SECTION 9. MAGNESIUM AND MAGNESIUM ALLOYS

6-148. GENERAL. Magnesium and magnesium alloys are the most chemically active of the metals used in aircraft construction and are the most difficult to protect. However, corrosion on magnesium surfaces is probably the easiest to detect in its early stages. Since magnesium corrosion products occupy several times the volume of the original magnesium metal destroyed, initial signs show a lifting of the paint films and white spots on the magnesium surface. These rapidly develop into snow-like mounds or even white whiskers. The prompt and complete correction of the coating failure is imperative if serious structural damage is to be avoided.

6-149. TREATMENT OF WROUGHT MAGNESIUM SHEETS AND FORGINGS. Corrosive attack on magnesium skins will usually occur around the 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 to ensure complete inhibition and treatment.

a. Complete mechanical removal of corrosion products should be practiced when practical. Mechanical cleaning should normally be limited to the use of stiff bristle brushes and similar nonmetallic cleaning tools.

b. Any entrapment of steel particles from steel wire brushes, steel tools, or contamination of treated surfaces, or dirty abrasives, can cause more trouble than the initial corrosive attack. The following procedural summary is recommended for treatment of corroded magnesium areas when accomplished under most field conditions.

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

(1) When machine screw fasteners are used, aluminum insulating washers must be removed from all locations to surface treat the magnesium panel.

(2) Where permanent fasteners other than machine screws are used, the insulating washer and fastener must be removed.

(3) When located so water can be trapped in the counter-bored area where the washer was located, use sealants to fill the counterbore. If necessary, fill several areas adjacent to each other. It may be advantageous to cover the entire row of fasteners with a strip of sealant.

6-150. 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 one. Where it is difficult to form magnesium alloys in the contour, aluminum alloy may be utilized. When this is done, it is necessary to ensure effective dissimilar metal insulation. Vinyl tape will ensure 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 non-corrosive type sealant be used, since it serves a dual purpose of material separation and sealing.

6-151. 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. Bellcranks, fittings, and numerous covers, plates, and handles may also be magnesium castings. When attack occurs on a casting, the earliest practical treatment is required to prevent dangerous corrosive penetration. Engine cases in salt water can develop moth holes and complete penetration overnight.

a. If at all practical, faying surfaces involved shall be separated to treat the existing attack effectively and prevent its further progress. The same general treatment sequence as detailed for magnesium skin should be followed. Where engine cases are concerned, baked enamel overcoats are usually involved rather than other top coat 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 or a DER may be necessary to evaluate the adequacy of structural strength remaining. Refer to the aircraft manufacturer if any questions of safety are involved.

6-152. EXAMPLE OF REMOVING CORROSION FROM MAGNESIUM. If possible, corroded magnesium parts shall be removed from aircraft. When impossible to remove the part, the following procedure will be used.

a. Positively identify metal as magnesium.

b. Clean area to be reworked.

c. Strip paint if required.

d. Determine the extent of corrosion damage.

e. Remove light to moderate corrosion by one of the following means.

(1) Non-Powered Corrosion Removal.

(a) Non-powered removal can be accomplished using abrasive mats, cloth, and paper with aluminum oxide grit (do not use silicon carbide abrasive). Metallic wools and hand brushes compatible with magnesium such as stainless steel and aluminum, may be used.

(b) When a brush is used the bristles should not exceed 0.010 inch in diameter. After using a brush, the surface should be polished with 400 grit aluminum oxide abrasive paper, then with 600 grit aluminum oxide abrasive paper.

(c) Pumice powder may be used to remove stains or to remove corrosion on thin metal surfaces where minimum metal removal is allowed.

(2) Chemical Corrosion Removal.

(a) Chemical corrosion removal on magnesium alloys is usually done with a chromic acid pickle solution. Chemical corrosion removal methods are not considered adequate for areas that have:

1 Deep pitting,

2 Heavy corrosion and corrosion by products,

3 Previously had corrosion removed by mechanical means, or

4 Previously been sand blasted.

(b) Do not use this method for parts containing copper and steel-based inserts (unless the inserts are masked off) and where it might come into contact with adhesive bonded skins or parts.

(3) The following solution may be used to remove surface oxidation and light corrosion products from magnesium surfaces.

(a) Solution Composition and Operation:

1 Chromium Trioxide. 24 oz.

2 (O-C-303, Type II). Water to Make 1 gal. Reaction Time 1 to 15 min.

3 Operation Temperature. (Solution can be operated at room temperature for a longer reaction time if desired.) 190 to 202 °F.

4 Container Construction. Lead-lined steel, stainless steel, or 1100 aluminum.

(b) Mask off nearby operating mechanisms, cracks and plated steel to keep the solution from attacking them.

(c) Apply chromic acid solution carefully to the corroded area with an acid-resistant brush.

(d) Allow the solution to remain on the surface for approximately 15 minutes. Agitation may be required.

