishing the welded areas.
  - Level the MIG welded areas with a disc sander.



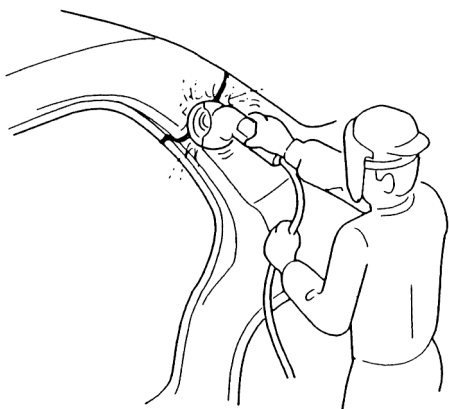
#### WARNING



To prevent eye injury, wear goggles or safety glasses whenever sanding, cutting or grinding

NOTE: Take care not to grind excessively.

- Even out high areas with a hammer. Be careful not to deform them.
- Smooth out welded door and tailgate areas and window opening flanges with a hammer and dolly.
- Fill the deformed area and smooth out the welded areas with body filler.



### Rust Prevention / Paint

1. Applying the sealer. Seal the overlapped areas of the outer panel, and the welded surfaces of the new parts. Seal gaps completely.
2. Applying the paint.



#### WARNING



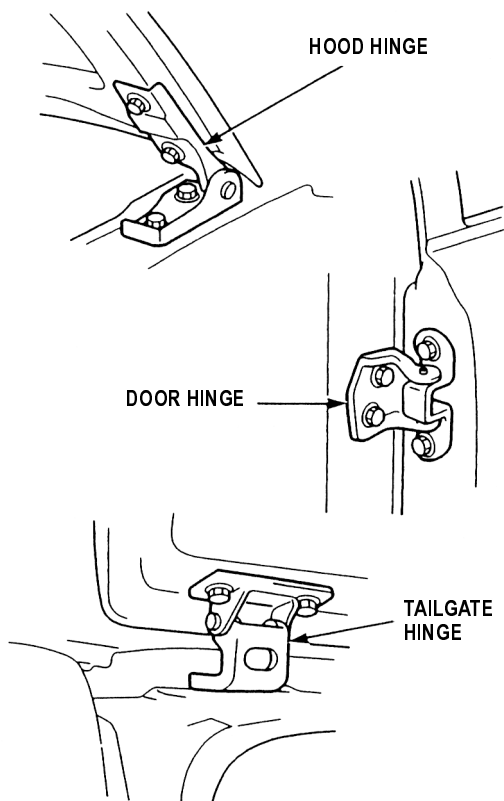
- Ventilate when spraying paint. Most paint contains substances that are harmful if inhaled or swallowed. Read the paint label before opening the paint container.
- Avoid contact with skin. Wear an approved respirator, gloves, eye protection and appropriate clothing when painting.
- Paint is flammable. Store it in a safe place, and keep it away from sparks, flames or cigarettes.

3. Apply undercoat to the wheelhouse and under-floor.
4. Apply the anti-rust agent to the inside of the outer panel and welded areas.

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## Installation and Inspection

1. Check the clearance of the door, hood, tailgate, and adjust if necessary.  
Check the operation of the parts and make sure the doors lock securely.
2. Apply the sealer to the hinges of the hood, door, and tailgate.



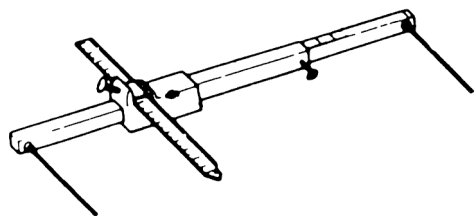
3. Adjust the wheel alignment.
4. Check the windows for water leaks.
5. Clean the passenger compartments.

