

4-62. **STRUCTURAL REPAIRS.** Structural repair methods used may be made in accordance with the regulations set forth in FAA Advisory Circular 43.13-1A. To assist in making repairs, Figure 4-3 identifies the type and thickness of skin structure used. Never make a skin replacement or patch from a material other than the type of the original skin. Original material and thickness is recommended and must result in a surface which is as strong as, or stronger than, the original skin. However, flexibility must be retained so that the surrounding areas will not receive extra stress.

When making major structural repairs, using other than factory manufactured parts, it is recommended the manufacturer be contacted. No major alterations are recommended without contacting the manufacturer.

4-63. **FIBERGLASS REPAIRS.** The repair procedure in this manual will describe the methods for the repair of fiberglass reinforced structures. Paragraph 4-64 describes Touch-up and Surface Repairs such as blisters, open seams, delaminations, cavities, small holes, and minor damages that have not harmed the fiberglass cloth material. Paragraph 4-65 describes Fracture and Patch Repairs such as puncture, breaks, and holes that have penetrated through the structure and damaged the fiberglass cloth. A repair kit, Part Number 756 729, that will furnish the necessary material for such repairs is available through Piper Aircraft Distributors.

**NOTE**

Very carefully follow resin and catalyst mixing instructions furnished with repair kit.

4-64. **FIBERGLASS TOUCH-UP AND SURFACE REPAIRS.**

- a. Remove wax, oil, and dirt from around the damaged area with acetone, methylethylketone or equivalent and remove paint to gel coat.
- b. The damaged area may be scraped with a fine blade knife or a power drill with a burr attachment to roughen the bottom and sides of the damaged area. Feather the edge surrounding the scratch or cavity. Do not undercut the edge. (If the scratch or cavity is shallow and penetrates only the surface coat, continue to Step f.)
- c. Pour a small amount of resin into a jar lid or on a piece of cardboard just enough to fill the area being worked on. Mix an equal amount of milled fiberglass with the resin using a putty knife or stick. Add catalyst, according to kit instructions, to the resin and mix thoroughly. A hypodermic syringe may be used to inject gel into small cavities not requiring fiberglass millings mixed with the gel.
- d. Work the mixture of resin, fibers, and catalyst into the damaged area, using the sharp point of a putty knife or stick to press it into the bottom of the hole and to puncture any air bubbles which may be present. Fill the scratch or hole above the surrounding undamaged area about 1/16 inch.
- e. Lay a piece of cellophane or waxed paper over the repair to cut off air and start the cure of gel mixture.
- f. Allow the gel to cure 10 to 15 minutes until it feels rubbery to the touch. Remove the cellophane and trim flush with the surface, using a sharp razor blade or knife. Replace the cellophane and allow to cure completely for 30 minutes to an hour. The patch will shrink slightly below the structure surface as it cures. (If wax paper is used, ascertain wax is removed from surface.)

- g. Rough up the bottom and edges of the hole with an electric burr attachment or rough sandpaper. Feather hole into surrounding gel coat, do not undercut.
- h. Pour out a small amount of resin, add catalyst and mix thoroughly, using a cutting motion rather than stirring. Use no fibers.
- i. Using the tip of a putty knife or finger tips, fill the hole to about 1/16 inch above the surrounding surface with the gel coat mixture.
- j. Lay a piece of cellophane over the patch to start the curing process. Repeat Step f, trimming patch when partially cured.
- k. After trimming the patch, immediately place another small amount of gel coat on one edge of the patch and cover with cellophane. Then, using a squeegee or the back of a razor blade, squeegee level with area surrounding the patch, leave the cellophane on patch for one or two hours or overnight, for complete cure.
- l. After repair has cured for 24 hours, sand patched area, using a sanding block with fine wet sandpaper. Finish by priming, again sanding and applying color coat.



4-65. FIBERGLASS FRACTURE AND PATCH REPAIRS.