(e) Thoroughly rinse the solution from the surface with plenty of clean water.

(f) Repeat the preceding sequence as necessary until all corrosion products have been removed and the metal is a bright metallic color.

f. Remove moderate to heavy corrosion by one of the following means.

(1) Powered Corrosion Removal.

(a) Powered corrosion removal can be accomplished using pneumatic drill motor with either an aluminum-oxide-impregnated abrasive wheel, flap brush, or rubber grinding wheel with an abrasive value to approximately 120 grain size.

(b) Also a rotary file with fine flutes can be used for severe or heavy corrosion product buildup on metals thicker than 0.0625 inch. If a flap brush or rotary file is used, it should only be used on one type of metal. Do not use either a hand or rotary carbon steel brush on magnesium.

(c) Pneumatic sanders are acceptable if used with disk or paper of aluminum oxide. When using sanders, use extra care to avoid over heating aircraft skins thinner than 0.0625 inch.

(d) Do not use rotary wire brushes on magnesium.

WARNING: Cuttings and small shavings from magnesium can ignite easily and are an extreme fire hazard. Fires of this metal must be extinguished with absolutely dry talc, calcium carbonate, sand, or graphite by applying the powder to a depth of 1/2 inch over the metal.

(2) Blasting. Abrasive blasting is an approved method of corrosion removal on magnesium alloys of a thickness greater than 0.0625 inch. Remove heavy corrosion products by hand brushing with a stainless steel or fiber brush followed by vacuum abrasive

blasting with glass beads, (Spec. MIL-G-9954) sizes 10-13; or grain abrasive (Spec. MIL-G-5634), types I or III at an air pressure of 10 to 35 psi (if suction equipment is used, use a 50 percent higher pressure). Upon completion of blasting, inspect for the presence of corrosion in the blast area. Give particular attention to areas where pitting has progressed into intergranular attack. This is necessary because abrasive blasting has a tendency to close up streaks of intergranular corrosion rather than remove them if the operator uses an improper impingement angle. If the corrosion has not been removed in a total blasting time of 60 seconds on any one specific area, other mechanical methods of removal should be utilized.

CAUTION: When blasting magnesium 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.

g. Inspect the reworked area to ensure that no corrosion products remain. If corrosion products are found, repeat method used and re-inspect.

h. 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 finally polish with 400 grit abrasive paper.

i. Determine depth of faired depressions to ensure that rework limits have not been exceeded. Refer to the manufacture's specifications.

j. Clean reworked area using a solvent to provide a water-break-free surface. Do not use kerosene or another petroleum base fuel as a cleaning solvent.

k. Apply Chromic Acid Brush-on Pretreatment.

(1) Chemical pretreatment such as the following chromic acid solution (Conversion coat conforming to Spec. MIL-M-3171, type VI) provides a passive surface layer with an inhibitive characteristic that resists corrosive attack and also provides a bond for subsequent coatings. Properly-applied magnesium pretreatment tend to neutralize corrosion media in contact with the surface.

(2) The chromic acid brush-on pretreatment may be applied to all magnesium parts that require touch-up. This treatment is generally used in refinishing procedures or when parts and assemblies are too large to be immersed. This treatment is less critical to apply than the other brush-on treatments. It is relatively inexpensive and not as harmful when trapped in faying surfaces.

(a) Solution Composition and Operation:

1 Distilled Water 1 gal.

2 Chromic Acid (CrO_3) 1.3 oz.

3 (99.5 pure), Calcium Sulfate 1 oz. ($CaSo_4.2H_2O$)

4 Operating Temp. 70-90 °F.

5 Container: Stainless Steel, Aluminum, Vinyl, Polyethylene, or Rubber.

NOTE: Good application requires proper preparation of the chromic acid coating solution and cleaning of the surface where the solution will be applied. A water-break test is recommended if the cleanliness of the surface is in doubt.

(b) Add chemicals to water in the order shown.

(c) Stir vigorously for at least 15 minutes, either mechanically or by air agitation, to ensure that the solution is saturated with calcium sulfate. (Let solution stand for 15 minutes before decanting.)

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

(e) Apply solution by brush, swab, or flow on using low-pressure spray (non-atomizing) until the metal surface becomes a dull color (the color can vary from green-brown, brassy, yellow-brown to dark-brown). For good paint adhesion, a dark-brown color free of powder is considered best. The color may vary in using different vendors' materials.

NOTE: Too long an exposure to the brush-on solution produces coatings that will powder and impair adhesion of applied paint finish/films.

(f) Observe the coating closely during the treatment for color changes, rinsed with cold running water when the desired condition/color is reached and air dried. Preparation and use of test panels made of the same material and under the same conditions, before starting the actual treating operation may be used as to determine the application time required to produce the required coating. A good coating is uniform in color/density, adheres well and is free of loose powder.

l. Apply primer and top coat finish

m. Remove masking and protective coverings.

6-153.—6-163. [RESERVED.]