# Preparation of Work

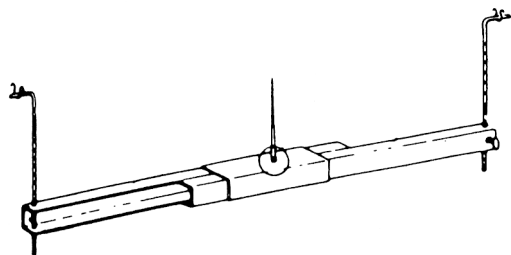
## Repair Tools

### Measurement Equipment

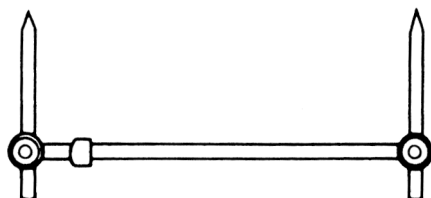
TRAM TRACKING GAUGE



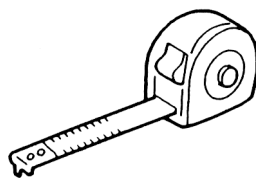
FRAME CENTERING GAUGE



UNIVERSAL TRAM GAUGE



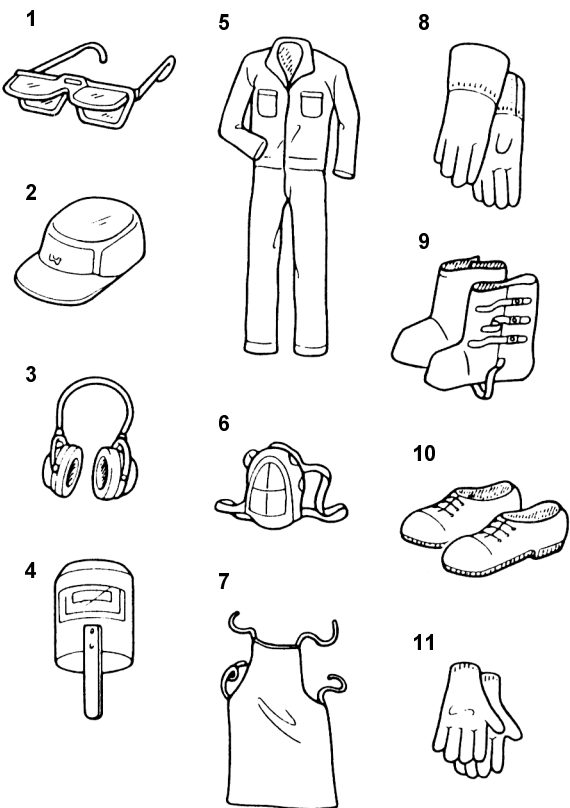
CONVEX TOOL



### Protective Tools

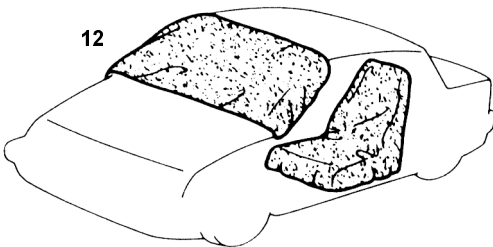
#### OPERATOR:

- |                              |                    |
|------------------------------|--------------------|
| 1 Protective goggles         | 7 Protective apron |
| 2 Cap                        | 8 Welding glove    |
| 3 Ear plugs                  | 9 Foot protector   |
| 4 Shield for eyes            | 10 Safety shoes    |
| 5 Overalls with long sleeves | 11 Work glove      |
| 6 Dust-proof mask            | 12 Splatter guard  |



#### VEHICLE BODY:

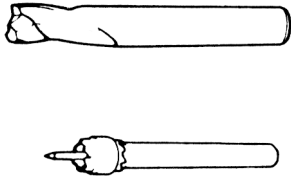
Heat-resistant protective cover



## Processing Tools

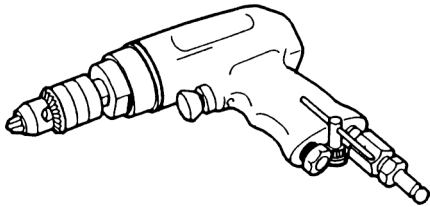
### SPOT CUTTER

Install the spot cutter in the air drill, and drill a hole at the spot weld nugget and the plug to make the hole.