- a. Remove wax, oil, and dirt from around the damaged area with acetone, methylethylketone or equivalent.
- b. Using a keyhole saw, electric saber saw or sharp knife, cut away ragged edges. Cut back to sound material.
- c. Remove paint three inches back from around damaged area.
- d. Working inside the structure, bevel the edges to approximately a 30 degree angle and rough sand the hole and the area around it, using 80 grit dry paper. Feather back for about two inches all around the hole. This roughens the surface for strong bond with patch.
- e. Cover a piece of cardboard or metal with cellophane. Tape it to the outside of the structure, covering the hole completely. The cellophane should face toward the inside of the structure. If the repair is on a sharp contour or shaped area, a sheet of aluminum formed to a similar contour may be placed over the area. The aluminum should also be covered with cellophane.
- f. Prepare a patch of fiberglass mat and cloth to cover an area two inches larger than the hole.
- g. Mix a small amount of resin and catalyst, enough to be used for one step at a time, according to kit instructions.
- h. Thoroughly wet mat and cloth with catalyzed resin. Daub resin on mat first and then on cloth. Mat should be applied against structures surface with cloth on top. Both pieces may be wet out on cellophane and applied as a sandwich. Enough fiberglass cloth and mat reinforcements should be used to at least replace the amount of reinforcements removed in order to maintain the original strength. If damage occurred as a stress crack, an extra layer or two of cloth may be used to strengthen area.
- i. Lay patch over hole on inside of structure; cover with cellophane and squeegee from center to edges to remove all air bubbles and assure adhesion around edge of hole. Air bubbles will show white in the patch and they should all be worked out to the edge. Remove excess resin before it gels on the part. Allow patch to cure completely.
- j. Remove cardboard or aluminum sheet from outside of hole and rough sand the patch and edge of hole. Feather edge of hole about two inches into undamaged area.
- k. Mask area around hole with tape and paper to protect surface. Cut a piece of fiberglass mat about one inch larger than the hole and one or more pieces of fiberglass cloth two inches larger than the hole. Brush catalyzed resin over hole; lay mat over hole and wet out with catalyzed resin. Use a daubing action with brush. Then apply additional layer or layers of fiberglass cloth to build up patch to the surface of structure. Wet out each layer thoroughly with resin.
- l. With a squeegee or broad knife, work out all air bubbles in the patch. Work from center to edge, pressing patch firmly against the structure. Allow patch to cure for 15 to 20 minutes.
- m. As soon as the patch begins to set up, but while still rubbery, take a sharp knife and cut away extra cloth and mat. Cut on outside edge of feathering. Strip cut edges of structure. Do this before cure is complete, to save extra sanding. Allow patch to cure overnight.
- n. Using dry 80 grit sandpaper on a power sander or sanding block, smooth patch and blend with surrounding surface. Should air pockets appear while sanding, puncture and fill with catalyzed resin. A hypodermic needle may be used to fill cavities. Let cure and resand.
- o. Mix catalyzed resin and work into patch with fingers. Smooth carefully and work into any crevices.
- p. Cover with cellophane and squeegee smooth. Allow to cure completely before removing cellophane. Let cure and resand.
- q. Brush or spray a coat of catalyzed resin to seal patch. Sand patch; finish by priming; again sanding and applying color coat.

NOTE

Brush and hands may be cleaned in solvents such as acetone or methylethylketone. If solvents are not available, a strong solution of detergent and water may be used.





