Fillet Welding Procedures

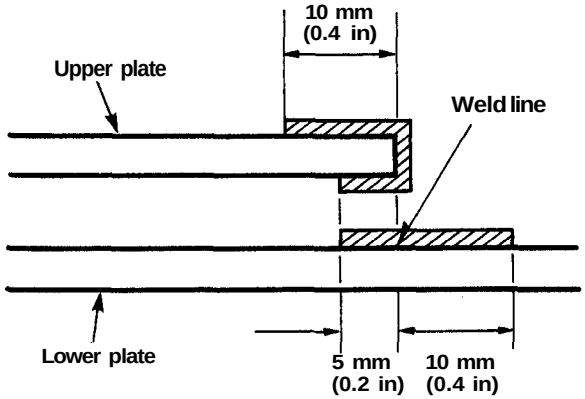
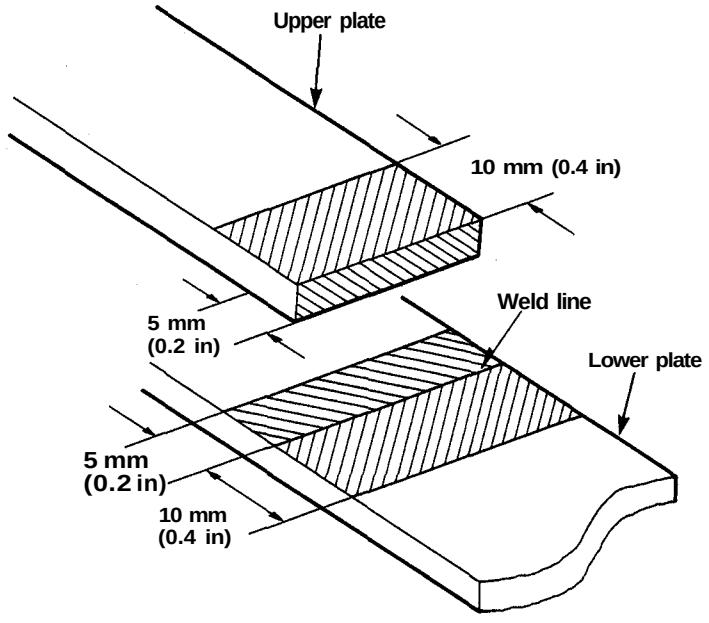
Fillet welding is used on body parts which have different thickness and which need to be strong comparatively. It is important to have a thorough grasp of what follows.

1. Adherence
   The aluminum alloy plates where the fillet welding is to be performed must fit together firmly, otherwise, the weld will be defective.

2. Cleaning and sanding
   Use a wax and grease remover to clean away any dirt, oil or grease prior to welding. If the aluminum alloy surface is coated with a paint film, use a disc sander with a #80 sanding disc to remove the paint.

   NOTE: Use a stainless steel wire brush to burnish the bare surface of the aluminum alloy immediately before welding.

Sanding range:

	Sand the top and bottom surfaces of the upper plate and the adhesion surface of the lower plate.
Range of oxide film removal by sanding: 	Sand to a width of about 10 mm (0.4 in) on both the upper and lower plates on the outside of the weld line, and to a width of about 5 mm (0.2 in) from the weld line for the inside surface which will be overlapped. Also sand the end of the upper plate.

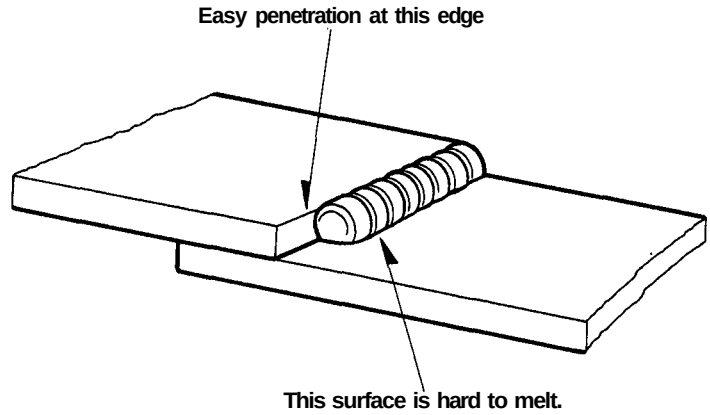
(cont'd)