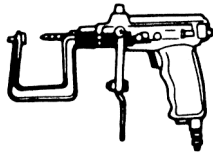
### AIR DRILL

The rotation speed can be adjusted and an adequate hole opening can work.



### PRESSURE DRILL

The depth of the hole can be adjusted and only necessary plate thickness can puncture.



### CENTER PUNCH

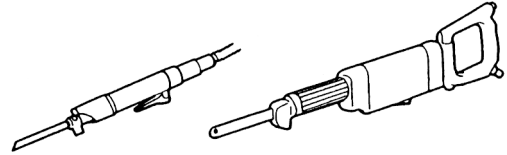
When an accurate hole opening is necessary.



## Cutting Tools

### AIRSAW

Cut the outer panel.



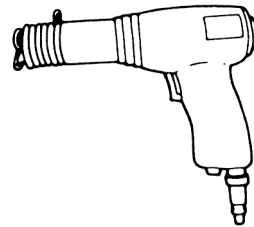
### AIR CHUCK GRINDER

Detaching the MIG welding part and the panel can be cut by installing cut grinding wheel in air chuck grinder.

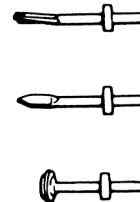


### AIR IMPACT CUTTER

Cut the outer panel roughly.

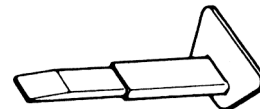


### CHISEL SET



### SPOT WELD CUTTER

Pry off the spot welded flange.



### HAND NIBBLER



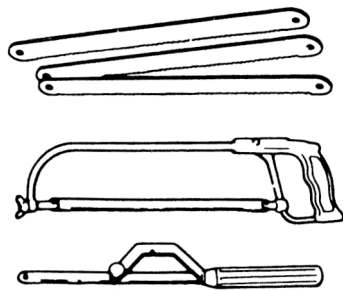
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# Preparation of Work

## Repair Tools (cont'd)

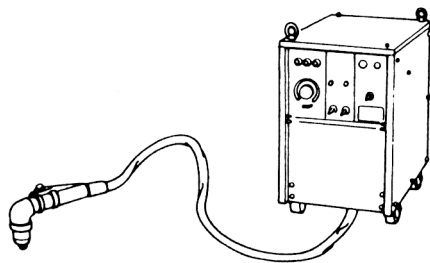
### Cutting tools (cont'd)

#### HANDSAW

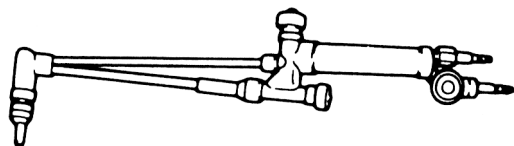


#### PLASMA CUTTER

Cut the thick plate.

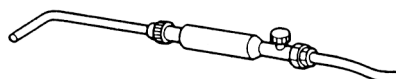


#### GAS CUTTER



#### ACETYLENE BURNER

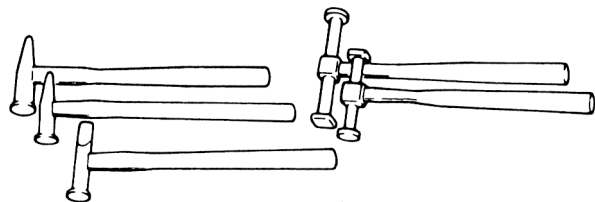
Peel off the undercoat.