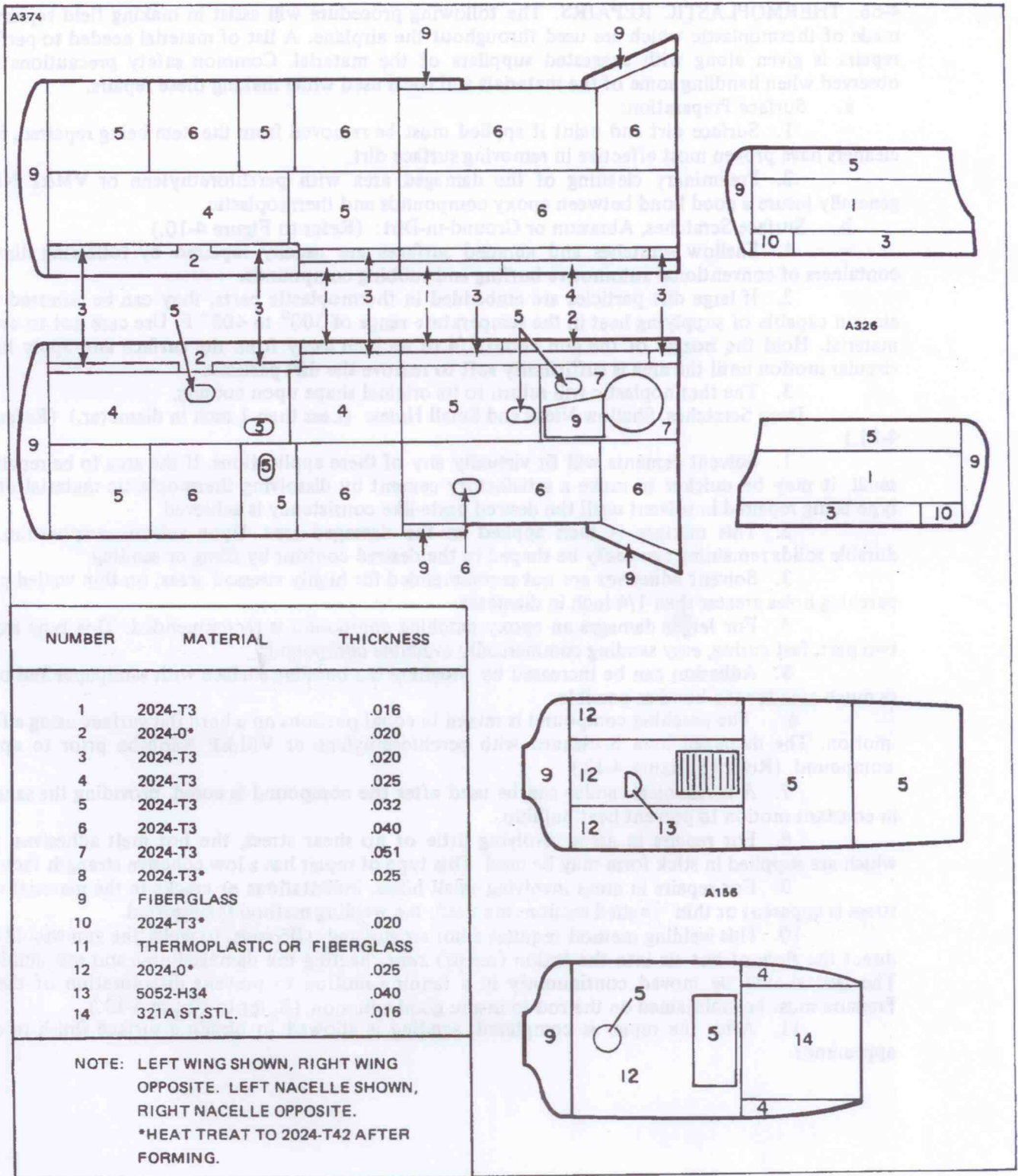


Figure 4-9. Skin Material and Thickness (cont.)

**4-66. THERMOPLASTIC REPAIRS.** The following procedure will assist in making field repairs to items made of thermoplastic which are used throughout the airplane. A list of material needed to perform these repairs is given along with suggested suppliers of the material. Common safety precautions should be observed when handling some of the materials and tools used while making these repairs.

a. Surface Preparation:

1. Surface dirt and paint if applied must be removed from the item being repaired. Household cleaners have proven most effective in removing surface dirt.

2. Preliminary cleaning of the damaged area with perchlorethylene or VM&P Naphtha will generally insure a good bond between epoxy compounds and thermoplastic.

b. Surface Scratches, Abrasion or Ground-in-Dirt: (Refer to Figure 4-10.)

1. Shallow scratches and abraded surfaces are usually repaired by following directions on containers of conventional automotive buffing and rubbing compounds.

2. If large dirt particles are embedded in thermoplastic parts, they can be removed with a hot air gun capable of supplying heat in the temperature range of 300° to 400° F. Use care not to overheat the material. Hold the nozzle of the gun about 1/4 of an inch away from the surface and apply heat with a circular motion until the area is sufficiently soft to remove the dirt particles.

3. The thermoplastic will return to its original shape upon cooling.

c. Deep Scratches, Shallow Nicks and Small Holes: (Less than 1 inch in diameter.) (Refer to Figure 4-11.)

1. Solvent cements will fit virtually any of these applications. If the area to be repaired is very small, it may be quicker to make a satisfactory cement by dissolving thermoplastic material of the same type being repaired in solvent until the desired paste-like consistency is achieved.

2. This mixture is then applied to the damaged area. Upon solvent evaporation, the hard durable solids remaining can easily be shaped to the desired contour by filing or sanding.

3. Solvent adhesives are not recommended for highly stressed areas, on thin walled parts or for patching holes greater than 1/4 inch in diameter.

4. For larger damages an epoxy patching compound is recommended. This type material is a two part, fast curing, easy sanding commercially available compound.

5. Adhesion can be increased by roughing the bonding surface with sandpaper and by utilizing as much area for the bond as possible.

6. The patching compound is mixed in equal portions on a hard flat surface using a figure eight motion. The damaged area is cleaned with perchlorethylene or VM&P Naphtha prior to applying the compound. (Refer to Figure 4-12.)

7. A mechanical sander can be used after the compound is cured, providing the sander is kept in constant motion to prevent heat buildup.

8. For repairs in areas involving little or no shear stress, the hot melt adhesives, polyamids which are supplied in stick form may be used. This type of repair has a low cohesive strength factor.

9. For repairs in areas involving small holes, indentations or cracks in the material where high stress is apparent or thin walled sections are used, the welding method is suggested.

10. This welding method requires a hot air gun and ABS rods, to weld, the gun should be held to direct the flow of hot air into the fusion (repair) zone, heating the damaged area and rod simultaneously. The gun should be moved continuously in a fanning motion to prevent discoloration of the material. Pressure must be maintained on the rod to insure good adhesion. (Refer to Figure 4-13.)

11. After the repair is completed, sanding is allowed to obtain a surface finish of acceptable appearance.



d. Cracks: (Refer to Figure 4-14.)