Aluminum Alloy Repair

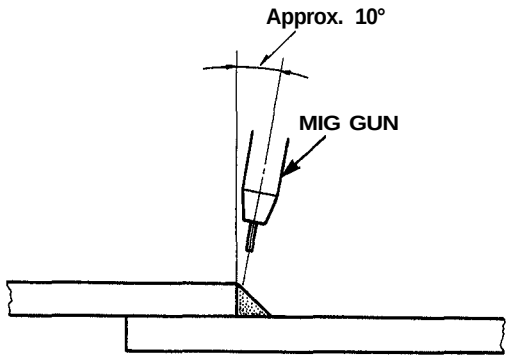
Fillet Welding Procedures (cont'd)

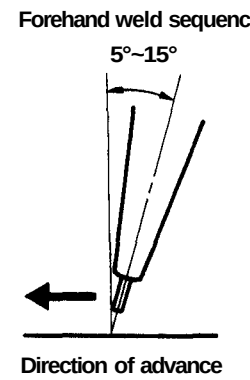
3. Welding

During actual welding, penetration will occur quickly for the top plate since the end of the plate is being welded. For the bottom plate, however, welding starts at the center of the plate, which is hard to melt. Proceed with the current slightly higher than for butt welding and closely observe bottom plate penetration.

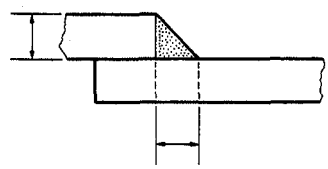


Although in the case of butt welding the gun is positioned perpendicular to the base metal, in fillet welding it is used at an angle with the base metal surface which depends on the plate thickness. The operator should carefully observe the melting of the base metal and proceed. Special attention must be paid when the thicknesses of the top and bottom plates differ.

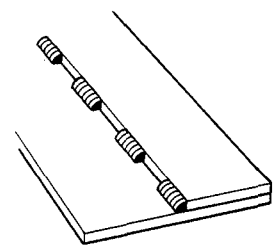




The ideal size of the bead in a cross-sectional view of fillet welding is identical to or slightly larger than the plate thickness, If the thickness of the plates differ, proceed to weld in alignment with the thin plate so as to minimize both the strain induced by welding the base metal and any changes in organization which may occur.

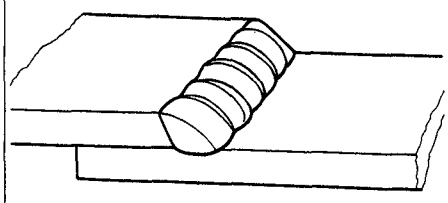
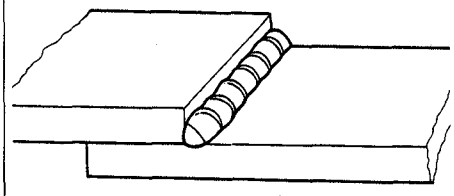
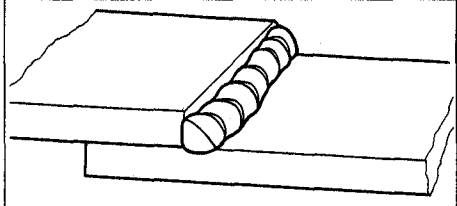
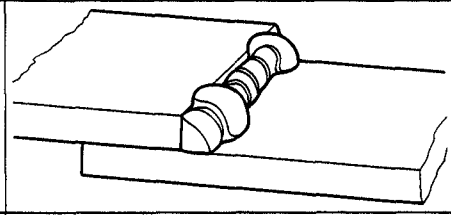
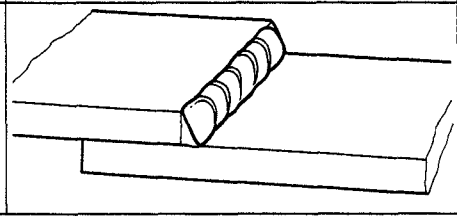


NOTE: Welding should be intermittent.



Fillet weld zone defects:

The table below shows frequent fillet weld zone defects and their causes.