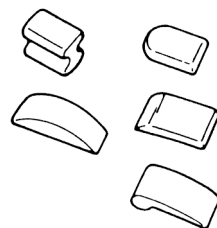
## Shaping Tools

### Skin Panel Shaping:

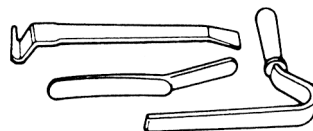
#### HAMMERS



#### DOLLIES



#### SPOONS



#### CHISEL

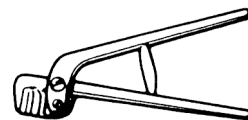


#### SNIPS/SHEARS



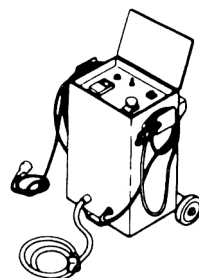
#### FLANGE TOOLS

Edge preparation.

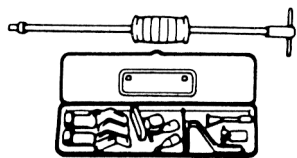


### Body and Frame Shaping:

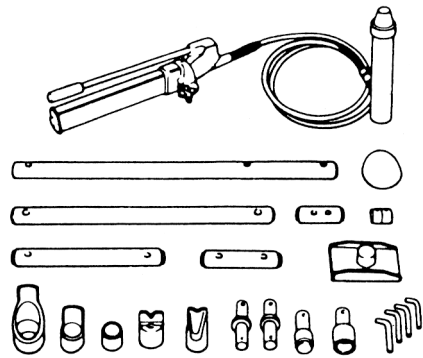
#### WASHER WELDER



SLIDE HAMMER



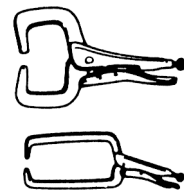
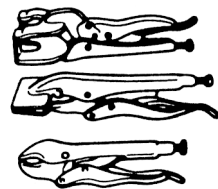
BODY JACK



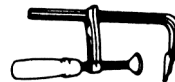
FRAME CORRECTOR

Fixing Tools

VICE-GRIPS



SCREW CLAMP



SCREW VICES



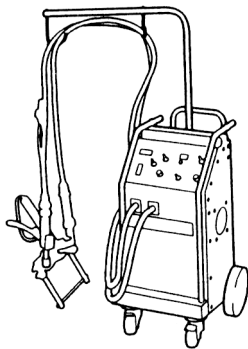
(cont'd)

# Preparation of Work

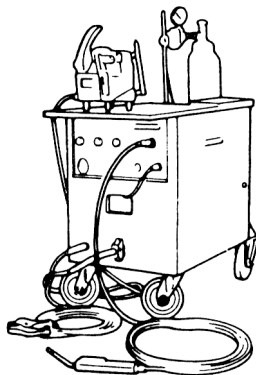
## Repair Tools (cont'd)

### Welders

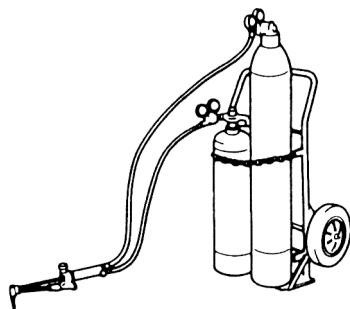
#### SPOT WELDER



#### MIG WELDER



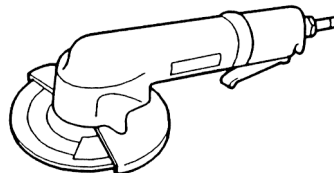
#### GAS WELDER



### Sanding Tools

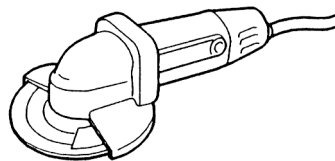
#### DISC GRINDER

Grinding of welded flange.



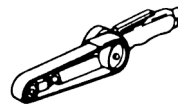
#### DISC SANDER

Sand off the paint film and use to finish the welded flange.