1. Before repairing a crack in the thermoplastic part, first determine what caused the crack and alleviate that condition to prevent it recurring after the repair is made.
2. Drill small stop holes at each end of the crack.
3. If possible, a double plate should be bonded to the reverse side of the crack to provide extra strength to the part.
4. The crack should be "V" grooved and filled with repair material, such as solvent cement, hot melt adhesive, epoxy patching compound or hot air welded, whichever is preferred.
5. After the repair has cured, it may be sanded to match the surrounding surface finish.

e. Repairing Major Damage: (Larger than 1 inch in diameter.) (Refer to Figure 4-15.)

1. If possible a patch should be made of the same material and cut slightly larger than the section being repaired.
2. When appearances are important, large holes, cracks, tears, etc. should be repaired by cutting out the damaged area and replacing it with a piece of similar material.
3. When cutting away the damaged area, under cut the perimeter and maintain a smooth edge. The patch and/or plug should also have a smooth edge to insure a good fit.
4. Coat the patch with solvent adhesive and firmly attach it over the damaged area.
5. Let the patch dry for approximately one hour before any additional work is performed.
6. The hole, etc. is then filled with the repair material. A slight overfilling of the repair material is suggested to allow for sanding and finishing after the repair has cured. If patching compound is used the repair should be made in layers, not exceeding a 1/2 inch in thickness at a time, thus allowing the compound to cure and insuring a good solid buildup of successive layers as required.

f. Stress Lines: (Refer to Figure 4-16.)

1. Stress lines produce a whitened appearance in a localized area and generally emanate from the severe bending or impacting of the material. (Refer to Figure 4-17.)
2. To restore the material to its original condition and color, use a hot air gun or similar heating device and carefully apply heat to the affected area. Do not overheat the material.

g. Painting the Repair:

1. An important factor in obtaining a quality paint finish is the proper preparation of the repair and surrounding area before applying any paint.
2. It is recommended that parts be cleaned prior to painting with a commercial cleaner or a solution made from one-fourth cup of detergent mixed with one gallon of water.
3. The paint used for coating thermoplastic can be either lacquers or enamels depending on which is preferred by the repair facility or customer. (See NOTE.)

NOTE

It is extremely important that solvent formulations be considered when selecting a paint, because not all lacquers or enamels can be used satisfactorily on thermoplastics. Some solvents used in the paints can significantly affect and degrade the plastic properties.

4. Another important matter to consider is that hard, brittle coatings that are usually best for abrasion resistance should not be used in areas which incur high stress, flexing or impact. Such coatings may crack, thus creating a weak area.

TABLE IV-III. LIST OF MATERIALS (THERMOPLASTIC REPAIR)

ITEMS	DESCRIPTIONS	SUPPLIERS
Buffing and Rubbing Compounds	Automotive Type - DuPont #7	DuPont Company Wilmington, Del. 19898
	Ram Chemical #69 x 1	Ram Chemicals Gardena, Cal. 90248
	Mirror Glaze #1	Mirror Bright Polish Co., Inc. Irvin, Cal. 92713
Cleaners	Fantastic Spray Perchloroethylene VM&P Naphtha (Lighter Fluid)	Obtain From Local Suppliers
ABS-Solvent Cements	Solarite #11 Series	Solar Compounds Corp. Linden, N.J. 07036
Solvents	Methylethyl Ketone Methylene Chloride Acetone	Obtain From Local Suppliers
Epoxy Patching Compound	Solarite #400	Solar Compounds Corp. Linden, N.J. 07036
Hot Melt Adhesives Polyamids and Hot Melt Gun	Stick Form 1/2 in. dia. 3 in. long	Sears Roebuck & Co. or Most Hardware Stores
Hot Air Gun	Temp. Range 300° to 400°F	Local Suppliers



