SECTION 8. ALUMINUM AND ALUMINUM ALLOYS

6-132. GENERAL. Aluminum and aluminum alloys are the most widely used material for aircraft construction. Aluminum appears high in the electro-chemical series of elements and corrodes very easily. However, the formation of a tightly-adhering oxide film offers increased resistance under most corrosive conditions. Most metals in contact with aluminum form couples that undergo galvanic corrosion attack. The alloys of aluminum are subject to pitting, intergranular corrosion and intergranular stress corrosion cracking. In some cases the corrosion products of metal in contact with aluminum are corrosive to aluminum. Therefore, aluminum and its alloys must be cleaned and protected.

6-133. SPECIAL TREATMENT OF ANODIZED SURFACES. Anodizing is the most common surface treatment of aluminum alloy surfaces. The aluminum sheet or casting is made the positive pole in an electrolyte bath in which chromic acid or other oxidizing agents produce a supplemental protective oxide film on the aluminum surface. The anodized surface coating offers the alloy a great deal of protection as long as it is not damaged. Once the film is damaged, it can only be partially restored by chemical surface treatment. Therefore exercise care to avoid breaking of the protective film, particularly at the edges of the sheet.

6-134. REPAIR OF ALUMINUM ALLOY SHEET METAL. After extensive corrosion removal the following procedures should be followed:

a. If water can be trapped in blended areas, chemical conversion coat in accordance with MIL-C-81706 and fill the blended area with structural adhesive or sealant to the same level and contour as the original skin. When areas are small enough that structural strength has not been significantly decreased, no other work is required prior to applying the protective finish.

b. When corrosion removal exceeds the limits of the structural repair manual, contact a DER or the aircraft manufacturer for repair instructions.

c. Where exterior doublers are installed, it is necessary to seal and insulate them adequately to prevent further corrosion.

d. Doublers should be made from alclad, when available, and the sheet should be anodized (preferred) or a chemical conversion coat applied after all cutting, drilling, and countersinking has been accomplished.

e. All rivet holes should be drilled, countersunk, surface treated, and primed prior to installation of the doubler.

f. Apply a suitable sealing compound in the area to be covered by the doubler. Apply sufficient thickness of sealing compound to fill all voids in the area being repaired.

g. Install rivets wet with sealant. Sufficient sealant should be squeezed out into holes so that all fasteners, as well as all edges of the repair plate, will be sealed against moisture.

h. Remove all excess sealant after fasteners are installed. Apply a fillet sealant bead around the edge of the repair. After the sealant has cured apply the protective paint finish to the reworked area.

6-135. CORROSION REMOVAL AROUND COUNTERSUNK FASTENERS IN ALUMINUM ALLOY. Intergranular corrosion in aluminum alloys often originates at countersunk areas where steel fasteners are used.

a. When corrosion is found around a fixed fastener head, the fastener must be removed to ensure corrosion removal. All corrosion must be removed to prevent further corrosion and loss of structural strength. To reduce the recurrence of corrosion, the panel should receive a chemical conversion coating, be primed, and have the fasteners installed wet with sealant.

b. Each time removable steel fasteners are removed from access panels, they should be inspected for condition of the plating. If mechanical or plating damage is evident, replace the fastener. One of the following fastener installation methods should be used:

(1) Brush a corrosion-preventive compound on the substructure around and in the fastener hole, start the fastener, apply a bead of sealant to the fastener countersink, set and torque the fastener within the working time of the sealant (this is the preferred method).

(2) Apply the corrosion preventive compound to the substructure and fastener, set and torque the fastener.

(3) Apply a coating of primer to the fastener, and while wet with primer, set and torque the fastener.

6-136. EXAMPLES OF REMOVING CORROSION FROM ALUMINUM AND ALUMINUM ALLOYS.

a. Positively identify the metal as aluminum.

b. Clean the area to be reworked. Strip paint if required.

c. Determine extent of corrosion damage.

d. Remove light to moderate corrosion with one of the following.

(1) Non-Powered Corrosion Removal.

(a) The removal of corrosion products by hand can be accomplished by use of aluminum grit and silicon carbide abrasive, such as non-woven, non-metallic, abrasive mat (Spec. MIL-A-9962), abrasive cloth, and paper. Aluminum wool, fiber bristle brushes, and pumice powder are also acceptable methods.

(b) Stainless steel brush (Spec. H-B-178, type III, class 2) may be used as long as the bristles do not exceed 0.010 inch in diameter. After use of this brush the surface should be polished with 60 grit aluminum oxide abrasive paper, then with 400 grit aluminum oxide paper. Care should be exercised in any cleaning process to avoid breaking the protective film.

(c) Steel wool, emery cloth, steel wire brushes (except stainless steel brush) copper alloy brushes, rotary wire brushes, or severe abrasive materials should not be used on any aluminum surface.

(2) Chemical Corrosion Removal.

(a) The corrosion removal compound aluminum pretreatment MIL-C-38334, an acid material, may be used to remove corrosion products from aluminum alloy materials or items (e.g., skins, stringer, ribs in wings, tubing, or ducts). MIL-C-38334 is available in two types:

1 Type I Liquid concentrate materials should be diluted in accordance with the

manufacture's instructions before use. Type I has a 1 year shelf life; therefore it shall not be used after 1 year from the date of manufacture.