Defect	Appearance	Main causes
Excessive melting of upper plate		Poor gun angle. Poor gun position. Excessively high welding current.
Incomplete penetration		Insufficient welding current.
Poor adhesion position		Faulty gun feed position.
Unaligned beads		Improper gun feed speed. Poor gun height.
Incomplete penetration of lower plate.		Faulty gun feed position. Insufficient welding current.

Aluminum Alloy Repair

Weld Area Finishing

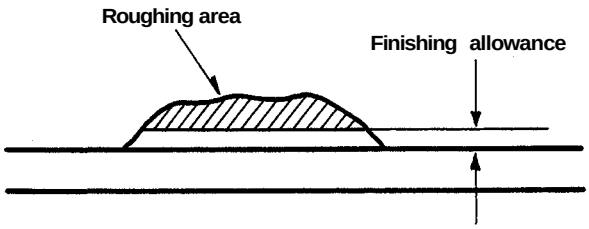
NOTE: Inspect for cracks before finishing the weld zones of aluminum alloys (see page 2-29).

When sanding weld zones

Use a disc grinder (A36P grindstone) for roughing and a disc sander for finishing (#80).

-1)Roughing

Use the disc grinder (A36P) for weld reinforcements, always leaving a finishing allowance.



-2) Finishing Cut Operation

Use the disc sander (#80 disc) to finish the area of the finishing allowance and give the weld zone a smooth finish.

NOTE:

- Roughing applies only to weld reinforcements. Care should be taken to leave the surface of the aluminum alloy untouched.
- Take care not to remove too much material in the roughing process since this can cause a loss of strength.
- Take care not to press the sanding tool too forcefully against the surface.
- Replace the disc of the sanding tool with a fresh disc if the surface becomes clogged with aluminum alloy fragments.
- Weld zones that are hidden from view do not need to be finished.

Crack Inspection

An inspection for cracks must be conducted after the weld zones of the aluminum alloy have been welded and after buckling in aluminum alloy body frames has been straightened out.

A color contrast penetrant examination method is used for crack inspection.

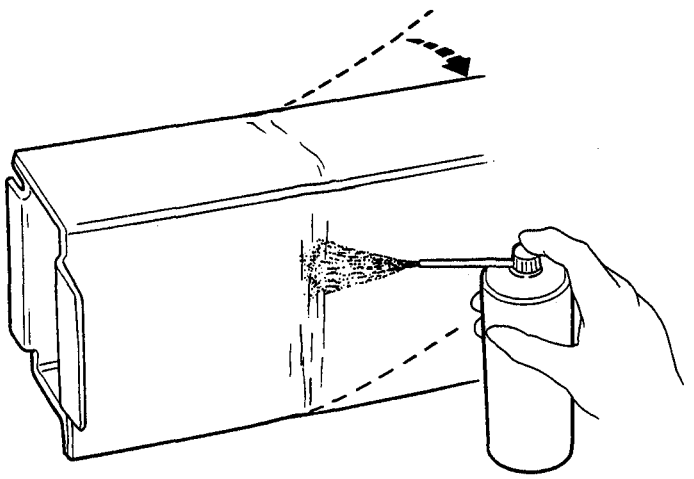
- The penetrant method utilizes the capillary phenomenon of liquids. The test itself uses a liquid with a powerful penetration capability to check out the location of minute defects which are not visible to the naked eye.
- The color contrast penetrant method is a type of penetrant test which uses a penetrant solution containing coloring. A penetrant solution which contrasts strongly with the color of the developing solution is used to enable the lighter locations to be observed.

Method of application

Items used: penetrant solution, developing solution, washer

1. Wash the inspection surface with the washer.
2. Apply penetrant solution to the surface and allow the solution ample time to soak down inside the cracks.
3. Wash off any excess penetrant solution remaining on the surface.
4. Spread the developing solution and cracks will be clearly indicated.

NOTE:
- During these operations, be sure to follow the instructions for use given by the manufacturer of the color contrast penetration agent.
- Be careful of ventilation.