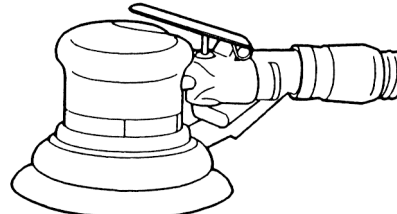
#### BELT SANDER

Finish off narrow welded flange.



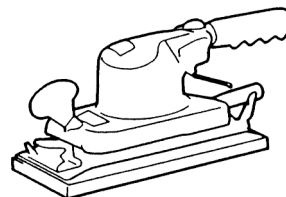
#### DOUBLE ACTION SANDER

Featheredge and finish of putty.



#### LONG ORBITAL SANDER

Sanding putty within the wide range and finish.

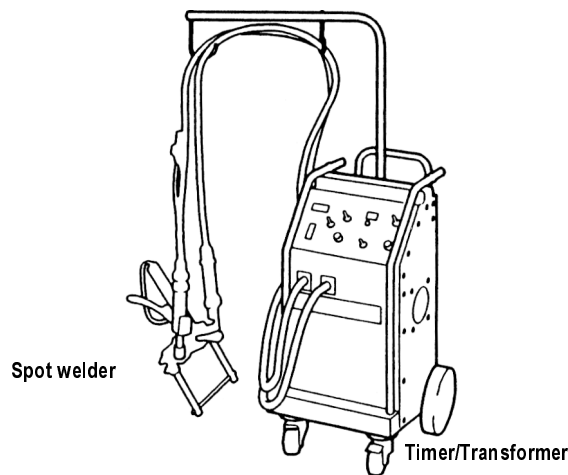


## Welding Methods

### Spot Welding

Spot welding is also known as resistance spot welding, and it is the most suitable method of welding for vehicles. It has 3 main features: the welding can be performed instantaneously, it has minimal effect on the source material and it has a minimum effect on distortion to the absolute minimum. However, please remember to remove all paint and other impurities from the surface of the material you intend to weld for reliable results.

#### Welders

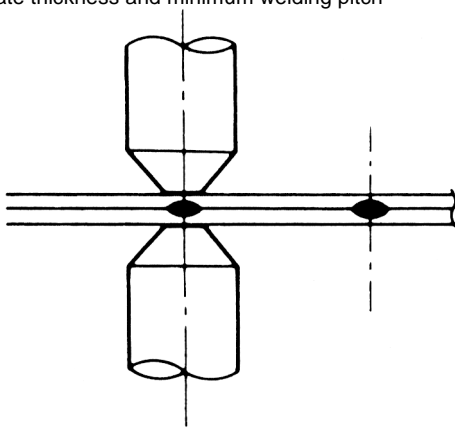


#### Welding Conditions:

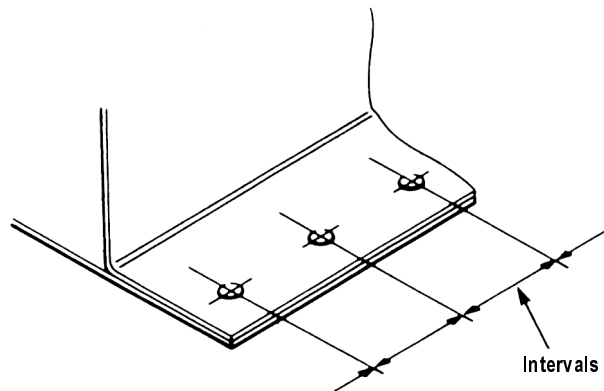
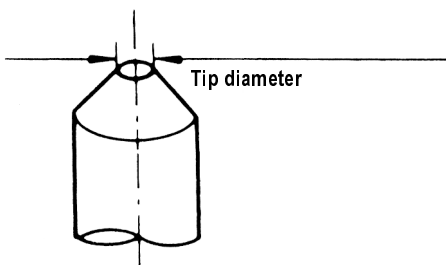
When performing spot welding, make sure that you conform to the following conditions: use the correct current, conductivity time, welding pressure, holding time and shutdown time recommended for the spot welder.