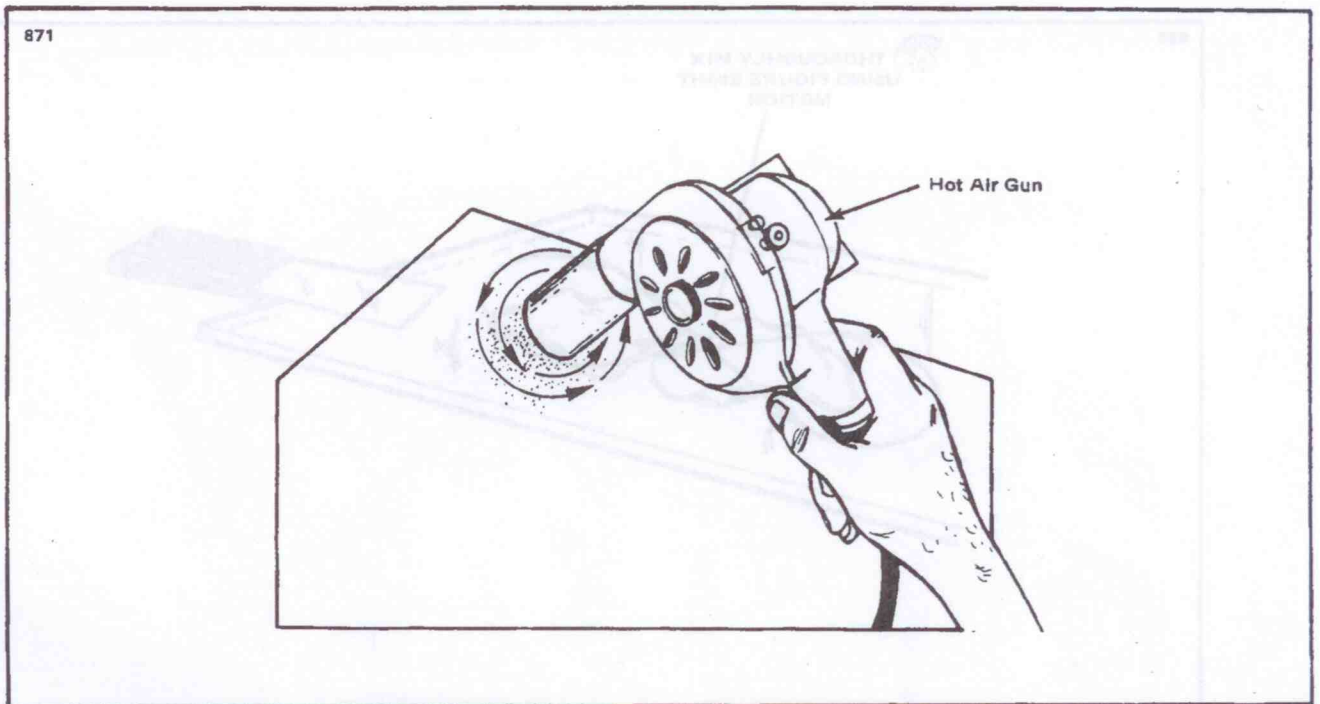


Figure 4-10. Surface Scratches, Abrasions or Ground-in-Dirt.

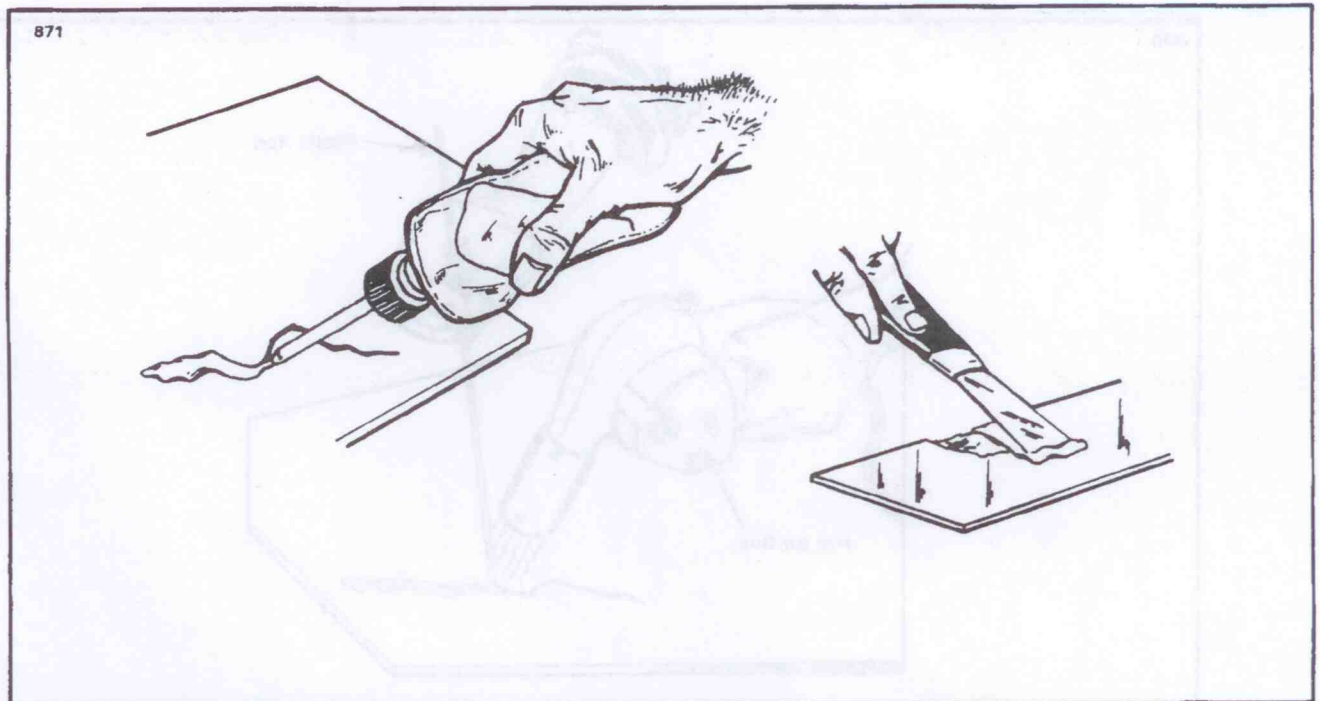


Figure 4-11. Deep Scratches, Shallow Nicks and Small Holes.

