SECTION 6. MAGNESIUM ALLOYS

660. TREATMENT OF WROUGHT MAGNESIUM SHEETS AND FORGINGS. Corrosive attack on magnesium skins will usually occur around edges of skin panels, underneath hold-down washers, or in areas physically damaged by shearing, drilling, abrasion, or impact. Entrapment of moisture under and behind skin crevices is frequently a contributing factor. If the skin section can be easily removed, this should be accomplished in order to assure complete inhibition and treatment.

a. Complete mechanical removal of corrosion products should be practiced when practicable. Such mechanical cleaning shall normally be limited to the use of stiff bristle brushes and similar nonmetallic cleaning tools, particularly during treatment in place under field conditions.

b. Any entrapment of steel particles from steel wire brushes, steel tools, or contamination of treated surfaces by dirty abrasives, can cause more trouble than the initial corrosive attack.

c. When aluminum insulating washers are used and they no longer adhere to magnesium panels, corrosion is likely to occur under the washers if corrective measures are not taken.

(1) When machine screw fasteners are used, they should be removed from all loose insulating washer locations in order to surface treat the magnesium panel.

(2) Where permanent fasteners other than machine screws are used, the insulating washer and fastener should be removed to ensure complete corrosion removal.

(3) When located so that water can be trapped in the counterbored area where the washer was located, use sealants to fill the counterbore. If necessary to fill several areas adjacent to each other, it may be advantageous to cover with a strip of sealant.

661. REPAIR OF MAGNESIUM SHEET METAL AFTER EXTENSIVE CORROSION REMOVAL. The same general instructions apply when making repairs in magnesium as in aluminum alloy skin, except that two coats of epoxy primer may be required on both the doubler and skin being patched instead of only one coat. Where it is difficult to form magnesium alloys in the contour, aluminum alloy may be utilized. When this is done, it is necessary to insure effective dissimilar metal insulation. Vinyl tape will insure positive separation of dissimilar metals, but edges will still have to be sealed to prevent entrance of moisture between mating surfaces at all points where repairs are made. It is recommended that only noncorrosive type sealant be used, since it serves a dual purpose of material separation and sealing.

662. IN-PLACE TREATMENT OF MAGNESIUM CASTINGS. Magnesium castings, in general, are more porous and more prone to penetrating attack than wrought magnesium skin. However, treatment in the field is, for all practical purposes, the same for all magnesium areas. Engine cases are among the most common examples of cast magnesium encountered in modern aircraft. Bellcranks, fittings, and numerous covers, plates, and handles may also be magnesium castings. When attack occurs on a casting, the earliest practicable treatment is required if dangerous corrosive penetration is to be avoided. Engine cases in salt water can develop "moth holes" and complete penetration overnight.

a. If it is at all practicable, faying surfaces involved should be separated in order to effectively treat the existing attack and prevent its further progress. The same general treatment sequence detailed for magnesium skin should be followed. Where engine cases are concerned, baked enamel overcoats are usually involved rather than other topcoat finishes. A good air drying enamel can be used to restore protection.

b. If extensive removal of corrosion products from a structural casting is involved, a decision from the aircraft manufacturer may be necessary in order to evaluate the adequacy of structural strength remaining. Structural repair manuals usually include dimensional tolerance limits for critical structural members. The FAA should be consulted if any questions of safety are involved.

663. EXAMPLE OF REMOVING CORROSION FROM MAGNESIUM. If possible, corroded magnesium parts should be removed from aircraft. When impossible to remove the part, make aircraft preparations detailed in paragraph 612. When using that procedure, observe the safety precautions and procedures of paragraph 600.

a. Positively identify metal as magnesium. (Refer to paragraph 618)

b. Clean area to be reworked.

c. Strip paint if required.

d. Determine extent of corrosion damage as detailed in paragraph 642. To remove light corrosion, proceed with paragraph 663.e. To remove moderate or severe corrosion, proceed with paragraph 663.f.

e. Remove light corrosion by light hand-sanding or chemically, as follows. Do not use the following procedure for adhesive bonded parts or assemblies, areas where the brush-on solution might become lodged, or local areas bared specifically for grounding or electrical bonding purpose.

(1) Remove loose corrosion with aluminum wool or abrasive mat, paper, or cloth.

(2) Mask off other materials and parts, especially rubber parts, bearings, and cast or pressed inserts to prevent contact with the treating solution or its fumes.