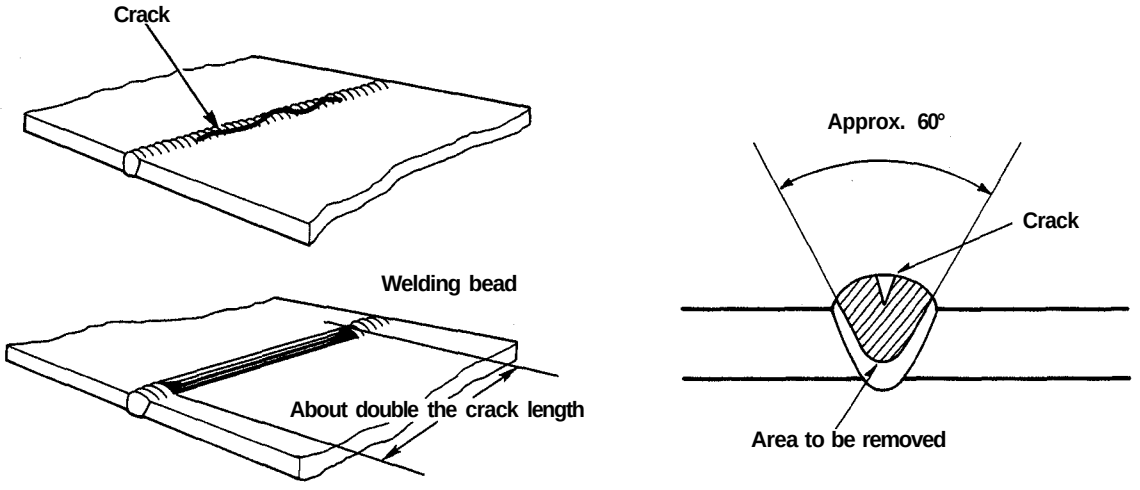


Aluminum Alloy Repair

When a Crack is detected

1. Weld zones

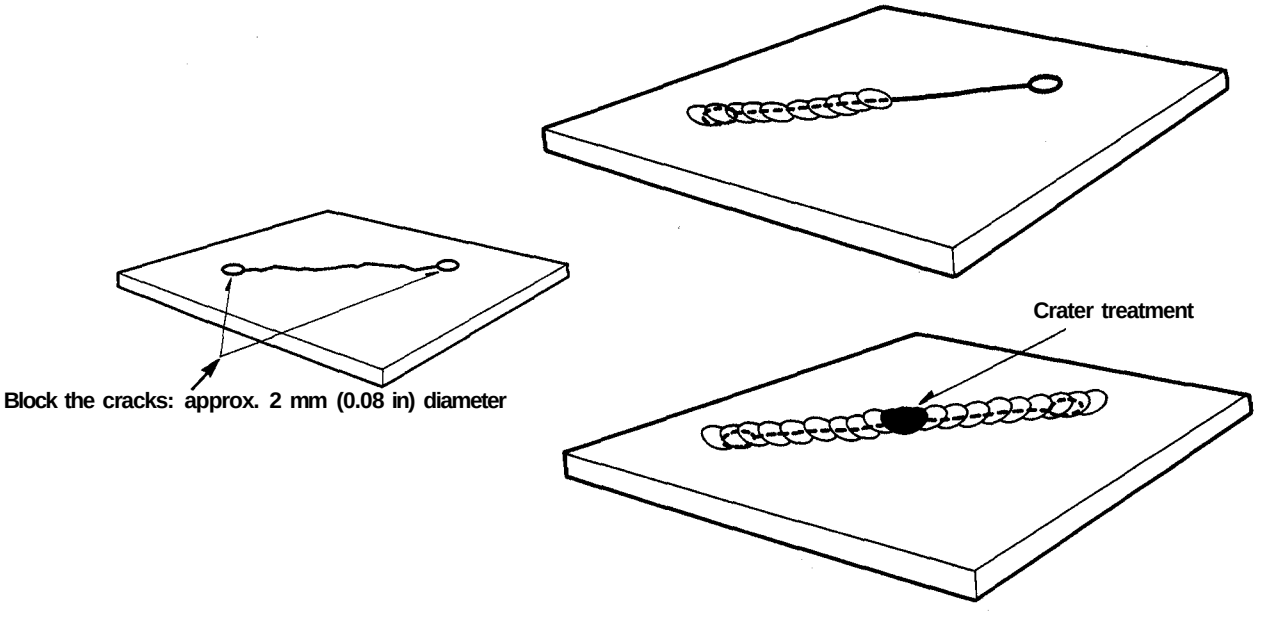
If a crack is detected in a weld, scrape off an area twice as long *as* the crack and reweld.