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THOROUGHLY MIX  
USING FIGURE EIGHT  
MOTION

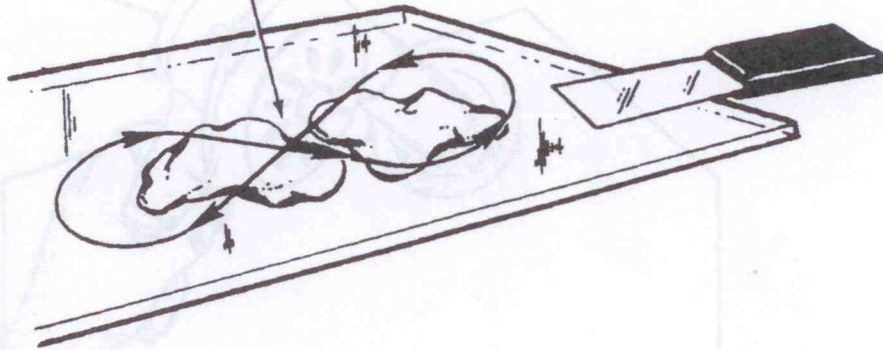


Figure 4-12. Mixing of Epoxy Patching Compound.

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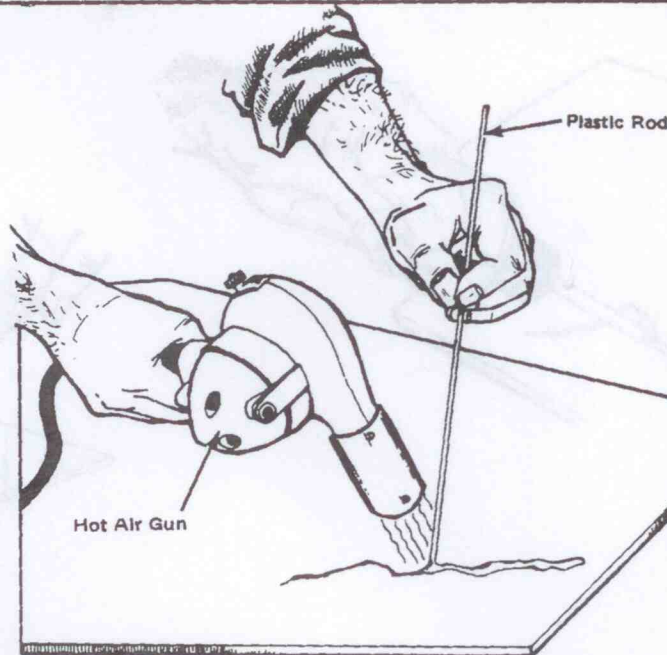


Figure 4-13. Welding Repair Method.



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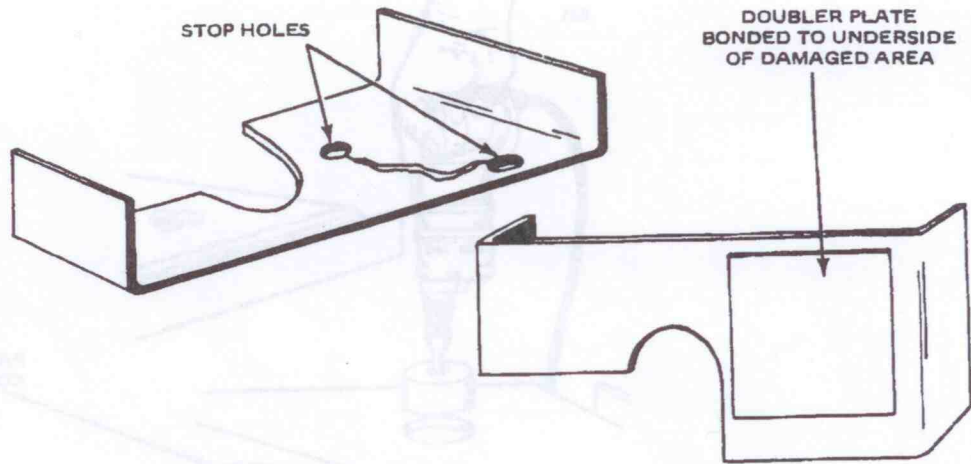


Figure 4-14. Repairing of Cracks.