2 Type II Powdered concentrate materials should be dissolved in the volume of water specified on the kit. These materials have an indefinite shelf life in the dry state. Once mixed, they should be used within 90 days.

(b) Mix MIL-C-38334 in wood, plastic, or plastic-lined containers only. Wear acid-resistant gloves, protective mask and protective clothing when working with this acid compound. If acid contacts the skin or eyes, flush immediately with water.

(c) Apply MIL-C-38334 solution by flowing, mopping, sponging, brushing, or wiping. When applying the solution to large areas, begin the application at the lowest area and work upward, applying the solution with a circular motion to disturb the surface film and ensure proper coverage. If pumping is required, pumps, valves, and fittings should be manufactured from 18-8 stainless steel or plastic.

CAUTION: When working with MIL-C-38334, keep the solution away from magnesium surfaces. The solution must be confined to the area being treated. All parts and assemblies including cadmium-plated items and hinges susceptible to damage from acid should be masked and/or protected. Also mask all openings leading to the primary structure that could trap the solution and doors or other openings that would allow the solution (uncontrolled) to get into the aircraft or equipment interior. It is a good practice to keep a wet rag on hand at all times, for removal of spills or splashes.

(d) Allow the solution to remain on the surface for approximately 12 minutes and then rinse away with clean tap water. For pitted or heavily-corroded areas the compound will be more effective if applied warm (140 °F) followed by vigorous agitation with a non-metallic acid-resisting brush or aluminum oxide abrasive nylon mat. Allow sufficient dwell time, 12 to 15 minutes, before rinsing. After each application examine the pits and/or corroded area to determine if another application is required with a 4 to 10 power magnifying glass. (Select the power depending on the distance available to make the inspection.) Corrosion still on the area will appear as a powdery crust slightly different in color than the uncorroded base metal. Darkening of area due to shadows and reaction from the acid remover should not be considered.

(e) Once the corrosion has been removed and the area well-rinsed with clean water, a chromate conversion coating such as MIL-C-81706 or MIL-C-5541 alodine 1200, must be applied immediately thereafter.

e. Remove moderate to heavy corrosion with one of the following.

(1) Powered Corrosion Removal.

(a) Where the problem is severe enough to warrant the use of power tools, a pneumatic drill motor driving either an aluminum-oxide-impregnated nylon abrasive wheel, flap brush or rubber grinding wheel may be used with an abrasive value to approximately 120 grit, as needed. Corrosion-removal accessories, such as flap brushes or rotary files, should be used on one type of metal only. For example, a flap brush used to remove aluminum should not be used to remove magnesium, steel, etc. Pneumatic sanders may be used with disk and paper acceptable for use on aluminum.

(b) When mechanically removing corrosion from aluminum, especially aircraft skin thinner than 0.0625 inch, extreme care must be used. Vigorous, heavy, continuous abrasive grinding can generate enough heat to cause metallurgical change. If heat damage is suspected, hardness tests or conductivity tests must be accomplished to verify condition of the metal. The use of powered rotary files should be limited to heavy corrosion and should not be used on skin thinner than 0.0625 inch.

(2) Blasting.

(a) Abrasive blasting may be used on aluminum alloys using glass beads (Spec. MIL-G-9954) sizes 10 to 13, or grain abrasive (Spec. MIL-G-5634) types I and III may be used as an alternate method of removing corrosion from clad and non-clad aluminum alloys. Abrasive blasting should not be used to remove heavy corrosion products. Direct pressure machines should have the nozzle pressure set at 30 to 40 psi for clad aluminum alloys and 40 to 45 psi for non-clad aluminum alloys. Engineering approval should be obtained prior to abrasive blasting metal thinner than 0.0625 inch.

(b) When using abrasive blasting on aluminum alloys, do not allow the blast stream to dwell on the same spot longer than 15 seconds. Longer dwell times will cause excessive metal removal. Intergranular exfoliation corrosion is not to be removed by abrasive blasting; however, blasting may be used with powered corrosion removal to determine whether all exfoliation corrosion has been removed.

f. Inspect the area for remaining corrosion. Repeat procedure if any corrosion remains.

NOTE: If corrosion remains after the second attempt, use a stronger method, e.g., chemical to mechanical.

g. Using a blend ratio of 20:1 (length to depth) blend and finish the corrosion rework area with progressively finer abrasive paper until 400-grit paper is used.

h. Clean reworked area using dry cleaning solvent. Do not use kerosene or any other petroleum base fuel as a cleaning solvent.

i. Determine depth of faired depressions to ensure that rework limits have not been exceeded.

j. Apply chemical conversion coating, MIL-C-81706, immediately after reworking. If 48 hours or more have elapsed since the conversion coating was first applied and the primer or final paint system has not yet been applied, then reapply the conversion coating before continuing.

NOTE: These solutions should not be allowed to come in contact with magnesium or high-strength steels (180,000 psi). Do not permit solutions or materials to contact paint thinner, acetone or other combustible material: FIRE MAY RESULT.

k. Apply paint finish to area.

6-137.—6-147. [RESERVED.]