(3) Prepare corrosion treating solution in the following proportions: 1-1/2 pounds of sodium dichromate and 1-1/2 pints of concentrated nitric acid (HNO_3) per gallon of water. Mix as follows, but prepare and store the solution in clean polyethylene or glass containers:

(i) Fill a suitable container with a volume of water equal to 1/4 the desired total quantity of solution.

(ii) Add full quantity of sodium dichromate in proportions indicated and agitate solution until the chemical is dissolved.

(iii) Add water until quantity of solution is equal to approximately 2/3 the desired total quantity.

(iv) Slowly add total volume of nitric acid (HNO_3) to solution and mix thoroughly.

(v) Add remaining water until total desired quantity of solution is reached and stir until entire solution concentration is equal.

(4) Remove remaining corrosion by swabbing the corroded surface 1 to 2 minutes with the nitric acid (HNO_3) solution, then wipe dry.

(5) Rinse thoroughly with clean water while scrubbing with a mop, brush, or abrasive mat and wipe dry.

(6) Repeat the preceding sequence, as necessary, until all corrosion has been removed.

(7) After all corrosion has been removed, proceed with paragraph 663.g.

f. Mechanically remove moderate or severe corrosion. Wear goggles or a face shield to preclude injury from corrosion particles breaking loose and flying off. Protect adjacent areas to prevent additional damage from corrosion products removed when using this procedure.

NOTE: DO NOT USE CARBON STEEL WIRE BRUSHES OR SILICONE CARBIDE ABRASIVES ON MAGNESIUM.

(1) Remove heavy corrosion products by hand brushing with a stainless steel or fiber brush followed by vacuum abrasive blasting with glass beads, (Specification MIL-G-9954) sizes 10, 11, 12, 13; or grain abrasive (Specification MIL-G-5634) Types I or III. An air pressure at the nozzle of 10 to 35 psi should be used for direct pressure machines. For suction type blast equipment, use 50 percent higher pressure.

(2) Remove residual corrosion by hand sanding or with approved hand-operated power tool.

(3) After removing all corrosion visible through a magnifying glass, apply corrosion treating solution.

g. Fair depressions resulting from rework using a blend ratio of 20:1. Clean rework area using 240 grit abrasive paper. Smooth with 300 grit and final polish with 400 grit abrasive paper.

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

i. Clean reworked area using a solvent to provide a water breakfree surface. Do not use kerosene.

j. Prepare and apply magnesium conversion coat conforming to MIL-M-3171, TYPE VI (DOW-19) as follows:

(1) Measure 1 gallon of distilled water into a clean polyethylene or glass container.

(2) Add 1.3 ounces (dry) of chromium trioxide or 1.3 ounces of technical grade chromic acid.

(3) Add 1 ounce of calcium sulfate dehydrate ($CaSO_4.2H_2O$).

(4) Vigorously stir for at least 15 minutes to ensure that the solution is saturated with calcium sulfate. (Let chromate solution stand for 15 minutes prior to decanting.)

(5) Prior to use, decant solution (avoid transfer of undissolved calcium sulfate) into suitable usage containers (polyethylene or glass).

(6) Apply solution by swabbing until the metal surface becomes a dull color (the color can vary from green-brown, brassy, yellow-brown to dark brown). Under optimum conditions of temperature at 70 °F or above and fresh materials, the time required to properly apply magnesium pretreatment is usually 1 to 5 minutes. Under these conditions, 1 to 2 minutes of treatment should produce a brassy film, and 3 to 5 minutes a dark brown coating. Under adverse conditions, and if the desired specified finish color is not produced in the specified time, the treatment may have to be prolonged up to 20 to 30 minutes in some instances until the proper finish is effected. For good paint adhesion, a dark brown color, free of powder, is considered best. The color may vary in using different vendors' materials. Too long exposure to the brush-on solution produces a coating which will powder and impair adhesion of applied paint finish/films. Use caution in swabbing on the solution. Severe rubbing of the wet surface will damage the coating.

NOTE: HIGH PRESSURE SPRAYING OR RUBBING ABRASION WILL DAMAGE THE FRESH COATING.

(7) Rinse with clean water, then allow to dry at ambient temperature for a minimum of 1 hour (more in high humidity areas).

k. Apply primer and topcoat finish.

l. Remove masking and protective covering.

664.-669. RESERVED.