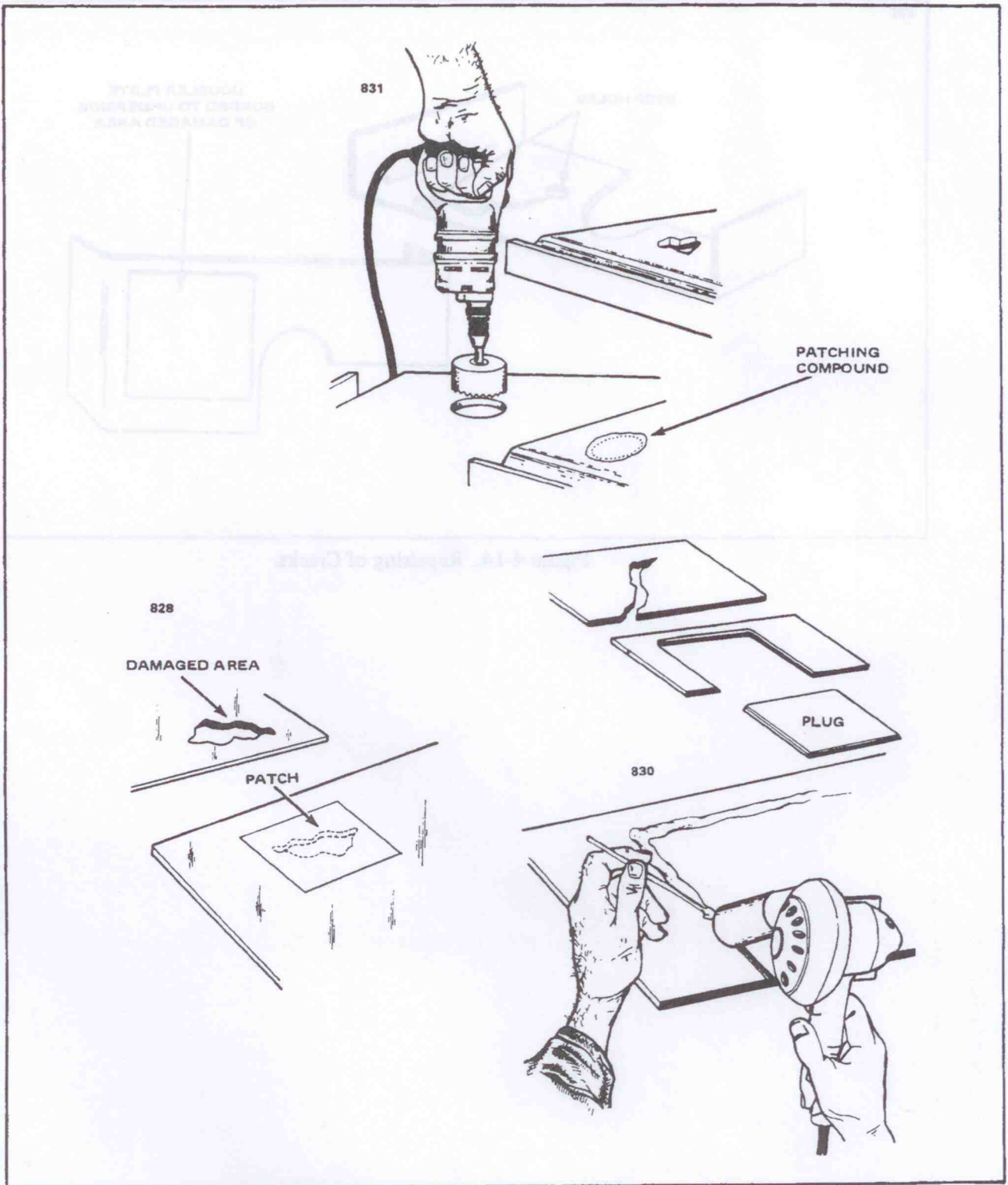


Figure 4-15. Various Repairs.