Please bear in mind the following points when welding :

- Plate thickness and minimum welding pitch



NOTE: If the welding intervals are too short, branching may occur, making it impossible to maintain the desired soldering state.  
Plate thickness and tip diameter.



Unit: mm (in.)

Plate thickness	0.6 (0.02)	0.9 (0.04)	1.2 (0.05)	1.6 (0.06)
Minimum intervals	11 (0.43)	16 (0.63)	20 (0.79)	24 (0.94)

Unit: mm (in.)

Plate thickness	0.8 (0.03)	0.9 (0.04)	1.2 (0.05)	1.6 (0.06)
Tip diameter	45 (0.12)	5.0 (0.2)	5.5 (0.22)	6.0 (0.24)

(cont'd)

# Preparation of Work

## Welding Methods (cont'd)

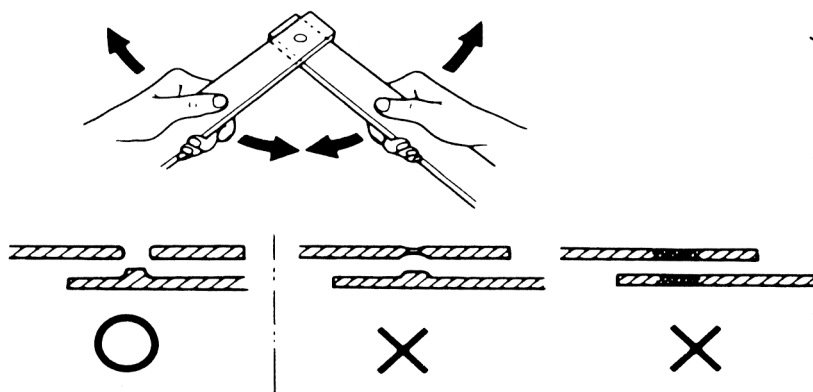
### Spot Welding (cont'd)

#### Welding Strength Test

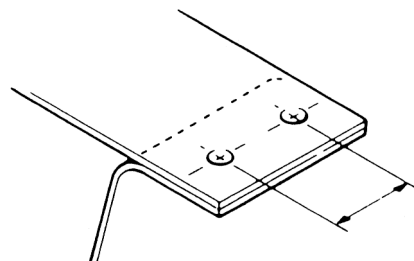
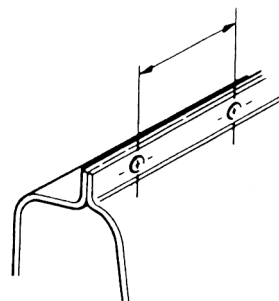
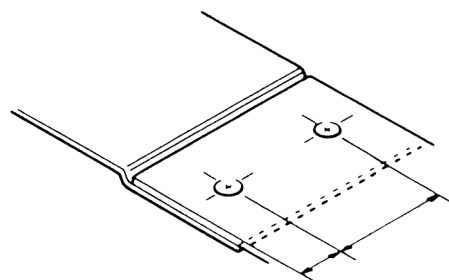
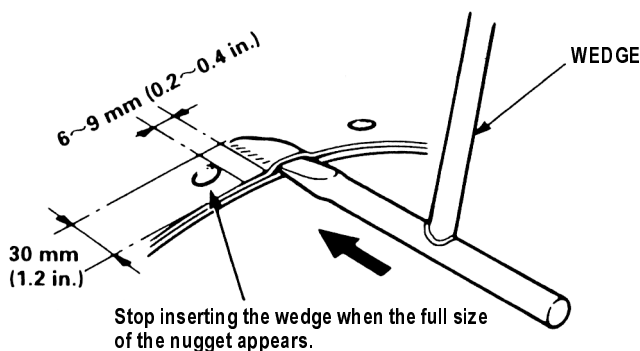
Even if you perform the welding according to the proper conditions, the strength of the welded sections may fluctuate due to drops in the voltage and other factors. The quality of the welding cannot be evaluated unless the welded sections are destroyed.