2. Shaping

CAUTION: If a crack is formed when the sheet metal is being straightened, replace the part, do not correct by welding.

NOTE: If, upon completion of the work, there are still very minute cracks which cannot be detected except with a color contrast penetrant, drill holes at both ends of the crack, and proceed with the welding.



Body, Frame Area Shaping

Body and frame areas made of aluminum alloys use plates which are between 1.5 and 2 times as thick as steel plates.
When deformations must be straightened out, aluminum alloys feel harder or stiffer to the touch than conventional steel plate.
In order to avoid inducing changes in the quality of steel plate, the use of a torch to heat up sheet plates is avoided whenever possible. In the case of aluminum alloys, however, work hardening occurs in buckled areas which makes it easy for cracks to form.
Do not use a frame straightener for straightening work without applying heat with an acetylene torch. At temperatures above 392°F (200°C) elongation characteristics are improved and work is facilitated.

Heating temperature control method

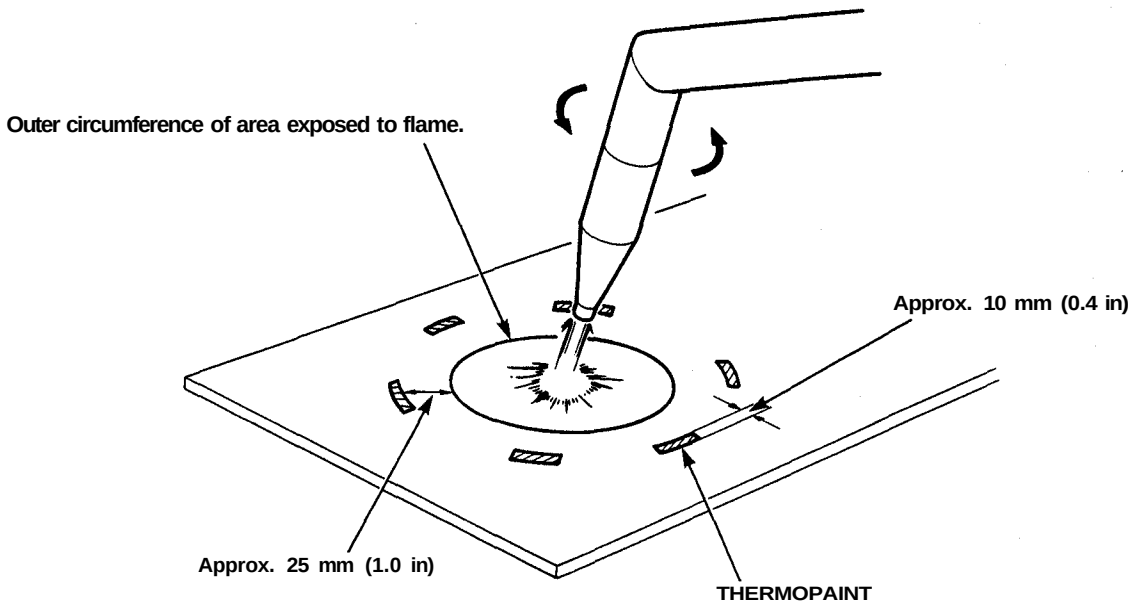
Since the melting point of aluminum alloys is approximately 1184°F (640°C) and since there is hardly any change in color even when the temperature rises, there is a tendency to apply too much heat.

To check the degree of heating and keep it within limits, use thermopaint which changes color 230°F (110°C).

Apply the thermopaint in a strip about 10 mm (0.4 in) wide at a point approx. 25 mm (1.0 in) from the outer circumference to be exposed to the torch flame. Stop heating when the color clearly changes in the surrounding area where the thermopaint was applied. The temperature of the heated at this time will be less than 752°F (400°C).

The time required for heating depends greatly on how the aluminum alloy is exposed to the torch flame and on the area covered by the heating.

As shown in the figure below, the upper temperature limit can be controlled and overheating prevented by applying thermopaint in places 25 mm (1.0 in) away from the area to be heated.



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