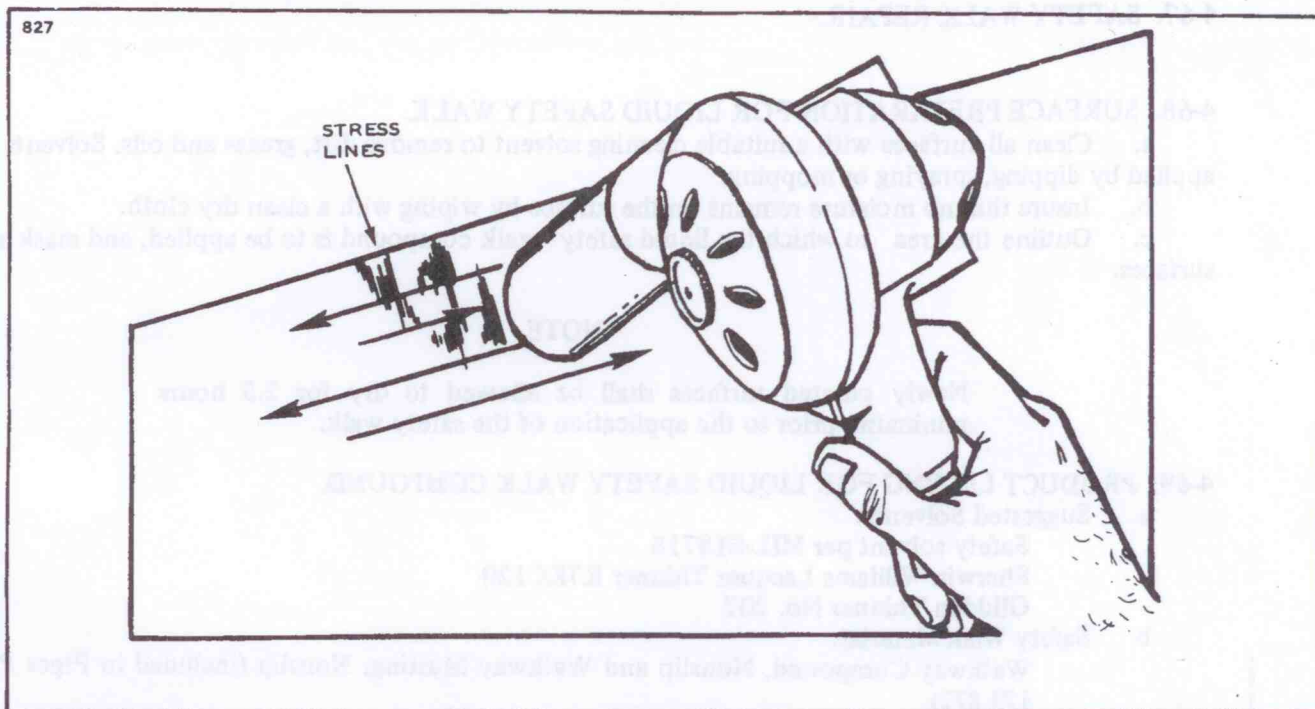


Figure 4-16. Repair of Stress Lines.

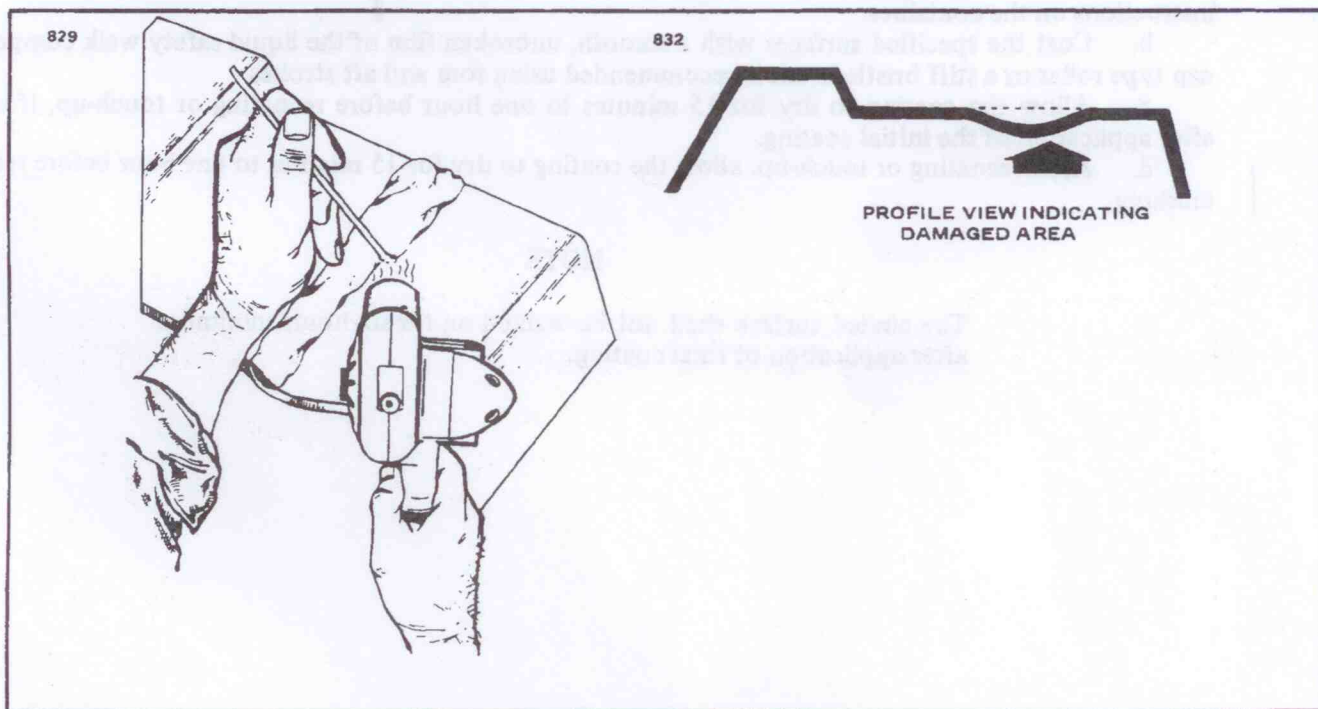


Figure 4-17. Repair of Impacted Damage.