Provide yourself with a steel plate of the same thickness and conduct a destruction test.

- If holes appear in the steel plates, this means that the welding is of standard strength.



- Drive a wedge between 2 panels near the nugget. If the welded parts do not come apart and the diameter of the nugget is more than 3 mm (0.1 in.), the welding should be satisfactory.



#### NOTE:

It is difficult to perform spot welding in the following circumstances:

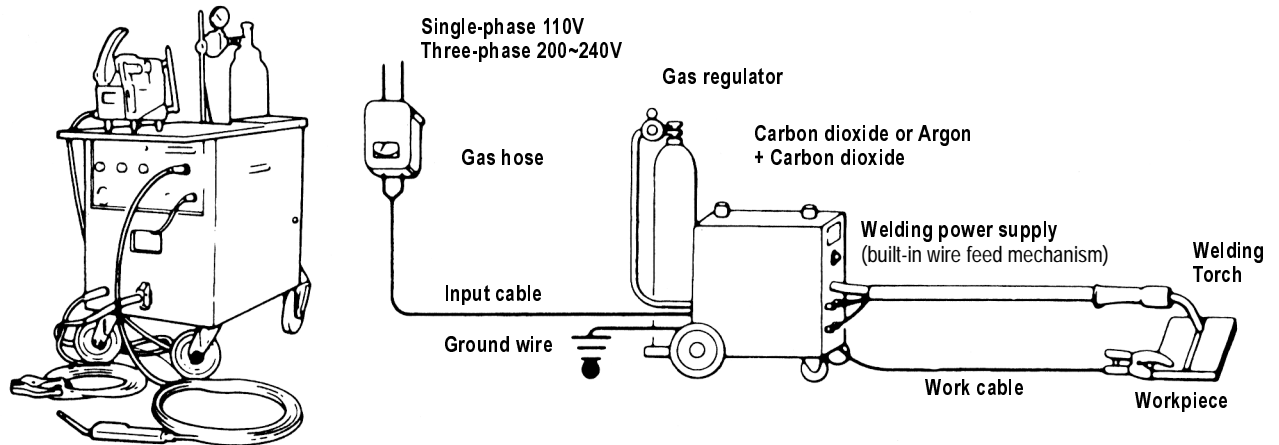
- When it is not possible to remove any rust or paint attached to the welding surfaces.
- When the tip of the spot welder cannot be inserted into the welding section.
- When the welding surfaces can be seen from the outside and welding will impair the exterior appearance.

In all these cases, the gas welding method should be employed. Moreover, if it is not possible to perform spot welding because of space restrictions, plug welding using on the arc welding method may be performed instead. For plug welding, the sections to be welded must be close together.

## Carbon Dioxide Arc Welder (MIG Arc Weld)

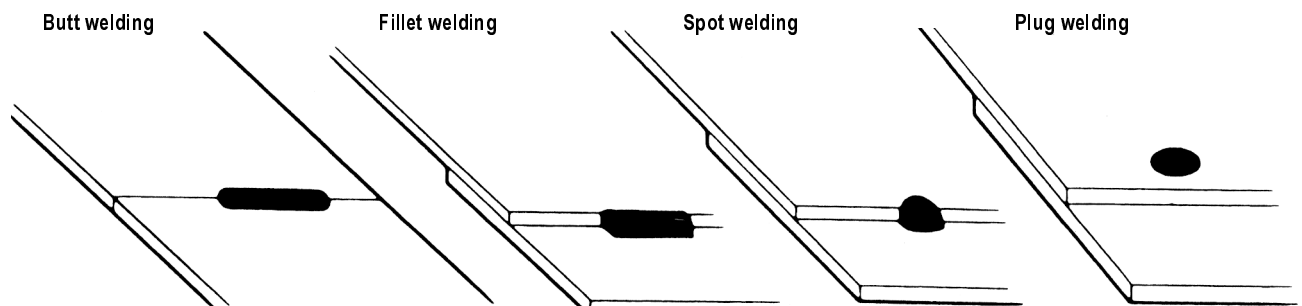
This welding process uses inexpensive carbon dioxide instead of expensive inert gases as a shielding means. Consumable metal electrodes are employed. It has a wide range of applications, including butt welding of a thin plate, fillet welding, plug welding and MIG spot welding. In terms of the weld strength, it is also highly stable.

### Welders:



CAUTION: Disconnect the negative battery cable before arc welding.

### Welding Methods:



### Plug Welding Conditions:

Plate thickness and weld holes

Unit: mm (in.)

Plate thickness	~ 1.0 (0.04)	1.0 (0.04) ~ 1.5 (0.06)	1.5 (0.06) ~
Weld hole diameter	5 (0.2)	6.5 (0.26)	8 (0.3)

(cont'd)

# Preparation of Work

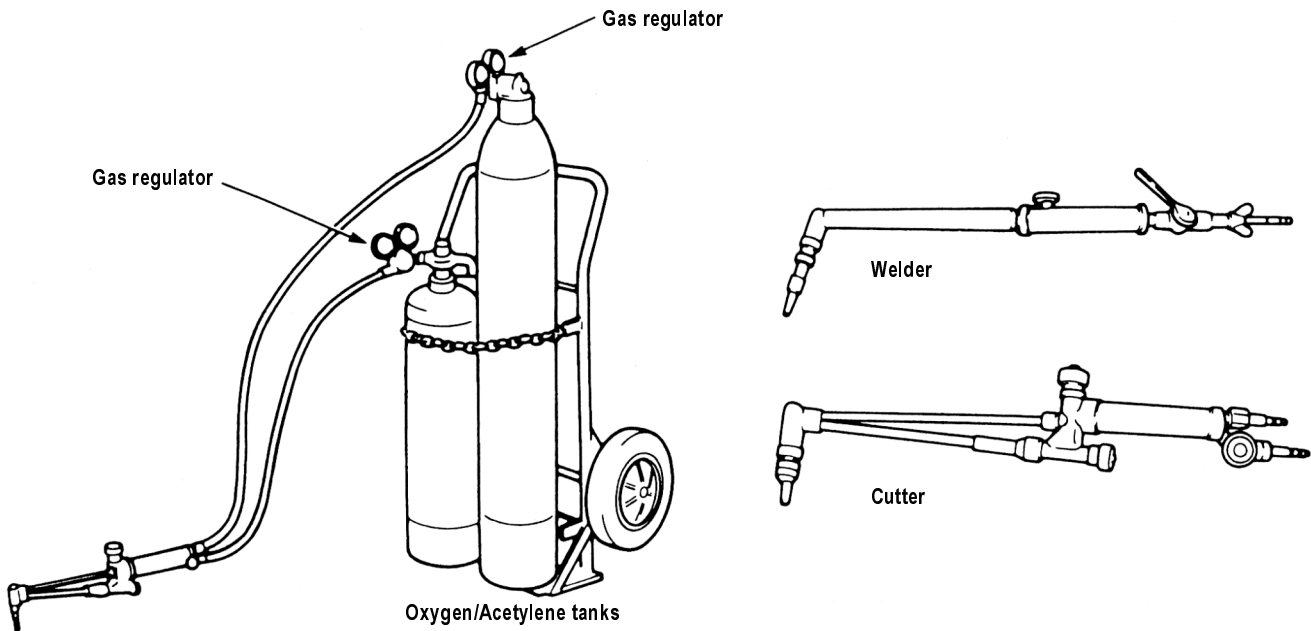
## Welding Methods (cont'd)

### Gas Welding

Gas welding is indispensable for body repair because of the broad range of its applications to join the body panels, cut the materials that construct the body, apply heat to reform panels and also because it is easy to get hold of the tools.

However, this method requires experience.

#### Welders:



#### Welding Methods:

