CHAPTER 6. TREATMENT OF SPECIFIC AVIONICS EQUIPMENT

601. GENERAL. All aircraft electrical/electronic equipment should be opened and inspected for evidence of internal moisture and corrosion on a scheduled basis as determined by the original equipment manufacturer (OEM) or for cause. When corrosion is detected, prompt corrective action is required. Corrective action should include cleaning, corrosion removal, treatment, application of protective finish, and preservation where required. Maintenance personnel should always use the mildest method of cleaning and corrosion removal described in chapters 4 and 5. The procedures and techniques for corrosion removal and the restoration of protective coatings described in this chapter are intended to aid the avionics technician in typical repair of specific equipment. In each case, some discretion on the part of the maintenance personnel is warranted. It is important that the maintenance personnel analyze the problem, select the appropriate corrective action, and confirm the effectiveness of their corrosion control. It is recommended that maintenance personnel periodically review the conditions required for and the types of corrosion in avionics equipment described in chapter 2.

602. REPAIR OF AVIONICS EQUIPMENT HOUSINGS, MOUNTING RACKS, AND STORAGE HARDWARE.

a. Bilge Areas. A common trouble spot on all aircraft is the bilge area. This is especially true for helicopters. These areas contain all types of avionics equipment and present a natural sump or collection point for all types of liquids. Accumulation of waste, hydraulic fluids, fuel, water, dirt, grime, loose fasteners, drill shavings, and other debris is typical. Sump liquids should be pumped or drained from the bilge area whenever discovered. Bilge areas should be cleaned using the procedures and materials in AC 43-4A, Corrosion Control for Aircraft, chapter 4, paragraph 412c. Maintenance personnel should ensure, prior to installing any avionics equipment in the bilge area, that the area and equipment are cleaned and preserved.

b. Equipment Bays. Avionics equipment bays and installed equipment are highly susceptible to corrosion. This area is especially corrosion-prone in helicopters and other aircraft and equipment that are cooled with external ram air. Maintenance personnel should perform an inspection of all structures and equipment any time equipment bays are opened. The corrosion inspection and treatment processes are outlined in the following paragraphs.

(1) Visually inspect the structure, fixed mountings, installed equipment, hardware, and wiring for evidence of corrosion. Particular attention should be paid to dissimilar metal couples.

(2) Remove corrosion using 320 grit abrasive cloth, conforming to Federal Specification P-C-451, or an abrasive nylon mat, conforming to MIL-A-9962, Type I, in accordance with the OEM's maintenance instructions.

NOTE: Generally, corroded hardware is replaced.

(3) Clean, rinse, and dry the affected area in accordance with the instructions and materials detailed in chapter 4, paragraphs 405i and o.

(4) After the corrosion is removed, treat all affected aluminum surfaces with a chemical conversion coating in accordance with chapter 4, paragraph 405m.

(5) Apply primer and topcoat as required in accordance with the OEM's maintenance instructions or chapter 4, paragraph 405m, and chapter 5, paragraph 503.

(6) Apply preservation as required or when environmental conditions dictate in accordance with chapter 4, paragraph 407.

c. Engine Compartments. Inspect compartment hardware, electrical wire bundles and connectors, terminal boards, and junction boxes for evidence of corrosion and damage (Figure 6-1).

(1) Repair or replace damaged components as required.

(2) Clean and treat corrosion in accordance with paragraphs 602b(2) through (6) with the following exceptions:

(a) Clean and treat electrical connectors in accordance with paragraph 603k.

(b) Clean and treat electrical terminal boards in accordance with paragraph 602h.

d. Battery Compartments, Boxes, and Adjacent Areas. The battery, battery cover, battery box, and adjacent areas (especially areas below the battery compartment) are very susceptible to the corrosive action of spills and fumes of the battery and electrolyte. Figure 6-2 shows a typical battery compartment. Two different types of batteries are encountered on avionics equipment: lead acid (sulfuric acid electrolyte) and nickel-cadmium (potassium hydroxide electrolyte). Neutralize and clean the battery, battery cover, battery box, and adjacent areas as follows:

(1) Preparation of Solutions for Cleaning and Neutralizing Battery Electrolytes. Indicating solutions are required for cleaning areas that are subject to battery electrolyte spills. These solutions will determine the size and location of the spill and will indicate when the area has been completely neutralized. Use a 10% sodium bicarbonate (household baking soda) solution to neutralize sulfuric acid from lead acid batteries and a 3% boric acid solution to neutralize potassium hydroxide from nickel-cadmium batteries.

(2) Litmus Indicating Solution for Lead Acid Batteries. Litmus indicating solutions are used on lead acid battery electrolyte spills. Mix, by volume, 70% Isopropyl Alcohol, PT-I-737, and 30% distilled water in a plastic bottle with a hand squeeze pump in a 1 pint solution. Add 1 tablespoon of litmus powder to the liquid and mix thoroughly until a deep blue color is observed.

(**3) Bromothymol Blue Indicating Solution for Nickel-Cadmium Batteries.** Bromothymol blue indicating solutions are used on nickel-cadmium battery electrolyte spills. Pour 1 pint of Bromothymol blue indicating solution into a plastic bottle with a hand squeeze pump. Using an eyedropper, add 1 drop at a time of phosphoric acid into the solution, with subsequent mixing after each drop, until the color of the solution changes from blue to gold/amber.

(4) Sodium Bicarbonate Neutralizing Solution for Lead Acid Batteries. Pour 1 pint of fresh water into a plastic bottle, add 2 ounces of sodium bicarbonate, O-S-576, and mix thoroughly.

(5) Boric Acid Neutralizing Solution. Pour 1 pint of fresh water into a plastic bottle, add 1/2 ounce of boric acid, O-C-265, and mix thoroughly.

FIGURE 6-1. ENGINE COMPARTMENT ELECTRICAL CONNECTORS

FIGURE 6-2. BATTERY COMPARTMENT

(6) Cleaning and Neutralizing Procedures.

WARNING: Sulfuric acid and battery electrolytes are highly toxic to the eyes, skin, and respiratory tract. Avoid all contact. Skin and eye protection is required. Ensure adequate ventilation. If any acid or electrolyte contacts the skin or eyes, flood the affected area immediately with water and consult medical services. When working around batteries, always wear eye protection (face shield), an acid-resistant apron, and gloves.

(a) Remove any standing liquid or puddles of electrolyte with a squeeze bulb type syringe, absorbent cloth, or sponge. Place these items in a leak-proof container for removal from the work area. Properly dispose of or neutralize these items to prevent contamination of other areas.

(b) Using a pump spray bottle with the proper indicating solution, spray the entire area with the minimum amount of spray needed to wet the area.

i. For lead acid battery spills, use the litmus solution, which will change in color from deep blue to red in any area that is contaminated with battery acid.

ii. For nickel-cadmium battery spills, use the Bromothymol Blue Indicating Solution, which will change in color from amber or gold to a deep blue in any area that is contaminated with potassium hydroxide.

(c) Using a pump spray bottle with the proper neutralizing solution, spray the entire area where the indicating solution showed a change in color. Ensure the area is well saturated and that the stream is directed into all seams and crevices where the battery electrolyte could collect. Use care to prevent liquids from spreading to adjacent areas and ensure that bilge area drains are open to allow fluids to flow overboard. Allow the neutralizing solution to remain on the surface for at least 5 minutes or until all bubbling action ceases.

(d) Rinse the area thoroughly with a liberal amount of clean water and remove any standing liquid or puddles, as in step (a).

(e) Reapply the indicating solution as in step (b). If the solution does not change color, rinse the area as in step (d) and dry the area with clean cloths or rags. If the solution changes color, repeat steps (c), (d), and (e).

(f) Corrosion Preventive Compound, as discussed in chapter 4, paragraph 407, may be used to displace any moisture or temporarily preserve any bare metal until the area is properly protected.

(g) Repair or apply as required, pre-paint treatment, paint coatings, and sealant per chapters 4 and 5. Special acid and/or alkali resistant coatings are usually required for battery compartments, boxes, and surrounding areas. Refer to the OEM's maintenance instruction manual.

e. Frames, Mounting Racks, and Shock Mounts. Shock mounts and associated hardware on pod or airframe mounted equipment are usually the last items to be inspected for corrosion damage. Figure 6-3 shows evidence of a moisture entrapment area on the avionics shelf and corrosion on equipment racks and shock mounts. These inspections normally require the removal of shock mounts to facilitate a thorough examination. For this reason, shock mounts, their associated racks, and hardware should be preserved after inspection to ensure protection from the elements. For frames, mounting racks, and shock mounts that are not normally painted, remove corrosion and preserve as follows:

(1) Remove corrosion with 320-grit abrasive cloth, conforming to Federal Specification P-C-451, or abrasive nylon mat, conforming to MIL-A-9962, Type I. Pay particular attention to dissimilar metal couples.

NOTE: The use of dissimilar metals in the selection of screws, washers, and nuts should be minimized wherever possible. Refer to chapter 7 for information on bonding and grounding hardware.

(2) Clean the affected area with Isopropyl Alcohol, TT-I-735. Apply with a clean cloth or cheesecloth. Pay particular attention to the rubber shock absorbers of the shock mounts. The rubber may swell if saturated with Isopropyl Alcohol, TT-I-735. If the rubber shock mounts do swell, they should return to normal size in a short time after the Isopropyl Alcohol, TT-I-735, evaporates.

(3) For frames, mounting racks, and shock mounts that are normally painted, remove corrosion and clean as indicated in steps (1) and (2). Conversion coat, prime, and paint in accordance with the OEM's maintenance instructions and the procedures of chapter 5, paragraphs 503 and 504.

(4) Frames, mounting racks, shock mounts, and associated hardware should be preserved with a thin film of Water-Displacing Corrosion Preventive Compound, identified in chapter 4, paragraph 407, and Table 4-4. Corrosion Preventive Compound, conforming to MIL-C-85054, is recommended for lasting protection.

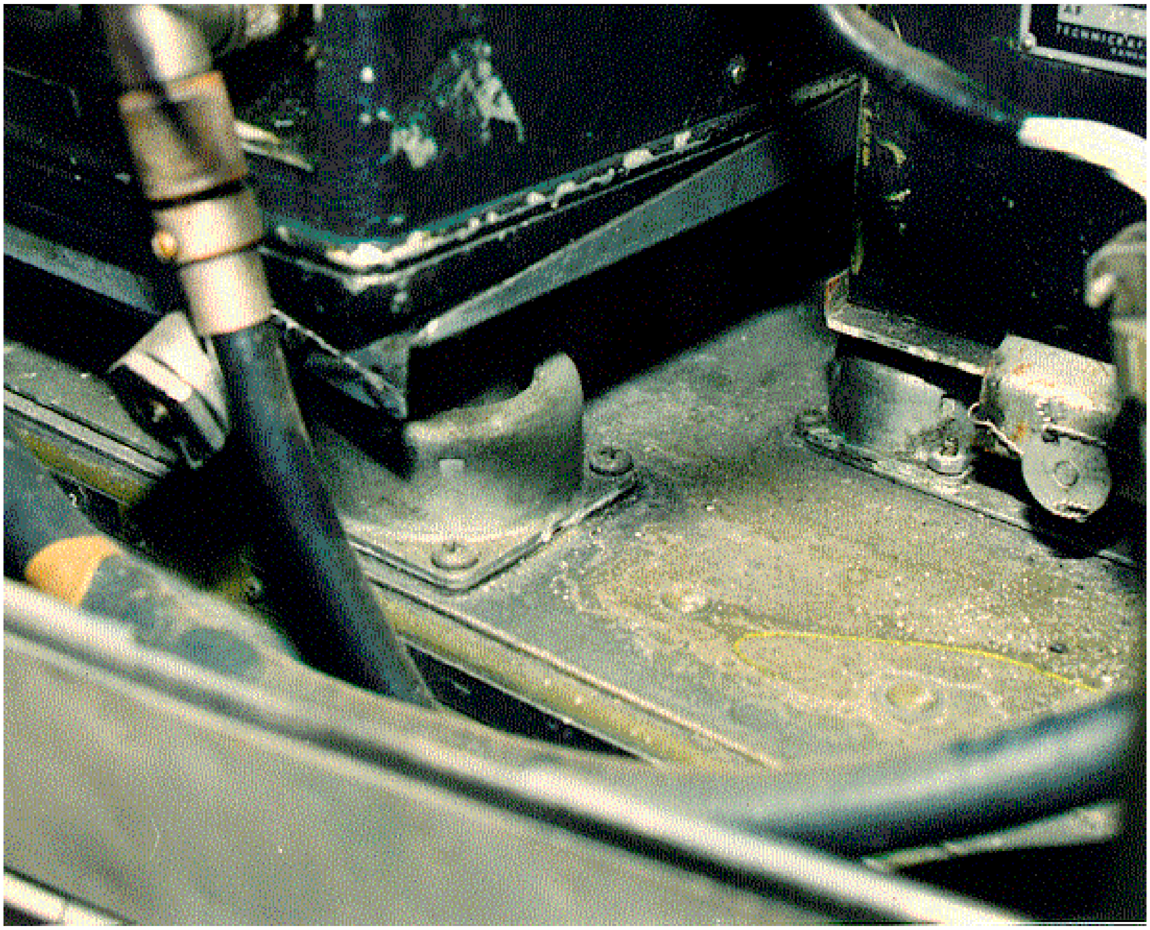


FIGURE 6-3. MOISTURE ENTRAPMENT AREA AND CORRODED FRAME, MOUNTING RACKS, AND SHOCK MOUNTS

f. External Mounted Equipment. External mounted equipment is susceptible to the same corrosive environment as the airframe. Internal and external cleaning techniques are the same as for the airframe except for electromagnetic gaskets, shields, electrical connectors, and mating surfaces. Treat these areas as follows:

NOTE: Refer to chapter 8 and the OEM's maintenance manual for information on electromagnetic gaskets and mating plating where the plating surfaces may have been removed.

(1) Remove corrosion and clean in accordance with paragraph 602g.

(2) Conversion coat, prime, and paint in accordance with the OEM's maintenance manual and the procedures of chapter 5, paragraphs 503 and 504.

(3) Clean and preserve electrical connectors in accordance with paragraph 603k.

(4) If the application of conversion coating, primer, and paint cannot be accomplished, temporarily preserve the external surfaces with a thin film of Water-Displacing Corrosion Preventive Compound, conforming to MIL-C-85054. For internal surfaces, apply a thin film of Water-Displacing Corrosion Preventive Compound, conforming to MIL-C-81309, Type II.

g. Cockpit and Control Boxes. Cockpits are susceptible to dirt, grime, and corrosive attack from cooling air and general human occupancy. The following inspection, cleaning, and treatment procedures should apply to the cockpit and avionics components.

(1) Use a vacuum cleaner to clean the cockpit area of dirt and dust. Pay particular attention to the areas under and behind control boxes.

(2) Inspect control box units for corrosion and contaminants. Pay particular attention to switches, dials, knobs, electrical connectors, control box and instrument panel mating surfaces, and attaching fasteners.

(3) Remove corrosion products from metal surfaces using an abrasive nylon mat, conforming to MIL-A-9962, Type I, or an appropriate cleaning and polishing pad.

(4) Clean affected area with an approved solvent or Dry Cleaning Solvent, P-D-680, Type II, and a clean cloth or cheesecloth.

NOTE: Local air pollution regulations may restrict the use of this solvent. Comply with all local air pollution regulations.

WARNING: Dry Cleaning Solvent, P-D-680, is flammable and toxic to the eyes, skin, and respiratory tract. Skin and eye protection is required. Avoid repeated or prolonged contact. Use only in well ventilated areas. Keep away from open flames or other sources of ignition.

(5) Following solvent cleaning, perform a final wipe using a clean cloth or cheesecloth and Isopropyl Alcohol, TT-I-735.

(6) Repaint or touch-up existing paint as required in accordance with the OEM's maintenance instructions manual or the procedures of chapter 5, paragraphs 503 and 504.

(7) Apply a thin film of Water-Displacing Corrosion Preventive Compound, MIL-C-81309, Type II, on exterior metal surfaces and wipe off any excess with a clean cloth or cheesecloth. Do not get preservative on acrylic plastic faceplates of instruments.

(8) Clean and preserve toggle, rotary, and push-button switches in accordance with paragraph 603k.

(9) Clean control box faceplates with a solution of 1 ounce nonionic liquid detergent, conforming to MIL-D-16791, Type I, and 1 gallon of clean water. Wipe faceplates with a clean, soft flannel cloth or cheesecloth and the nonionic liquid detergent solution. Dry and polish the glass faceplate with a clean, soft flannel cloth or cheesecloth.

(10) Clean and preserve cockpit and control box electrical connectors in accordance with paragraphs 603k(2) through 603k(5).

(11) Hardware (panel fasteners, clamps, etc.) is generally replaced if found corroded.

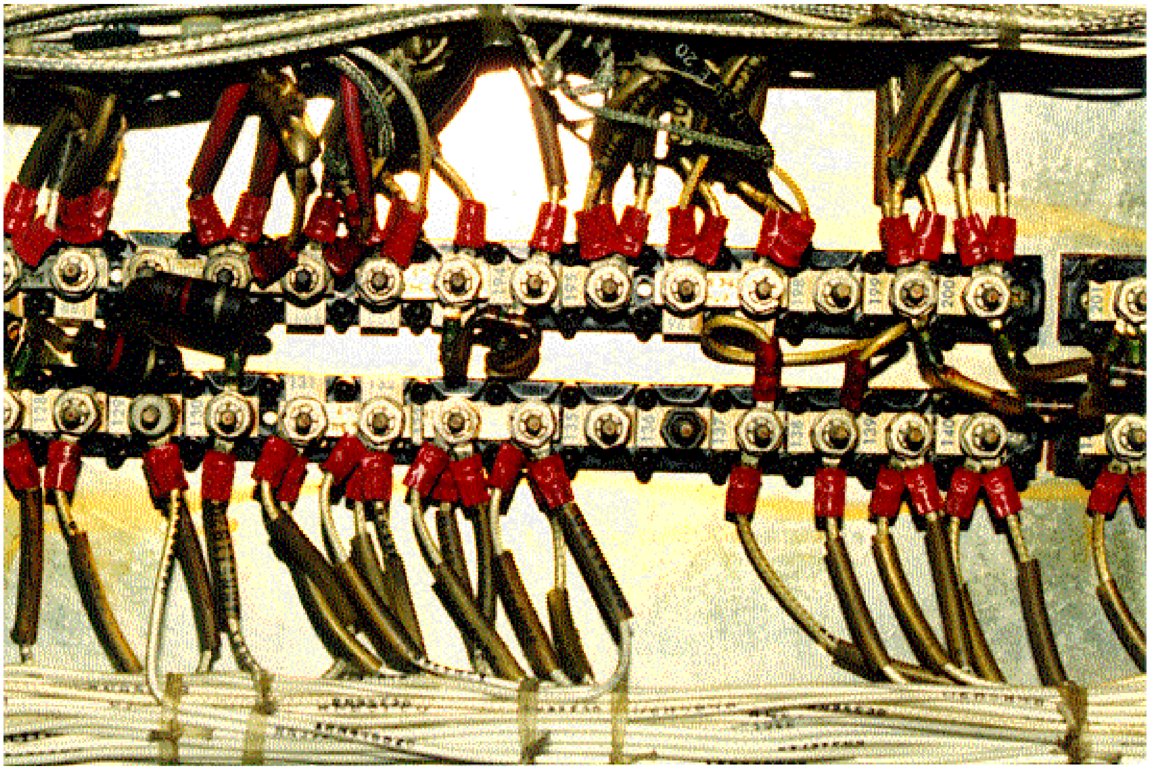


FIGURE 6-4. TERMINAL BOARD INSTALLATION

h. Terminal Boards, Junction Boxes, Relay Boxes, and Circuit Breaker Panels. Remove covers and access panels, as required. Figure 6-4 shows a typical terminal board installation. Treat corrosion and preserve as follows:

WARNING: Ensure that all electrical power is disconnected from the aircraft and all electrical systems in the aircraft are deactivated. Disconnect all batteries.

(1) External Surfaces:

(a) Inspect, clean, and treat in accordance with paragraph 602k.

(b) If the application of conversion coating, primer, and paint cannot be accomplished, temporarily preserve the external surfaces with a thin film of Water-Displacing Corrosion Preventive Compound, conforming to MIL-C-85054.

(2) Internal Surfaces and Components:

(a) Remove corrosion with an abrasive nylon mat, conforming to MIL-A-9962, Type I.

(b) Clean affected area by wiping or brushing with Isopropyl Alcohol, TT-I-735. While the surface is still wet, perform a final wipe with a clean cloth or cheesecloth and allow surface to air dry.

(c) Clean and preserve electrical connectors in accordance with paragraphs 603k(2) through (5).

(d) Preserve internal surfaces of terminal boards, junction boxes, relay boxes, and circuit breaker panels by applying a thin film of Water-Displacing Corrosion Preventive Compound conforming to MIL-C-81309, Type III. Avoid applying preservative to relays and circuit breaker contact points.

i. Metallic Equipment Covers and Housings. Avionics equipment cases, covers, housings, and associated hardware can also be exposed to harsh environmental elements. Inspect, clean, treat, and preserve in accordance with paragraph 602b, except for the following:

(1) Hardware (fasteners, clamps, etc.) is generally replaced if found corroded.

(2) Hinges and latches on equipment covers should be preserved and lubricated in accordance with paragraphs 602k(6) and (7).

j. Nonmetallic Covers and Housings. In some cases, avionics equipment, support equipment, and general test equipment use nonmetallic high impact plastic, fiberglass, Kevlar, or graphite/carbon epoxy covers and housings. These should be inspected and cleaned, and the paint touched-up as follows:

(1) Inspect nonmetallic covers and housings for structural damage (cracks and delaminations), corrosion around metallic hardware, hinges, latches, and damaged paint.

(2) Repair any structural damage per the OEM's maintenance instructions.

(3) Inspect hardware, hinges, and other metal attachments for signs of corrosion. Remove any corrosion with 320 grit abrasive cloth, conforming to Federal Specification P-C-451, or an abrasive nylon mat, conforming to MIL-A-9962, Type I.

(4) Clean nonmetallic covers and housings with a solution of 9 parts fresh water and 1 part Aircraft Cleaning Compound, conforming to MIL-C-85570, Type II. Apply with a brush or clean cloth.

(5) Rinse with fresh water and wipe dry with a cleaning cloth.

(6) Touch-up paint finish in accordance with chapter 5, paragraph 504.

(7) Lubricate and preserve hinges and latches per paragraph 602k.

(8) Preserve unpainted metallic hardware, hinges, and latches in accordance with chapter 4, paragraph 407.

k. Equipment Hinges and Latches. Inspect hinges and latches on equipment boxes, doors, and covers for corrosion and proper operation. Treat as follows:

(1) Clean hinges and latches with a cleaning cloth dampened with an approved solvent.

(2) Remove corrosion with 320 grit abrasive cloth, conforming to Federal Specification P-C-451, or an abrasive nylon mat, conforming to MILA-9962, Type I.

(3) Wipe residue with a clean cloth dampened with Isopropyl Alcohol, TT-I-735, and allow to air dry.

(4) Clean and treat bare aluminum and magnesium hinges and latches in accordance with chapter 4, paragraph 405m, and chapter 5, paragraph 503.

WARNING: Chemical conversion material is flammable and toxic to the eyes, skin, and respiratory tract. Skin and eye protection is required. Avoid repeated or prolonged contact. Use only in well ventilated areas. Keep away from open flames or other sources of ignition.

CAUTION: Exercise care when using chemical conversion materials near electronic hardware. The solutions can cause corrosion of delicate electronic devices not suitably protected.

(5) Touch-up paint finish in accordance with chapter 5, paragraph 504.

(6) Lubricate hinges and rotating latches as follows:

(a) Spray hinges and latches at pivot points with Water-Displacing Corrosion Preventive Compound, MIL-C-81309, Type II.

NOTE: The purpose of Water-Displacing Corrosion Preventive Compound is to displace any entrapped water between hinge and latch components. The subsequent application of a lubricating oil may then fill the void areas and provide lubrication. Without the Water-Displacing Corrosion Preventive Compound, the lubricating oil will not displace the entrapped water because it is less dense than the water.

(b) Apply Lubricating Oil, General Purpose Preservation, conforming to MIL-L-VV-L-800, to all moving parts.

(7) Preserve unpainted metallic hardware, hinges, and latches not requiring lubrication per chapter 4, paragraph 407.

l. Shelves, Bulkheads, and Crevices. Inspect shelves, bulkheads, crevices, and corners for signs of dust, lint, debris, and corrosion. Figures 6-5 and 6-6 show lint and debris accumulation on a shelf. Pay particular attention to cracked, chipped, peeling, or deteriorating paint and sealant. Treat in accordance with paragraph 602b.

m. Moisture Traps and Cavity Areas. Inspect for moisture traps and cavities at the rear of equipment shelves. Figure 6-3 shows evidence of a moisture entrapment area on the avionics shelf. Treat in accordance with paragraph 602b.

(1) Moisture traps and cavities may be filled with Sealing Compound, conforming to MIL-S-81733, when authorized.

(2) Apply sealant and finish in accordance with chapter 5, paragraphs 504 and 505.

n. Electrical Bonding and Grounding Straps. Bonding and grounding straps used on aircraft and avionics equipment may exhibit galvanic corrosion when not protected. Figures 3-8 (Chapter 3) and 6-7 show examples of a corroded bonding strap and attach hardware. In most cases the material used for bonding and grounding straps is different than the mating surfaces of the aircraft and avionics equipment. Treat these areas in accordance with chapter 7, paragraph 702.

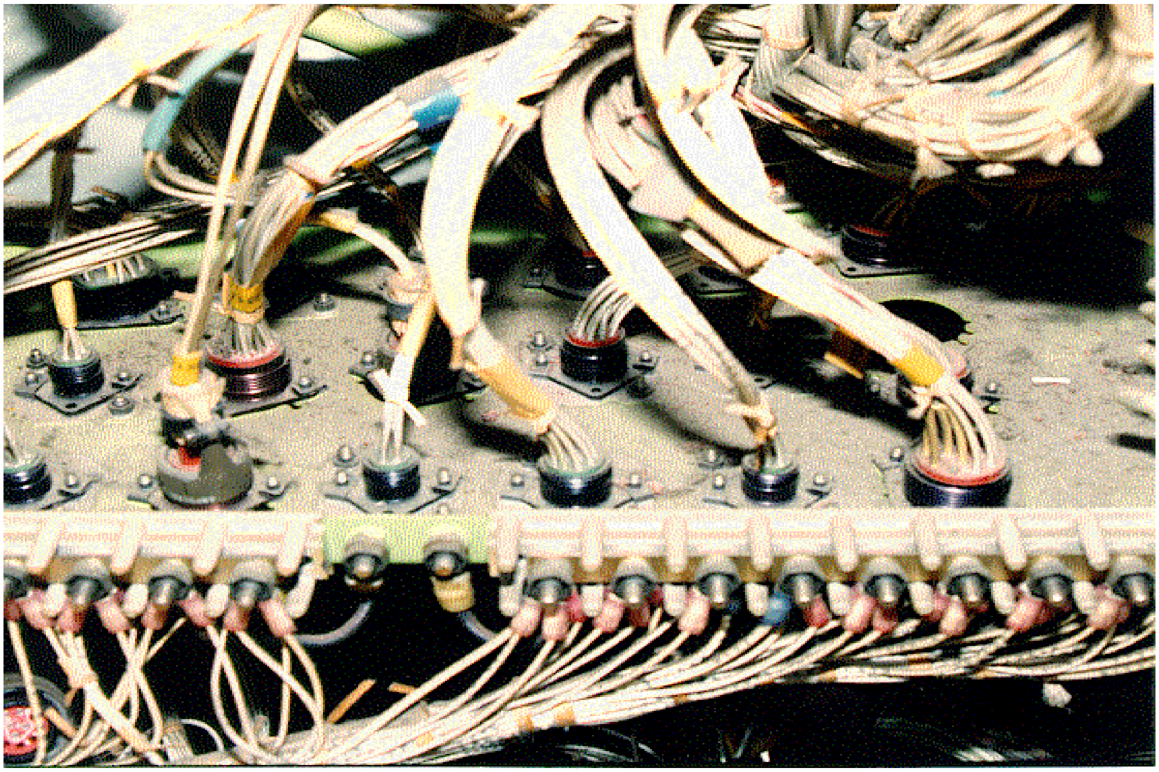


FIGURE 6-5. LINT ACCUMULATION ON A SHELF

FIGURE 6-6. LINT AND DEBRIS ACCUMULATION ON A SHELF

603. REPAIR OF AVIONICS SYSTEMS, EQUIPMENT, AND COMPONENTS.

a. Antenna Systems. Antenna systems are normally exposed to fairly severe environments. Without adequate corrosion protection, these systems can fail via shorts, open circuits, loss of dielectric strength, signal attenuation, poor bonding, or electromagnetic interference (EMI). Structural damage to the aircraft can also result. Antennas mounted on the fuselage require openings in the aircraft structural skin to route the various cables to the antenna. The area around the antenna mounting is susceptible to moisture intrusion from rain, runway de-icing fluids/materials, condensation, aircraft wash, and internal fluids (i.e., fuel, oil, lavatory and galley products, etc.). Antennas mounted on the lower fuselage are particularly susceptible to corrosion. The inspection and treatment process is outlined in the following paragraphs.

(1) Visual Corrosion Inspection. A visual examination of installed antennas and mounting areas can reveal evidence of a corrosion attack. Cracks, splits, and peeling of the exterior paint finish and sealant are a good indicator of possible corrosion damage. Evidence of corrosion deposits at the antenna mounting areas is the most obvious indication that an attack has taken place. Examine for a grayish-white to white powdery deposit (aluminum oxide). Figure 6-8 shows corroded antenna mounting area and electrical plug.

(2) Antenna Mounting Area Preparation Procedures. When corrosion is visually evident or highly suspected, corrective action, including further inspection by disassembly, is necessary to determine the full extent of any damage and prevent further deterioration. Corrosion treatment includes: stripping exterior finishes in the affected area, removing corrosion products, cleaning, and applying surface treatment for avionics bonding. The recommended procedures that may be used on the antenna base and mating aircraft structure for corrosion removal, cleaning, and mounting preparation are as follows:

(a) Remove dirt, grime, oil, and grease from antenna mating surfaces using a cleaning cloth or cheesecloth dampened with an approved solvent. A clean surface will allow proper evaluation of the extent of corrosion damage. Figure 6-10 shows a corroded antenna mounting area on a removed lower fuselage skin.

(b) Remove existing fillet sealant from the mating surface of the antenna and aircraft structure/skin with a nonmetallic scraper. See Figure 6-9.

(c) Remove paint as required from the area surrounding the antenna mounting with an epoxy paint remover as described in chapter 5, paragraph 502.

(d) Thoroughly clean the stripped area with a water-moistened cleaning cloth or cheesecloth.

(e) Remove corrosion deposits to the limits of the OEM's maintenance instructions with 320-grit abrasive cloth, conforming to Federal Specification P-C-451, or an abrasive nylon mat, conforming to MIL-A-9962, Type I. Ensure complete corrosion removal from the antenna base and mating aircraft surface.

(f) Wipe off corrosion removal products using a cleaning cloth or cheesecloth dampened with Isopropyl Alcohol, TT-I-735. Allow surface to air dry.

(g) If bare metal was exposed on the antenna base or aircraft structure/skin, treat the cleaned surface with an avionics grade Chemical Conversion Coating conforming to MIL-C-81706, Class 3, in accordance with chapter 5, paragraph 503.

FIGURE 6-7. CORRODED BONDING STRAP AND ATTACH HARDWARE

FIGURE 6-8. CORRODED ANTENNA MOUNTING AREA AND ELECTRICAL PLUG

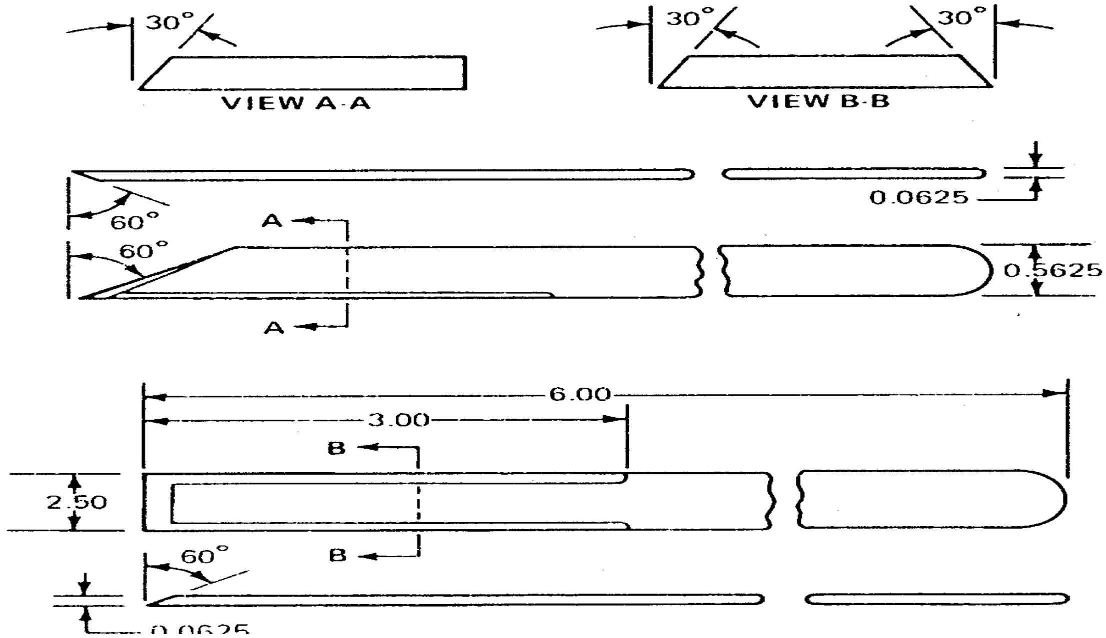


FIGURE 6-9. NONMETALLIC SEALANT REMOVAL TOOLS

NOTES: 1. All dimensions are in inches unless otherwise specified.
2. Material: Micarta suggested.

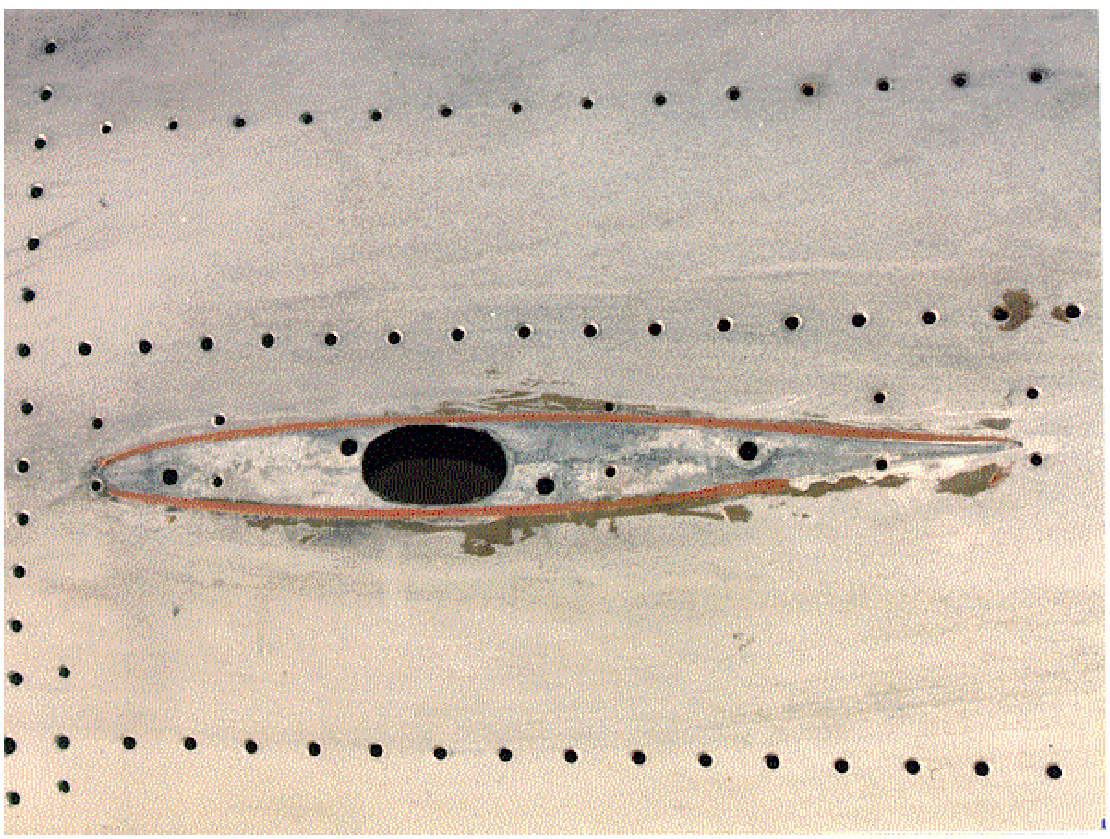


FIGURE 6-10. CORRODED ANTENNA MOUNTING AREA

(3) Rigid Antenna Mounting (without gasket). The mounting bases of rigid antennas vary in shape and size. The following installation procedures are typical and may be used for mast-type antennas (blade, spike, whip base, or long wire mast base) not requiring a gasket. Figures 6-11 and 6-12 show typical blade mounted antennas. The recommended procedures for the application of corrosion prevention measures and attachment of the antenna to the aircraft structure/skin are as follows:

(a) Clean and remove any corrosion from the antenna base and aircraft structure/skin as described in paragraph 603a(2).

(b) Remove corrosion from screw fastener countersinks and fastener bore areas on the antenna base in order to provide good electrical conductivity from the base to the screw fasteners. Remove corrosion deposits to the limits of the OEM's maintenance instructions with 320-grit abrasive cloth, conforming to Federal Specification P-C-451, or an abrasive nylon mat, conforming to MIL-A-9962, Type I.

(c) Clean base of antenna and mating aircraft structure/skin with a clean cloth or cheesecloth dampened with Isopropyl Alcohol, TT-I-735. Allow both surfaces to air dry.

(d) Apply avionics grade Chemical Conversion Coating, conforming to MIL-C-81706, Class 3, to bare areas on the antenna base, fastener countersinks, and mating aircraft structure/skin in accordance with chapter 5, paragraph 503.

(e) Install antenna per the OEM's maintenance instructions or as follows:

i. Apply an even coating of Corrosion Preventive Compound, conforming to MIL-C-16173, Grade 4, to the antenna base and mating aircraft structure/skin. Avoid applying the material in the antenna base fastener countersink areas. Wipe any Corrosion Preventive Compound from the fastener countersink areas using an approved solvent or Isopropyl Alcohol, TT-I-735, as described in step 603a(3)(c). Position the antenna and install, set, and torque the attach fasteners per the OEM's maintenance instructions.

NOTE: Mask as required an area just outside of the antenna base on the aircraft structure/ skin using pressure sensitive tape.

ii. (Alternate method 1.) Mix and apply an even coating of Polysulfide Sealing Compound, MIL-S-81733 or MIL-S-83430, to the antenna base and mating aircraft structure/skin in accordance with chapter 5, paragraph 505d. Within the working time of the sealant, position the antenna and install, set, and torque the attach fasteners per the OEM's maintenance instructions. Ensure sealant squeeze-out from all sides of the antenna base.

iii. (Alternate method 2.) Position the antenna and install, set, and torque the attach fasteners per the OEM's maintenance instructions.

iv. Clean the outside edge of the antenna using an approved solvent or Isopropyl Alcohol, TT-I-735, as described in step 603a(3)(c).

v. Conduct an electrical resistance test in accordance with paragraph 603a(12).

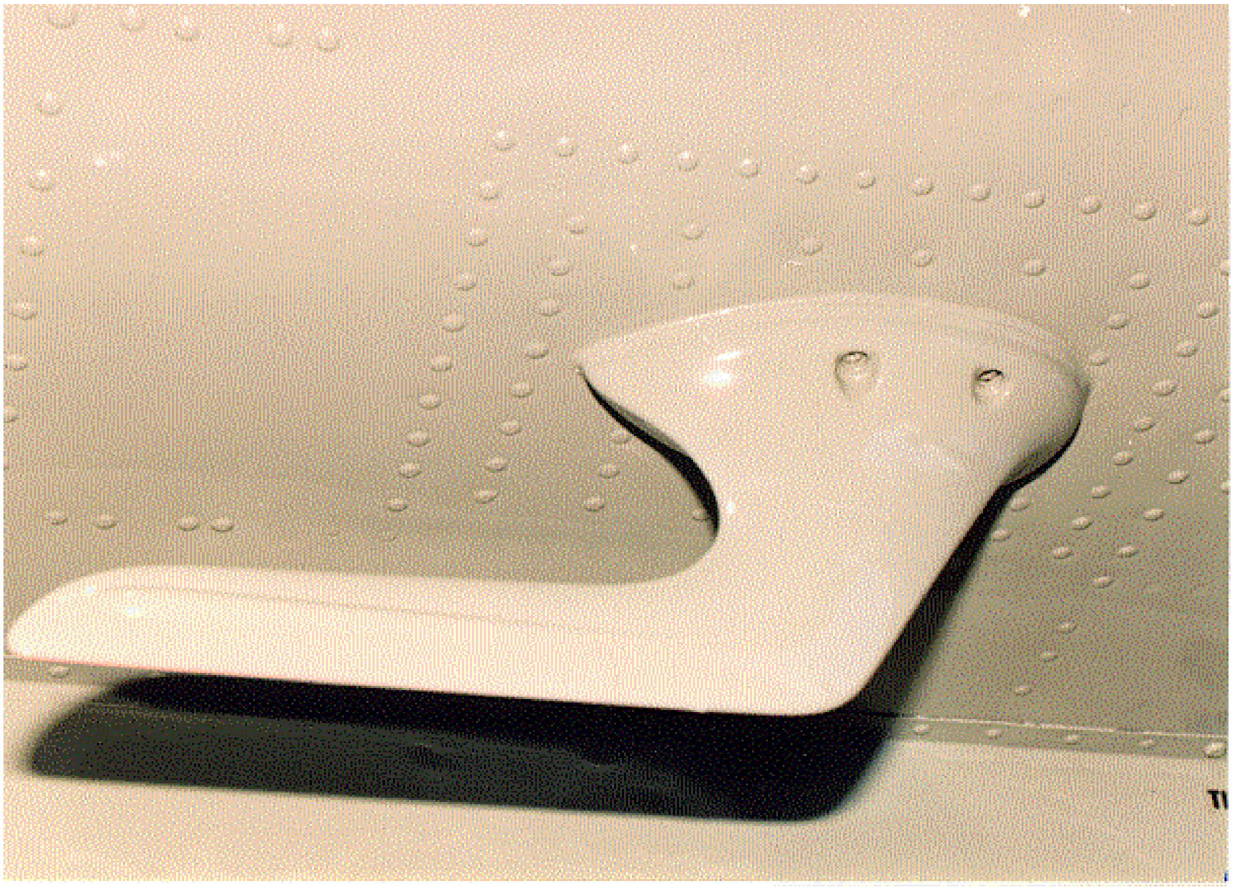


FIGURE 6-11. BLADE ANTENNA INSTALLATION

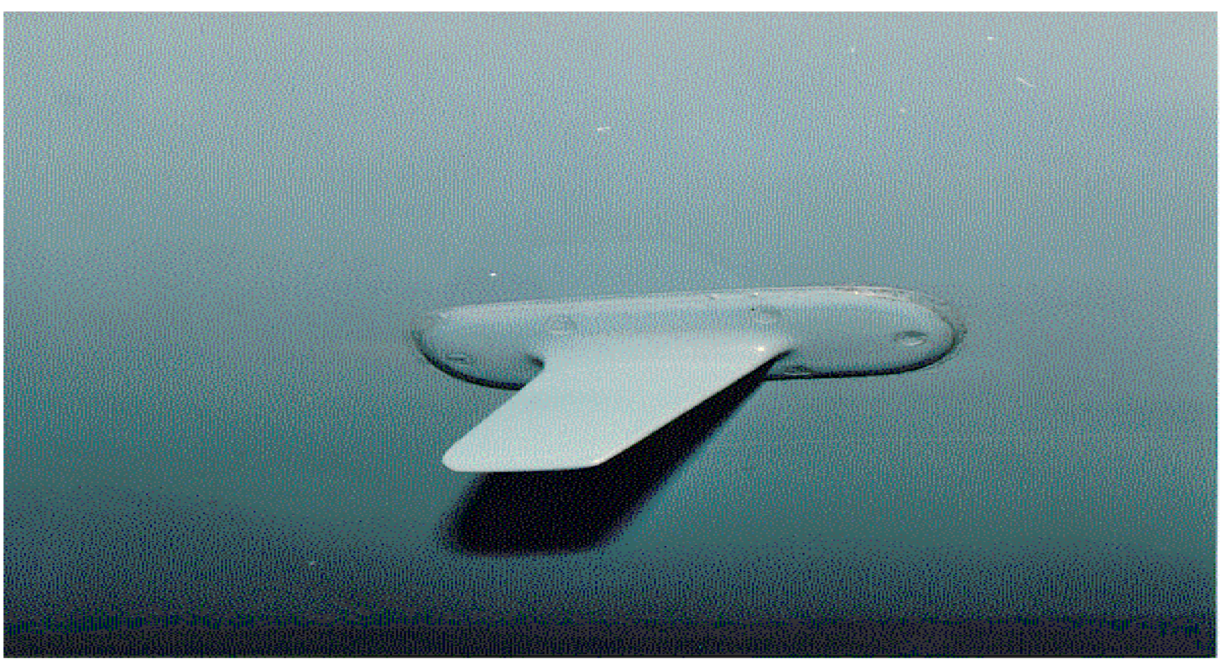


FIGURE 6-12. BLADE ANTENNA INSTALLATION

vi. (For all installation methods.) Apply a fillet seal of Polysulfide Sealing Compound, MIL-S-81733 or MIL-S-83430, to the antenna base and mating aircraft structure/skin, and coat the fastener heads using a spatula or sealant gun in accordance with chapter 5, paragraph 505d to form a watertight seal.

vii. Remove masking tape within the working time of the sealant.

viii. Allow the sealant to fully cure before any flight operations.

(4) Rigid Antenna Mounting (with gasket). These procedures are applicable to blade or spike antennas that require a conductive gasket between the antenna base and aircraft skin/structure. The following procedures are recommended for the application of sealant, corrosion prevention, and mounting the antenna base.

(a) Clean and remove corrosion from the antenna mounting and screw countersink areas and apply chemical conversion coating in accordance with paragraphs 603a(3)(a) through (e).

(b) With the gasket in place on the antenna base and the coaxial connector mated, apply a coating of Corrosion Preventive Compound, conforming to MIL-C-16173, Grade 4, using a brush. Apply compound to the skin around the edge of the coaxial cable hole and to the coaxial connector. Ensure the Corrosion Preventive Compound will not interfere (insulate) with the conductive gasket and the antenna when mated to the fuselage skin.

(c) Clean any Corrosion Preventive Compound from the fastener countersink areas using a clean cloth or cheesecloth dampened with Isopropyl Alcohol, TT-I-735.

(d) Position the antenna base. Ensure countersink area is clean under the fastener heads. Set and torque the fasteners.

(e) Conduct an electrical resistance test in accordance with paragraph 603a(12).

(f) Clean and seal the antenna base to fuselage skin/structure and fastener heads in accordance with paragraph 603a(3)(e) vi, vii, and viii.

(5) Flush or Dome Antenna Mounting. These installation procedures are applicable to flush or dome covered (radome) antennas. These antennas are usually installed on aircraft as part of the primary structure. The radiating elements of the antenna and fiberglass cover are normally individual units. Figure 6-13 shows a flush mounted antenna radome. The recommended procedures for applying corrosion preventives to these antennas are:

(a) Clean and remove corrosion from the antenna and fuselage skin/structure as described in paragraph 603a(2).

(b) Install antenna in accordance with the OEM's installation instructions. Prior to attaching the cover or dome (radome), spray a coat of (avionics grade) Water-Displacing Corrosion Preventive Compound, conforming to MIL-C-81309, Type III, on the internal areas of the coaxial and antenna connectors. Shake out excess. Mate the coaxial connector with the antenna. Spray a coat of Water-Displacing Corrosion Preventive Compound, conforming to MIL-C-85054, on the exterior of the antenna, coaxial connectors, and all other exposed metallic hardware. Mount antenna and secure fasteners.

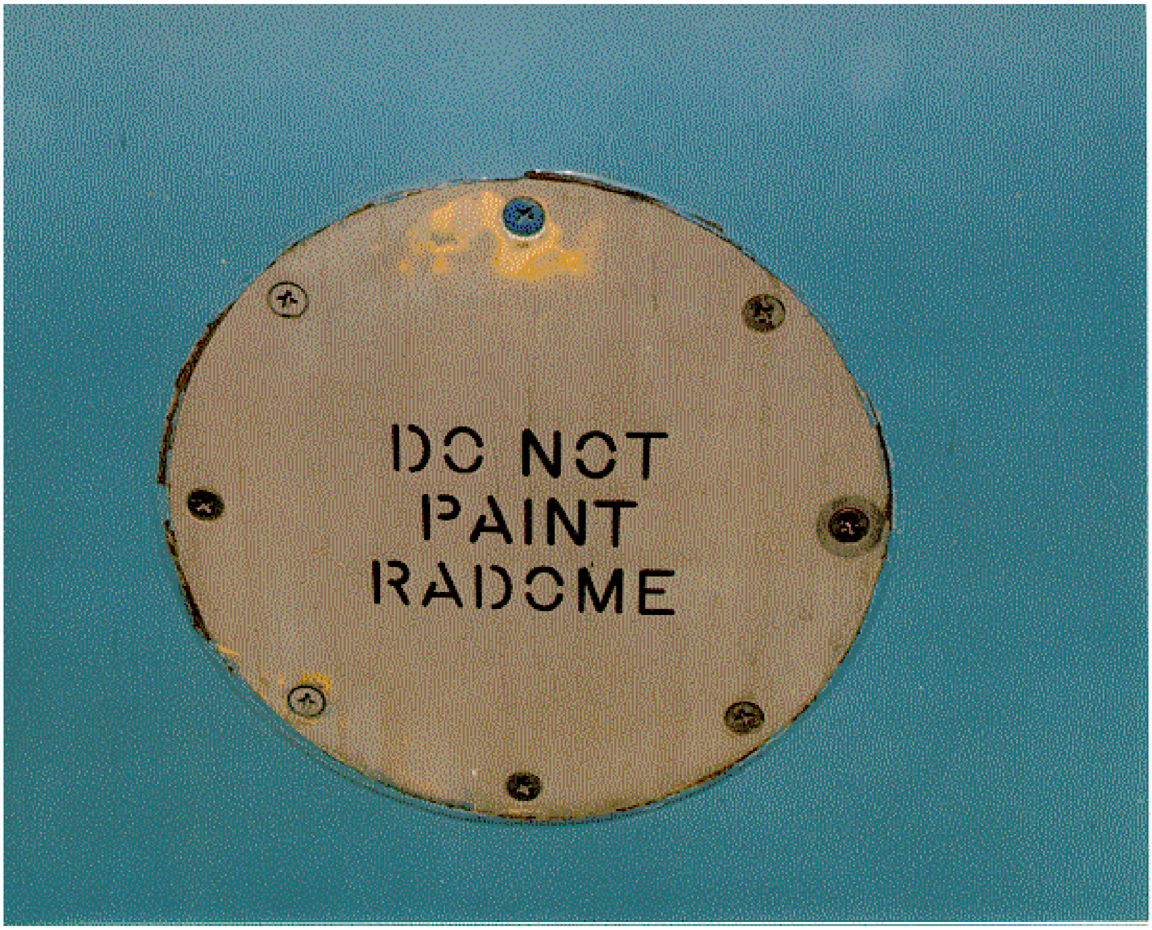


FIGURE 6-13. FLUSH MOUNTED ANTENNA RADOME

(c) Position the cover or dome (radome), and install, set, and torque the attach fasteners per the OEM's maintenance instructions. Mask as required, using pressure sensitive tape, adjacent to the seam with two parallel strips of tape. Apply a smooth seam of Polysulfide Sealing Compound, MIL-S-81733 or MIL-S-83430, within the two parallel strips of tape around the periphery of the antenna cover and mated aircraft structure/skin in accordance with chapter 5, paragraph 505d. Ensure sealant is also applied over the fastener heads to form a watertight seal. Remove the tape within the working time of the sealant. Allow the sealant to cure prior to flight.

(6) Radar Dish Antenna Corrosion Prevention Procedure. One of the primary problems related to dish antennas is the integrity of the protective finish. The protective finish is subject to scratches and chipping from normal maintenance and handling. The metal used in antenna construction is usually aluminum or magnesium. Both metals are anoxic to the attached hardware and subject to galvanic corrosive around the hardware. The dish and remainder of the mount are subject to surface corrosion when the finish is damaged. Spot touch-up, as required, the paint finish in accordance with the instructions of chapter 5, paragraphs 502 and 503. Complete paint stripping, cleaning, and refinishing is normally justified if 20% of the paint finish is damaged. There are some radar antennas that have a protective finish or covering of Mylar over the base aluminum or magnesium. For these types of antenna dishes, refer to the OEM's maintenance instructions.

(7) Temporary Dish Protection. This procedure is appropriate for line maintenance personnel to repair limited, minor surface damage of the finish to the dish. The procedure is also appropriate as an alternate procedure to paint touch-up until paint can be applied.

(a) Remove surface corrosion to the limits of the OEM's maintenance instructions with 320 grit abrasive cloth, conforming to Federal Specification P-C-451, or an abrasive nylon mat, conforming to MIL-A-9962, Type I.

(b) Wipe off corrosion products using a clean cloth or cheesecloth dampened with Isopropyl Alcohol, TT-I-735. Allow surface to air dry.

(c) Spray a coat of Water-Displacing Corrosion Preventive Compound, conforming to MIL-C-85054, on the affected area(s).

NOTE: Unless the area is subject to a significant amount of abrasion from operation or handling, MIL-C-85054 can provide up to a year of protection.

(8) Radar Antenna Hardware. For protection of the radar antenna hardware, such as nuts, bolts, screws, washers, and clamps, utilize the following procedure:

(a) Clean hardware with a clean cloth or cheesecloth dampened with Isopropyl Alcohol, TT-I-735. Allow surfaces to air dry.

NOTE: Replace nuts, bolts, screws, washers, and clamps which have worn off protective coatings (normally cadmium).

(b) If corrosion is present but replacement is not practical, the corrosion may be removed using 320-grit abrasive cloth, conforming to Federal Specification P-C-451, or an abrasive nylon mat, conforming to MIL-A-9962, Type I. Repeat step (a) following corrosion removal.

(c) Spray a coat of Water-Displacing Corrosion Preventive Compound, conforming to MIL-C-85054, on the affected hardware after installation.

(9) Antenna Connectors. Antenna connectors require special procedures to avoid moisture entry and corrosion damage. Corrosion is by far the principal cause of antenna performance deterioration. Clean and preserve antenna connectors, both multi-pin and coaxial, in accordance with this chapter, paragraphs 603k(2) through (5).

(10) UHF/VHF/ADF Antenna Sealing. The location of UHF/VHF/ADF antennas is normally on the lower fuselage. Figure 6-10 shows a corroded antenna mounting area on a removed lower fuselage skin. These mounting locations are particularly susceptible to corrosion because of fluid entrapment in bilge areas. This fluid entrapment is the principal reason for additional maintenance requirements for these types of antennas. The following preventive measures should be utilized to minimize this problem.

(a) With the antenna removed, clean the antenna and the mounting location on the aircraft of grease, oil, and dirt using a clean cloth or cheesecloth dampened with an approved solvent or the cleaning procedures described in chapter 4, paragraph 405.

(b) Remove corrosion deposits to the limits of the OEM's maintenance instructions with 320-grit abrasive cloth, conforming to Federal Specification P-C-451, or an abrasive nylon mat, conforming to MIL-A-9962, Type I.

(c) Wipe clean corrosion removal areas on the antenna and aircraft skin/structure with a clean cloth or cheesecloth dampened with Isopropyl Alcohol, TT-I-735. Allow surfaces to air dry.

(d) Install the UHF/VHF/ADF antennas per the OEM's maintenance instructions. The following procedures may be used as an alternative.

(e) (Alternate installation procedures.) Normally, antennas are assembled with the dustcover mated to the bottom of the antenna casting. A plate called the antenna element mates to the antenna cavity flange under a plastic plate. During reassembly of the antenna components, discard the extruded rubber dust cover channel which fits between the dustcover edge and the antenna casting (This area will be sealed with sealant). Wipe the circumference of the mated dustcover and antenna casting clean, using a clean cloth or cheesecloth dampened with Isopropyl Alcohol, TT-I-735. Additionally, clean around the circumference of the plastic plate which mates to the antenna cavity and the attached fastener heads. Allow all surfaces to air dry.

(f) Mask as required, using pressure sensitive tape.

(g) Seal the junction of the dustcover, antenna cavity, and antenna casting outer edge with Polysulfide Sealing Compound, conforming to MIL-S-81733, Type II. Mix sealant in accordance with the manufacturer's instructions; refer to chapter 5, paragraphs 504b(3) and 505d. Apply sealant with a spatula or extrude a bead of sealant using a sealant gun. Additionally, seal around the circumference of the plastic plate, antenna cavity, and the attach fastener heads for the dustcover. Remove any masking tape within the working time of the sealant.

(h) Allow the sealant to cure ("tack-free") as stated in the manufacturer's instructions. Install the antenna in accordance with the OEM's maintenance instructions.

(i) Spray a coat of Water-Displacing Corrosion Preventive Compound, conforming to MIL-C-85054, on the antenna mount.

(j) Clean and preserve the electrical connectors in accordance with the instructions of this chapter, paragraphs 603k(2) through (5).

(k) Mask as required the antenna and aircraft surfaces using pressure sensitive tape.

(l) Mix sealant in accordance with the manufacturer's instructions. Apply sealant to the circumference of the antenna and aircraft skin/structure with a spatula or extrude a bead of sealant from a sealant gun; refer to chapter 5, paragraphs 504b(3) and 505d. Smooth sealant using a spatula. Within the working time of the sealant remove any masking tape. Allow the sealant to cure prior to flight. Figures 6-11 and 6-12 show examples of properly mounted and sealed blade mounted antennas.

(11) Long Wire and Direction Finder (DF) Sense Antenna Corrosion Prevention Procedures. The cleaning and preservation procedures for this type of antenna are as follows:

NOTE: If the long wire is the stranded type, and the corrosion is more extensive than light surface corrosion, it is normal practice to replace the wire. Stranded wire has the propensity of wicking corrosives through capillary action, causing extensive damage that may not be readily apparent.

(a) Cleaning and corrosion procedures for individual parts prior to mounting the antenna are described in paragraph 603a(2), while antenna mounting procedures are described in paragraph 603a(3).

(b) Wipe clean all antenna parts with a clean cloth or cheesecloth dampened with Isopropyl Alcohol, TT-I-735. Allow surfaces to air dry.

(c) Assemble long wire or DF antenna parts and install in accordance with the OEM's maintenance instructions.

(d) After installing and tensioning the antenna, spray a coating of Water-Displacing Corrosion Preventive Compound, conforming to MIL-C-85054, over the attached hardware. If a new bare wire (no nylon sleeve) was installed, wipe the wire with a clean cloth or cheesecloth soaked with Water-Displacing Corrosion Preventive Compound, conforming to MIL-C-85054. This will allow the Corrosion Preventive Compound to penetrate around the individual wire strands.

NOTE: It is preferable to apply Water-Displacing Corrosion Preventive Compound, conforming to MIL-C-85054, to a new bare wire after the antenna is installed and tensioned. If access to the wire is impractical after installation, wet-wipe the wire with MIL-C-85054 prior to installation. In such cases, minimize flexing, coiling, or abrading the wire after the Corrosion Preventive Compound has been applied and before the wire is installed and tensioned.

(e) To prevent moisture intrusion into the insulator, fill the space around the wire where it enters the insulator with Room Temperature Vulcanizing (RTV) Sealant, conforming to MIL-A-46146, Type I; RTV 3140 (clear) is recommended. Use the cleaning and application procedures of chapter 5, paragraphs 505d(8) and (9). Seal both ends of the insulator in this manner.

(12) Bonding/Ground Connection Electrical Resistance Test.

NOTE: Select a scale on the milli-ohmmeter that will allow a reading of 2.5 milli-ohms around mid-scale. This will ensure maximum instrument accuracy. Proper torque on the connections, good resistance readings, and complete sealing of the antenna installation are all essential to ensure the antenna will function properly in service.

(a) The electrical resistance test is performed after an antenna base is mounted or ground installation is assembled. The test should take place prior to the application of sealant. The test uses a milli-ohmmeter to obtain resistance readings between the antenna base or grounded portion of the antenna and the aircraft skin/structure. It is essential that the test probe be placed against bare metal when taking the readings.

(b) The maximum allowable resistance reading between the antenna base or grounded portion of the antenna and the aircraft skin/structure is 2.5 milli-ohms.

b. Avionics Test Equipment. Precision measurement and test equipment is required for testing, troubleshooting, and repairing avionics components and systems. This makes the reliability of this equipment in any environment critical to safe aircraft flight and system functions. Aircraft operational requirements often result in short troubleshooting and repair times for malfunctioning avionics systems. Valuable maintenance time is lost if this equipment is not functioning properly. A major source of test equipment malfunction is corrosion on contacts. Corrosion sources that are particularly detrimental to avionics test equipment include moisture and fluid intrusion (rain, condensation, fuel, hydraulic fluid, etc.), corrosive elements in the surrounding atmosphere, malfunctioning or inadequate shop environmental control systems, and malfunctioning or inadequate built-in filter systems.

NOTE: In this section, use of the term "avionics test equipment" shall refer to all aircraft electrical and electronic system test equipment. This includes support equipment, oscilloscopes, signal generators, meters, automatic test equipment (ATE), and any other equipment used to perform measurements on test, or troubleshoot avionics equipment.

(l) Cleaning Versus Calibration. A problem common to all automatic/manual test equipment is the effect of dirt, dust, lint, etc., on equipment calibration. A large quantity of test equipment, particularly older equipment, is possibly not maintained (cleaned, calibrated, etc.) on a scheduled basis. This lack of maintenance allows contaminants to collect on the components and become an integral part of the circuit, thus altering circuit parameters. These contaminant-induced changes are compensated for during each re-calibration process and can limit the equipment's peak operating efficiency over time. Additionally, the calibration of equipment can shift in service if some of the contaminants become dislodged. Because of the effect that contaminants have on electrical characteristics, immediate cleaning and preservation is mandatory after exposure of the equipment to any of the following conditions:

(a) External exposure to wet weather conditions.

(b) Internal exposure to water or any other fluids.

(c) Internal or external exposure to fire extinguishing agents.

(d) Internal or external exposure to electrolytes or corrosive deposits from batteries.

(2) Support Equipment and General Purpose Test Equipment Covers and Housings. The inspection, cleaning, corrosion removal, and preservation of support equipment and general purpose test equipment covers and housings should be performed as follows:

NOTE: Prior to cleaning covers and housings, remove the operator's panel, electrical and electronic components, harnesses, and connectors.

(a) Inspect, remove corrosion, clean, treat, paint, and preserve in accordance with paragraph 602b.

(b) Hardware associated with test equipment housings and covers that are not normally painted should be preserved in accordance with paragraph 602e(4).

(c) Equipment covers with hinges and latches should be lubricated and preserved in accordance with this chapter, paragraphs 602k(6) and (7).

(3) ATE Cabinets, Doors, and Panels. Inspection, cleaning, corrosion removal, and preservation of ATE cabinets, doors, and panels should be performed as follows:

NOTE: The use of dissimilar metals in the selection of screws, washers, and nuts should be eliminated whenever possible. Refer to chapter 7 for information on bonding and grounding hardware.

(a) Inspect hardware and electrical bonding locations for signs of galvanic corrosion. Pay particular attention to dissimilar metal couples.

(b) Remove corrosion, clean, treat, and paint in accordance with paragraph 602b.

(c) Hardware associated with ATE cabinets, doors, and panels that are not normally painted should be preserved as often as required in accordance with paragraph 602e(4). Do not preserve water seal gaskets.

(d) Equipment covers with hinges and latches should be lubricated and preserved in accordance with paragraphs 602k(6) and (7).

(4) Battery Compartments. Some support equipment and general purpose test equipment contain internal batteries. Clean, neutralize, and preserve the battery compartment as follows:

(a) Clean and neutralize electrolyte spills in accordance with paragraphs 602d(1) through (6).

(b) Inspect, clean, treat, and paint battery compartment in accordance with chapter 5, paragraphs 504a through 504f.

(c) When painting of the battery compartment is not practical, temporarily preserve the area in accordance with paragraph 602e(4).

(5) Meters. Voltmeters, ammeters, and multi-meters are usually constructed of high impact plastic or acrylic. Normally these meters are not disassembled for cleaning. Clean the exterior surfaces as follows:

(a) Clean metal hardware and metal surfaces with cotton swabs and a clean cloth or cheesecloth dampened with Isopropyl Alcohol, TT-I-735. Allow surface to air dry.

(b) Apply a coating of Water-Displacing Corrosion Preventive Compound, conforming to MIL-C-85054, on metal hardware. Take necessary steps to avoid getting preservative on acrylic plastic face plates.

(c) Clean toggle, rotary, and push-button switches in accordance with paragraph 603g.

(d) Clean meter face plates in accordance with paragraph 602g(9).

(e) Clean high impact plastic or acrylic housings with a 1 ounce solution of nonionic liquid detergent, conforming to MIL-D-16791, Type I, in 1 gallon of water. Clean the surface with a clean cloth or cheesecloth wet with the detergent solution. When the surface is clean, remove the detergent solution by wiping the surface with a clean cloth or cheesecloth that has been dampened with clean water. Rinse the cloth frequently.

(6) Operator and Instrument Panels. Support equipment, general purpose test equipment, and ATE operator instrument panels should be inspected, cleaned, treated, painted, and preserved as follows:

(a) Visually inspect operator and instrument panels for corrosion and contaminants. Pay particular attention to switches, dials, knobs, and hardware.

(b) Remove corrosion using an abrasive nylon mat, conforming to MIL-A-9962, Type I.

(c) Clean metal surfaces with cotton swabs and a clean cloth or cheesecloth dampened with Isopropyl Alcohol, TT-I-735. Allow surface to air dry.

(d) Apply a coating of Water-Displacing Corrosion Preventive Compound, conforming to MIL-C-85054, on metal hardware. Take necessary steps to avoid getting preservative on acrylic plastic face plates.

(e) Treat and paint operator and instrument panels in accordance with chapter 5, paragraphs 504a through f.

(f) Clean toggle, rotary, and push-button switches in accordance with paragraph 603g.

(g) Clean meter face plates in accordance with paragraph 602g(9).

(h) Clean and treat light bulb assemblies in accordance with paragraph 603e.

(7) Internal Cleaning of Support Equipment. With the exception of emergency procedures described in chapter 10, the internal cleaning of support equipment is normally a function of a repair activity or the OEM. The recommended cleaning and preservation techniques for support equipment are as follows:

(a) Remove covers and housing.

(b) Inspect for oil, grease, hydraulic fluids, and corrosion. Additionally, inspect for components that can act as water and solvent traps. Chapter 4, table 4-3, lists components that may pose a problem with water and solvent entrapment.

(c) Seal, bag, or remove potential components that may entrap water and solvent. Chapter 4, paragraph 405f, describes sealing methods.

(d) Remove oil, grease, and hydraulic fluids using a solvent ultrasonic cleaner. Refer to ultrasonic cleaning instructions in chapter 4, paragraph 404d and table 4-2. Solvent ultrasonic clean for 15 seconds and solvent dry for 3 minutes.

(e) Remove corrosion with a mini-abrasive cleaning tool in an approved cleaning booth using technical grade sodium bicarbonate. Refer to chapter 4, paragraph 404e.

(f) If no corrosion, oils, greases, or hydraulic fluid were noted in the inspection, clean the internal areas of the support equipment with a water detergent solution as described in chapter 4, paragraph 404b.

(g) Treat and paint internal areas of the support equipment in accordance with chapter 5, paragraphs 504a through f.

(h) On areas that are not painted but require preservation, apply a thin coat of Water-Displacing Corrosion Preventive Compound, conforming to MIL-C-81309, Type III. Take necessary steps to avoid getting preservative on components that should not be preserved. Refer to chapter 4, paragraphs 407d and 407e, and table 4-4.

(8) Internal Cleaning of General Purpose Test Equipment. Oscilloscopes, signal generators, frequency counters, etc., usually accumulate more dust and dirt than other contaminants. Internal cleaning and preservation of general purpose test equipment should be accomplished as follows:

(a) Remove covers and housing.

(b) Inspect for oils, grease, dust, dirt, and corrosion. Additionally, inspect for components that can act as water and solvent traps. Chapter 4, table 4-3, lists components that may pose a problem with water and solvent entrapment.

(c) Seal, bag, or remove potential components that may entrap water and solvent. Chapter 4, paragraph 405f, describes sealing methods.

(d) Use a vacuum cleaner to remove loose dust, dirt, and lint from the internal chassis and circuit components.

(e) Remove corrosion with a mini-abrasive cleaning tool in an approved cleaning booth using technical grade sodium bicarbonate. Refer to chapter 4, paragraph 404e.

(f) If no corrosion, oils, or greases were noted in the inspection, clean the internal areas of the general purpose test equipment with a water detergent solution as described in chapter 4, paragraph 404b.

(g) Treat and paint internal areas of the support equipment in accordance with chapter 5, paragraphs 504a, through f.

(h) On areas that are not painted but require preservation, apply a thin coat of Water-Displacing Corrosion Preventive Compound, conforming to MIL-C-81309, Type III. Take necessary steps to avoid getting preservative on components that should not be preserved. Refer to chapter 4, paragraphs 407d and 407e, and table 4-4.

(9) Internal Cleaning of ATE. ATE is usually constructed so that circuits are installed in drawers or cabinet-type racks. Attempting to clean the entire drawer or cabinet could prove difficult because of the size and weight of the assembly. Where the assemblies can be moved and mechanically cleaned, use the procedures of paragraph 603b(8). Those assemblies that cannot be moved and mechanically cleaned should be cleaned and preserved as follows:

(a) Open cabinet doors, remove cover, and slide drawers to the fully extended position.

(b) Inspect for oil, grease, dust, dirt, and corrosion. Additionally, inspect for components that can act as water and solvent traps. Chapter 4, table 4-3, lists components that may pose a problem with water and solvent entrapment.

(c) Seal, bag, or remove potential components that may entrap water and solvent. Chapter 4, paragraph 405f, describes sealing methods.

(d) Use a vacuum cleaner to remove loose dust, dirt, and lint from the internal chassis, wiring, and circuit components. Avoid direct contact between the vacuum cleaner hose wand and any delicate circuit components.

(e) Hand clean in accordance with chapter 4, paragraph 405g, using a water detergent solution as described in paragraph 405(1), or Isopropyl Alcohol, TT-I-735.

CAUTION: If wire wrap circuit board construction is used in ATE, do not apply water detergent solutions or solvents. In wire wrap installations only vacuuming of dirt, dust, and lint is authorized. Do not apply preservation materials to wire wrap circuit boards.

(f) On areas that are not painted but require preservation, apply a thin coat of Water-Displacing Corrosion Preventive Compound, conforming to MIL-C-81309, Type III. Take necessary steps to avoid getting preservative on components that should not be preserved. Refer to chapter 4, paragraphs 407d and 407e, table 4-4, and the caution statement for the preceding, paragraph 603b(9)(e).

(10) Internal Cleaning of Microwave Test Equipment. Microwave equipment contains many potential water and solvent entrapment areas. In addition, microwave equipment makes use of many acrylic vanes and lenses in wave guides and cavities, variable attenuators, etc. Generally, these components can be sealed or removed from the chassis prior to cleaning and drying. Internal cleaning and preservation of microwave test equipment should be performed as follows:

(a) Clean external surface in accordance with paragraph 603c.

(b) Clean internal surface in accordance with paragraph 603c.

(c) Inspect wave guide for corrosion.

(d) Remove corrosion from external surfaces using an abrasive nylon mat, conforming to MIL-A-9962, Type I. Wipe off residue with a clean cloth or cheesecloth. Do not disturb the center connector with a cleaning tool or brush.

(e) Clean connector sections by spraying internal and external areas with Isopropyl Alcohol, TT-I-735. Do not disturb the center connector with a cleaning tool or brush. Wipe excess solvent dry with a clean cloth. Allow the section to air dry.

(f) If the wave guide will not be installed immediately, seal the ends of the section with OEM protective caps or pressure sensitive tape, conforming to MIL-T-22085.

(g) Preserve external areas of the wave guide section with a thin coat of Corrosion Preventive Compound, conforming to MIL-C-85054.

CAUTION: Do not apply preservative materials to internal surfaces or areas of wave guide sections or APC connectors.

(11) Special Cleaning Procedures. The following test equipment circuit components should be cleaned, lubricated, and preserved as follows:

(a) Bonding and Grounding Straps. Clean and preserve electrical bonding and grounding straps in accordance with chapter 7, paragraph 702.

(b) Relays and Circuit Breakers. Clean and preserve relays and circuit breakers in accordance with paragraph 603f.

(c) Rotary Switches, Trim Potentiometers, and Sliding Cam Switches. Clean, lubricate, and preserve rotary switches, trim potentiometers, and sliding cam switches in accordance with paragraph 603g, and as follows:

i. Apply Spray Cleaning And Lubricating Compound, conforming to MIL-C-83360, Type I, to the internal portion of switch.

CAUTION: Do not apply Spray Cleaning And Lubricating Compound, MIL-C-83360, to PCBs or other areas where soldering may be required. This material contains silicone which is difficult to remove and prevents proper adhesion of any material applied to the sprayed area.

ii. While the surface is still wet, wipe sliding contacts, cams, and contact points with a clean cotton swab or pipe cleaner as required, to remove dirt, dust, and other residue.

iii. Spray cleaned areas that require lubrication with Spray Cleaning And Lubricating Compound, conforming to MIL-C-83360, Type I. A silicone lubricant residue will remain. Do not apply preservative materials.

(d) Microminiature PCBs. Clean microminiature PCBs as follows:

i. Hand clean microminiature PCBs of dirt, dust, and other residue with a clean cotton swab or a soft bristle brush wet with Isopropyl Alcohol, TT-I-735, in accordance with chapter 4, paragraph 405g.

ii. Rinse the microminiature PCBs with deionized water.

iii. Dry the microminiature PCBs in accordance with chapter 4, paragraph 406e.

(e) Multi-Pin Electrical Connectors and PCB Edge Connectors. Clean, treat, and preserve multi-pin electrical connectors and PCB edge connectors in accordance with paragraph 603h, and paragraphs 603k(1) through (4).

(f) Sliding Attenuators, Variable Attenuators, and Tunable Cavities. Clean, treat, and preserve as follows:

i. Remove corrosion and tarnish by lightly rubbing with Magic Rub Plastic or a wooden pencil eraser. Care should be taken not to remove the thin plating on the surface.

ii. Clean the area by applying Isopropyl Alcohol, TT-I-735, with an acid brush. Rinse the area with Isopropyl Alcohol, TT-I-735, and wipe dry with a clean cloth or cheesecloth. Allow component to air dry.

CAUTION: Sliding and variable attenuators and tunable cavities are natural water and solvent traps. Do not leave these components exposed during internal equipment cleaning. Clean the exterior of sliding and variable attenuators and tunable cavities by hand where the cleaning solution, rinse water, or solvent can be properly dried.

iii. Lubricate sliding components with an application of Spray Cleaning and Lubricating Compound, conforming to MIL-C-83360, Type I. Mask any nearby areas where the presence of the silicone lubricant is not desired. Silicone is very difficult to remove and prevents proper adhesion of any material applied to the sprayed area. Refer to chapter 4, paragraph 405j.

iv. Spray a thin coating of Water-Displacing Corrosion Preventive Compound, conforming to MIL-C-81309, Type III, on external metal surfaces. Avoid placing preservative material on sliding components.

(g) Internal Surfaces of Sliding Attenuators, Variable Attenuators, and Tunable Cavities. Clean internal surfaces of sliding attenuators, variable attenuators, and tunable cavities as follows:

i. Hand clean the slide area(s) by applying Isopropyl Alcohol, TT-I-735, with an acid brush.

CAUTION: Sliding and variable attenuators and tunable cavities are natural water and solvent traps. Do not leave these components exposed during internal equipment cleaning. Clean the interior surfaces of sliding and variable attenuators and tunable cavities by hand only where the cleaning solution, rinse water, or solvent can be properly dried. Do not apply preservative material to internal slide surfaces.

ii. Rinse the area with Isopropyl Alcohol, TT-I-735, and wipe dry with a clean cloth or cheesecloth. Allow component to air dry.

(12) Painting Systems. It is important that the metallic housings of avionics test equipment be protected from the environment. A properly applied paint system provides effective long-term protection. These paint systems can be degraded by abrasion, chipping, scratching, and other forms of in-service damage. When damage to the paint finish occurs, immediate action should be taken to restore protection to the base metal. Restore corrosion protection as follows:

(a) Temporary Protection.

i. Clean bare area with a clean cloth or cheesecloth dampened with Isopropyl Alcohol, TT-I-735. Allow surface to air dry.

ii. Spray a thin coating of Corrosion Preventive Compound, MIL-C-85054, to the clean, bare area.

(b) Paint Finish Restoration. Inspect, clean, treat, and apply protective paint finish in accordance with paragraph 602b. The paint color selection should be in accordance with the OEM's maintenance instructions.

NOTE: Paint color matching is a difficult process. Paint from the same manufacturer, color number, and batch number will not match the same paint applied earlier that has been allowed to age and weather.

(13) Packaging, Handling, and Storage. The packaging, handling, and storage procedures of chapter 4, paragraph 409, should apply to test equipment. The following additional requirements should also apply.

(a) Wipe down test equipment on a regular basis using a clean, dry, soft cloth. This will prevent accumulation of soils and potentially corrosive materials on the equipment. Additionally, clean equipment generally receives better handling treatment from the user.

(b) Ensure all appropriate caps are installed on equipment cavities and connections.

(c) Ensure all decals, calibration stickers, part numbers, and serial numbers are kept legible and up-to-date.

(d) Test equipment should be stored and shipped in the appropriate carrying case in accordance with chapter 4, paragraph 409d.

c. Wave Guides. Wave guides are only effective if the internal surfaces are clean and free of damage (dents) and corrosion (surface or pitting). Wave guide mounting and flange seal integrity must be maintained, otherwise, the electrical characteristic of the wave guide will be adversely affected. Currently, there is no method of preserving the internal surface of the wave guide except by plating another metal, such as gold or silver, during the manufacture of the wave guide. This plating process is expensive. Wave guides used in aircraft are generally not plated. The method of protecting the internal finish on a wave guide is to prevent moisture intrusion. Moisture intrusion can occur any time the wave guide seal is broken and opened for maintenance. Wave guides that must be opened should be sealed at the flanged ends with an appropriate cap or pressure sensitive tape. Prior to assembly, all residue from the pressure sensitive tape should be removed. The following describes methods for cleaning, removing corrosion, and preserving external wave guide surfaces.

(1) Ensure the ends of the wave guide are sealed using an appropriate cap or pressure sensitive tape.

(2) Visually inspect the wave guide for evidence of corrosion.

NOTE: Wave guides are normally replaced if there is evidence of corrosion, either internally or on the mating surfaces.

(3) Remove corrosion on the exterior of wave guides using an abrasive nylon mat, conforming to MIL-A-9962, Type I.

(4) Remove protective caps or pressure sensitive tape from mating flange surfaces.

(5) Wipe clean exterior surfaces and mating flange surfaces with a clean cloth or cheesecloth dampened with Isopropyl Alcohol, TT-I-735. Allow surfaces to air dry.

(6) If the wave guide is not going to be installed immediately, install protective caps or apply pressure sensitive tape to mating flange surfaces.

(7) If the wave guide is to be installed, connect in accordance with the OEM's maintenance instructions.

(8) Preserve wave guides as follows:

(a) For wave guides that are not to be installed, spray a thin coating of Corrosion Preventive Compound, MIL-C-85054, on the exterior surfaces.

(b) For wave guides that will be installed, spray a thin coating of Corrosion Preventive Compound, MIL-C-85054, on the exterior surfaces and hardware after installation.

d. Wave Guide Feed Horns. Wave guide feed horns attached to some antenna dishes are subject to corrosive attack at the open end of the wave guide. To protect this open end area from corrosion, clean and preserve as follows:

(1) Wipe feed horn surfaces with a clean cloth or cheesecloth dampened with Isopropyl Alcohol, TT-I-735. Allow surfaces to air dry.

(2) Spray the inner and outer throat area of the wave guide opening with an ultra-thin coat of Water-Displacing Corrosion Preventive Compound, conforming to MIL-C-81309, Type III. Apply to exterior surfaces of the feed horn. For interior surfaces, direct the spray across the throat so that the spray is deposited on the opposite side (inner) of the feed horn and does not enter the wave guide past the flared throat area.

e. Lighting Systems and Assemblies. External formation lights, wing tip lights, rotating beacons, and anti-collision lights are highly susceptible to corrosion. The corrosive attack is usually caused by poor seals which allow moisture intrusion from aircraft wash or from the environment in flight. Interior lights and equipment-mounted bulbs are also susceptible to corrosive attack. In most cases, corrosion will be heaviest at the base of the bulb because of the dissimilar metal contact between the bulb and the bulb socket. Clean and treat as follows:

WARNING: Ensure that electrical power is disconnected from the light assembly prior to corrosion removal and preservation procedures.

(1) Exterior Mounted Light Assemblies.

(a) Remove the light cover assembly and bulb from the socket in accordance with the OEM's maintenance instructions.

(b) Remove corrosion using an abrasive nylon mat, conforming to MIL-A-9962, Type I. Scrub affected area to loosen corrosion and contaminants.

(c) Clean affected area with Isopropyl Alcohol, TT-I-735. Use an acid brush with the bristles trimmed back to assist in cleaning the base of the light socket.

(d) After cleaning, re-apply Isopropyl Alcohol, TT-I-735, to the light socket using a squeeze spray bottle to flush out any remaining residue.

(e) Wipe the light socket with a clean cloth or cheesecloth. Allow the area to air dry.

NOTE: The following procedures are applicable only to bulbs that are installed in their sockets with a turning, twisting, or scraping motion (screw base, bayonet base, or fuse-type clip). This scraping metal-to-metal contact is needed to ensure local displacement of the thin, soft film formed by Water-Displacing Corrosion Preventive Compound, MIL-C-81309, Type III.

(f) Preserve light assembles as follows:

i. Apply a thin film of Water-Displacing Corrosion Preventive Compound, MIL-C-81309, Type III, to the metal base of the bulb and bulb socket.

ii. Wipe to remove excess Corrosion Preventive Compound from the metal base of bulb using a clean cloth or cheesecloth.

iii. Install bulb in bulb socket.

iv. Preserve the outside area of the socket, light assembly, bare metal, and hardware by applying a thin film of Corrosion Preventive Compound, MIL-C-85054.

CAUTION: Allow the solvents in the Corrosion Preventive Compound to outgas prior to installing the light lens.

v. Assemble the light assembly. Touch up exterior paint finish as required and in accordance with chapter 5, paragraphs 504e and 504f.

(g) On lower fuselage light assemblies, water intrusion and entrapment is a problem during the aircraft wash; clean and preserve after each aircraft wash.

(2) Interior Lights and Small Equipment Light Assemblies.

(a) Interior lights and small equipment assemblies should be cleaned and preserved in accordance with this chapter, paragraphs 604e(1)(a) through 604e(1)(f) iii.

(b) Preserve the exterior of the light assembly using Water-Displacing Corrosion Preventive Compound, MIL-C-81309, Type II. Assemble light assembly in accordance with the OEM's maintenance instructions.

CAUTION: Allow the solvents in the Corrosion Preventive Compound to outgas prior to installing the light assembly.

f. Relay and Circuit Breakers. Remove corrosion and preserve as follows:

NOTE: Corrosion (tarnish) removal is required on most types of contacts. Tarnish acts as an insulator on contacts. Sliding-type contacts have a self-cleaning action, and tarnish removal is not required if a bright surface area is visible. Relay and circuit breaker contact areas are usually plated with a highly conductive metal. Care should be taken to avoid removing this plating. If the plating is removed during cleaning, replace the relay or circuit breaker.

(1) Heavy corrosion and tarnish may be removed by rubbing with a typewriter eraser. Medium corrosion and tarnish may be removed by rubbing with a pencil eraser.

(2) Rinse contacts with cotton swabs moistened with Isopropyl Alcohol, TT-I-735. Clean remainder of relay or circuit breaker with an acid brush wet with Isopropyl Alcohol, TT-I-735. Pipe cleaners may be used in hard-to-reach areas to assist in swabbing residue.

(3) Remove Isopropyl Alcohol, TT-I-735, from relays or circuit breakers using a clean cloth or cheesecloth. Allow to air dry.

(4) Preserve relays and circuit breakers as follows:

(a) Apply a thin film of Water-Displacing Corrosion Preventive Compound, MIL-C-81309, Type III, to all areas of the relay or circuit breaker, avoiding contact and mating areas.

NOTE: After application of preservative to relays and circuit breakers, it is necessary to ensure removal of the preservative material from all contact points and mating surfaces. Local air pollution regulations may restrict the use of this solvent. Comply with all local air pollution regulations.

CAUTION: Perform a final wipe of the contacts with Isopropyl Alcohol, TT-I-735, or the contacts will not function electrically.

(b) Wipe contact points and mating surfaces with a clean cloth, cotton swabs, or pipe cleaners (as applicable), dampened with an approved solvent or Dry Cleaning Solvent, P-D-680, Type II, to remove Corrosion Preventive Compounds. Perform a final cleaning wipe using a clean cloth, cotton swabs, or pipe cleaners (as applicable), dampened with Isopropyl Alcohol, TT-I-735.

g. Switches. Switches should include all cam-operated toggle, rotary, interlock, and push-button types. Remove corrosion and treat as follows:

NOTE: Local air pollution regulations may restrict the use of this solvent. Comply with all local air pollution regulations.

CAUTION: Cleaning compounds and solvents may react with some encapsulants or plastics used to form wire harness tubing, wiring coating, conformal coatings, gaskets, seals, etc. Test on a small area for softening or other adverse reactions prior to general application. Refer to chapter 4, paragraph 405, and table 4-3.

(1) Apply an approved solvent or Dry Cleaning Solvent, P-D-680, with an acid brush to remove contaminants.

(2) Wipe with a clean cloth or cheesecloth to remove excess solvent. Allow switch to air dry.

(3) Switches should be preserved as follows:

NOTE: After application of preservative to open switch assemblies, remove from the sliding contacts, cams, and contacts.

(a) Apply a thin film of Water-Displacing Corrosion Preventive Compound, MIL-C-81309, Type III, to the switch assembly. Cockpit and control box mounted switches should not be preserved on the exposed actuating arm or toggle. This area should be left clear of preservative so as not to hinder flight crew operation.

NOTE: After application of preservative to switches, it is necessary to ensure removal of the preservative material from the contact points and mating surfaces. Local air pollution regulations may restrict the use of this solvent. Comply with all local air pollution regulations.

CAUTION: Perform a final wipe of the contacts with Isopropyl Alcohol, TT-I-735, or the contacts will not function electrically.

(b) Wipe sliding contacts, cams, and contact points of open switches with a clean cloth, cotton swabs, or pipe cleaners (as applicable), dampened with an approved solvent or Dry Cleaning Solvent, P-D-680, Type II, to remove Corrosion Preventive Compounds. Perform a final cleaning wipe with a clean cloth, cotton swabs, or pipe cleaners, as applicable, dampened with Isopropyl Alcohol, TT-I-735.

h. Edge Connectors and Mating Plugs. Edge connectors on PCBs pose a particular corrosion problem because of the thinly plated surfaces. Most plugs and connectors used in micro-miniature circuit boards are plated with thin layers of gold. This gold is porous and moisture will penetrate to the base metal, causing corrosion. In addition, the very function of cleaning may create scratches in the plated surfaces which will accelerate the problem. Remove corrosion and preserve as follows:

(1) Remove corrosion and tarnish by rubbing the affected area with a pencil eraser. Care should be taken not to remove thinly plated surfaces.

NOTE: Local air pollution regulations may restrict the use of this solvent. Comply with all local air pollution regulations.

(2) Clean the contact areas with an approved solvent or Dry Cleaning Solvent, P-D-680, using an acid brush. Rinse affected area with Isopropyl Alcohol, TT-I-735, and wipe with a clean cloth or cheesecloth. Allow component to air dry.

(3) Edge connectors should be preserved as follows:

(a) Spray a thin coating of Water-Displacing Corrosion Preventive Compound to both male and female sections of the connector, conforming to MIL-C-81309, Type III.

(b) Wipe off excess preservative with a clean cloth or cheesecloth.

i. Wet-Slug Tantalum Capacitors. Wet-slug tantalum capacitors can be internally damaged in-service or during repair by the application of a reverse voltage. Such damage will often result in acid leakage which may cause corrosion in areas adjacent to the damaged capacitor. Capacitors having evidence of leakage should be replaced and all adjacent areas cleaned to prevent further corrosion. The following procedures should apply for the inspection of wet-slug tantalum capacitors:

(1) Inspect the seam between the slug and the case of each tantalum capacitor for evidence of small deposits of silver. The color of the silver deposit may be black or gray. When silver deposits are discovered, determine which capacitor is leaking, then place one drop of the following solution on the suspected capacitor, at the seam between the slug and the case, and on the silver deposit.

(a) Dissolve 1/4 teaspoon of Thymol Blue Reagent indicator crystals in 3 cups (24 ounces) of deionized or distilled water, conforming to O-C-265.

NOTE: Verify the color of the Thymol Blue Reagent indicator solution on a piece of white paper prior to use. The color of the solution should be amber or blue. If a reddish-purple color is indicated, the solution is contaminated and should be disposed of properly.

(b) Add 8 drops of ammonium hydroxide, conforming to O-A-451, to the Thymol Blue Reagent indicator and water solution. The ammonium hydroxide will aid in dissolving the Thymol Blue Reagent indicator crystals.

(2) If no color change is observed at the wet-slug tantalum capacitor, remove the indicator solution and any residue with Isopropyl Alcohol, TT-I-735, and an acid brush or a dampened clean cloth. Dry and preserve in accordance with paragraphs 603i(5) and (7).

(3) If an acid leak has occurred from a wet-slug tantalum capacitor, the solution will change from an amber or blue color to a reddish-purple color. Remove the damaged capacitor and neutralize the contaminated area by applying the following solution:

(a) Dissolve 8 ounces (1 cup) of sodium bicarbonate, conforming to O-S-576, in 1 gallon of fresh water.

(b) Apply the sodium bicarbonate solution to the affected area using an acid brush.

(c) Thoroughly rinse the affected area with deionized or distilled water. Ensure that the rinse water does not contaminate other areas.

(d) Apply another drop of the Thymol Blue Reagent indicator solution to the affected area. Inspect for the reddish-purple color. Repeat steps (b) and (c) above until no color change occurs.

(4) Clean affected area by scrubbing with a nonabrasive pad, conforming to MIL-C-83957. Thoroughly rinse the area with Isopropyl Alcohol, TT-I-735. Wipe area with a clean cloth or cheesecloth.

(5) Air dry the component.

(6) Install replacement capacitor.

(7) Preserve area as follows:

(a) Spray a thin coating of Water-Displacing Corrosion Preventive Compound, conforming to MIL-C-81309, Type III, to the capacitor and affected area.

(b) Wipe off excess preservative with a clean cloth or cheesecloth.

(8) Replace conformal coating in accordance with the OEM's maintenance instructions or chapter 5, paragraph 505e.

j. Aluminum Electrolytic Capacitors. Aluminum electrolytic capacitors that utilize synthetic rubber seals or rubber/plastic combination seals are susceptible to damage from cleaning solutions and processes. Such damage will often result in an acid leak which may cause corrosion in areas adjacent to the damaged capacitor. Capacitors having evidence of leakage should be replaced and all adjacent areas cleaned to prevent further corrosion. The following procedures should apply for the inspection and replacement of aluminum electrolytic capacitors:

(1) Inspect the end seals for deterioration. If the seal looks bulged or uneven, the capacitor should be replaced and all adjacent areas cleaned.

(2) Clean affected area by scrubbing with a nonabrasive pad, conforming to MIL-C-83957. Thoroughly rinse the area with Isopropyl Alcohol, TT-I-735. Wipe area with a clean cloth or cheesecloth.

(3) Air dry the component.

(4) Install replacement capacitor.

(5) Preserve area as follows:

(a) Spray a thin coating of Water-Displacing Corrosion Preventive Compound, conforming to MIL-C-81309, Type III, to the capacitor and affected area.

(b) Wipe off excess preservative with a clean cloth or cheesecloth.

(6) Replace conformal coating in accordance with the OEM's maintenance instructions or chapter 5, paragraph 505e.

k. Multi-Pin Electrical Connectors Cleaning and Preservation.

(1) General. Multi-pin electrical connectors require special attention to prevent corrosion and electrical failures, especially when the connectors are in areas that are exposed to harsh environments. The following techniques and associated warnings, cautions, and notes will assist in limiting the corrosion attack.

WARNING: Ensure that all electrical and hydraulic power is removed from the aircraft or component. Install applicable safety devices. Disconnect all batteries.

CAUTION: Cleaning compounds and solvents identified in chapter 4 and Appendix 1 may react with some encapsulants or plastics used to form wire harness tubing, wire coatings, conformal coating, gaskets, seals, etc. Test on a small area for softening or other adverse reaction prior to general application. Refer to chapter 4, table 4-3 for further restrictions on these materials.

NOTE: Local air pollution regulations may restrict the use of these solvents. Comply with all local air pollution regulations. A continuity test does not preclude a visual inspection of connectors, because corrosion can still occur outside of pin areas.

(a) Protect open connectors with conductive plastic or metal caps. Pressure sensitive tape, conforming to MIL-T-22085, Type II, as specified in chapter 4, paragraph 409e, is an alternate method of sealing connectors if proper caps are not available.

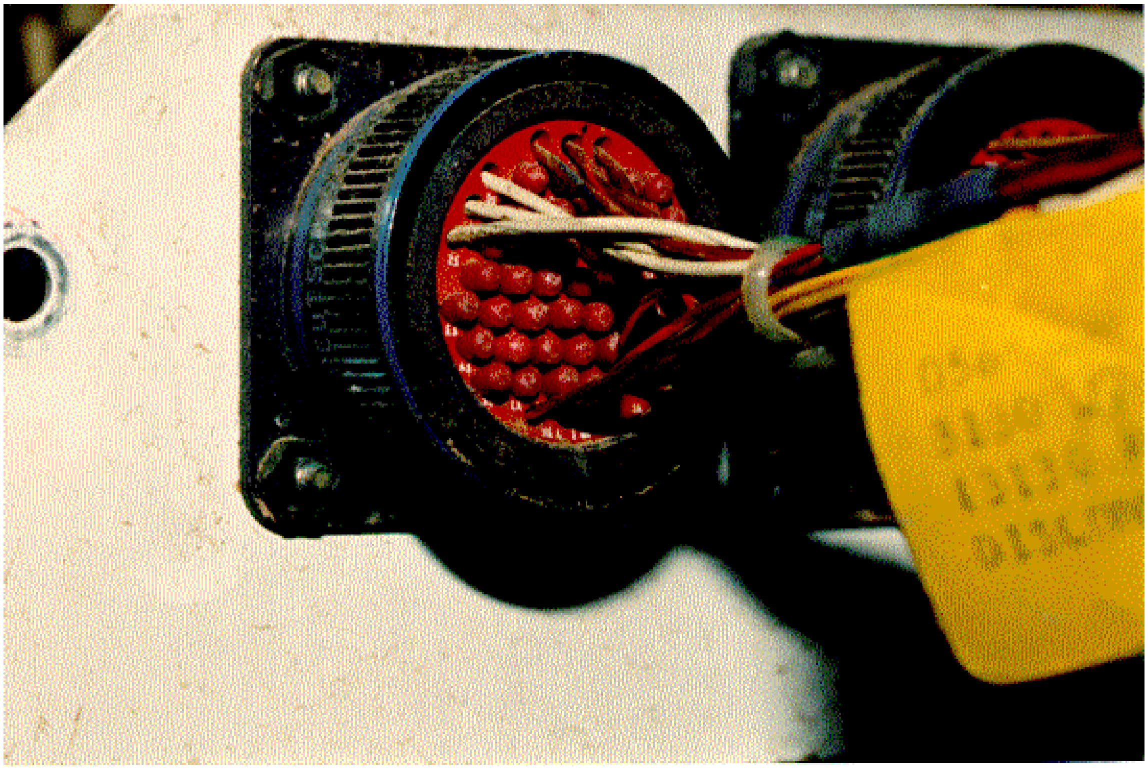


FIGURE 6-14. MULTI-PIN CONNECTOR WITH “DOG BONES” INSTALLED

(b) If connector boots are installed and water intrusion cannot be prevented due to design, a small drain hole (1/4 inch minimum, 3/8 inch maximum) may be incorporated at the lowest point on the connector boot to allow water to drain. This action requires approval of the OEM.

(c) Special attention should be given to connectors using replaceable pins. These connectors use a self-sealing gasket that seals the connector against water intrusion. “Dog bones” (plastic inserts) are used to fill unused connector (pin) cavities. Figure 6-14 shows “dog bones” installed in a multi-pin connector. The self-sealing gasket may lose its effectiveness to seal against water intrusion with repeated removal and replacement of connector pins or omission of the “dog bones.” The use of potting compounds mentioned in chapter 5, paragraph 505b may be required to prevent water intrusion in extreme cases where the connector cannot be replaced.

(d) Connectors that are susceptible to the same environment as the aircraft wire harness connectors should be treated with the same corrosion removal and preservation techniques. Mounting plates normally contain a gasket that acts as a watertight seal. These gaskets should be inspected each time a connector is dismantled for cleaning or repair.

(2) External Corrosion Inspection, Removal, and Cleaning. Inspection, removal, and cleaning of corrosion on the exterior of electrical connectors (see figures 6-15 and 6-16) should be performed as follows:

(a) Disassemble the connector backshell, if possible, and visually inspect all parts for evidence of corrosion. Extensive corrosion damage may require the replacement of the connector.

(b) Remove corrosion by scrubbing with a nonabrasive pad, conforming to MIL-C-83957, or an abrasive nylon mat, conforming to MIL-A-9962, Type I, as appropriate. Ensure connector mating surface threads, shell, and mounting plate (if used) are cleaned.

(c) Wipe off residue with a clean cloth or cheesecloth.

(d) Apply Isopropyl Alcohol, TT-I-735, with a typewriter brush or toothbrush. Scrub connector mating areas, threads, shell, and mounting plates.

(e) Remove solvent and residue with a clean cloth or cheesecloth. Allow all parts to air dry.

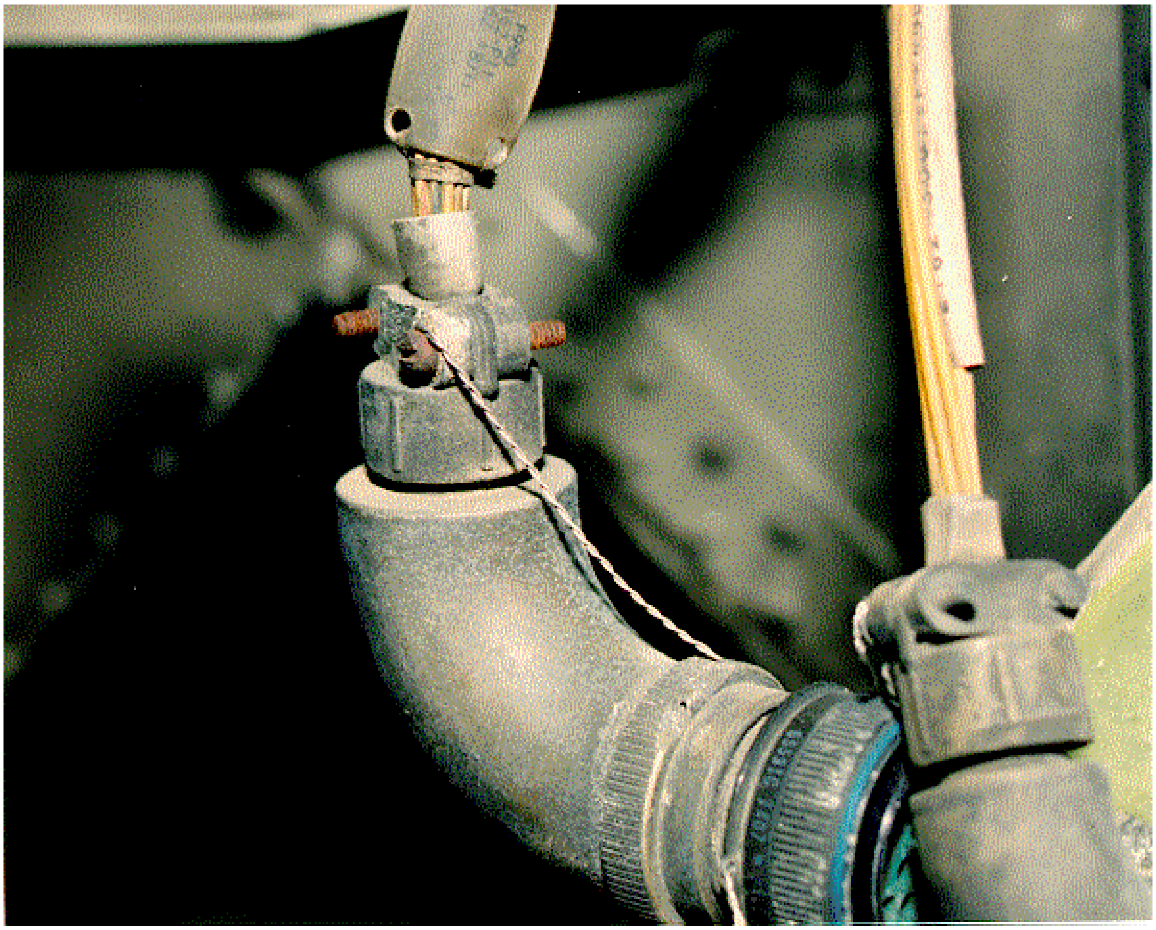


FIGURE 6-15. EXTERNAL MULTI-PIN CONNECTOR CORROSION

(3) Internal Corrosion Inspection, Removal, and Cleaning. Inspection, removal, and cleaning of corrosion on the interior of electrical connectors should be as follows:

NOTE: On most connectors it is difficult to clean and remove corrosion from the receptacle (female) contacts. If corrosion is noted, the most practical solution is to replace the pin.

(a) Visually inspect all areas of the connector for evidence of corrosion. Extensive corrosion damage may require the replacement of the pin(s) or the connector.

(b) Clean internal areas of the connector, wiring, and pins with Isopropyl Alcohol, TT-I-735, and an acid brush.

(c) Wipe excess solvent and residue with a clean cloth or cheesecloth. Use a pipe cleaner, as required, to remove solvent from the pin area.

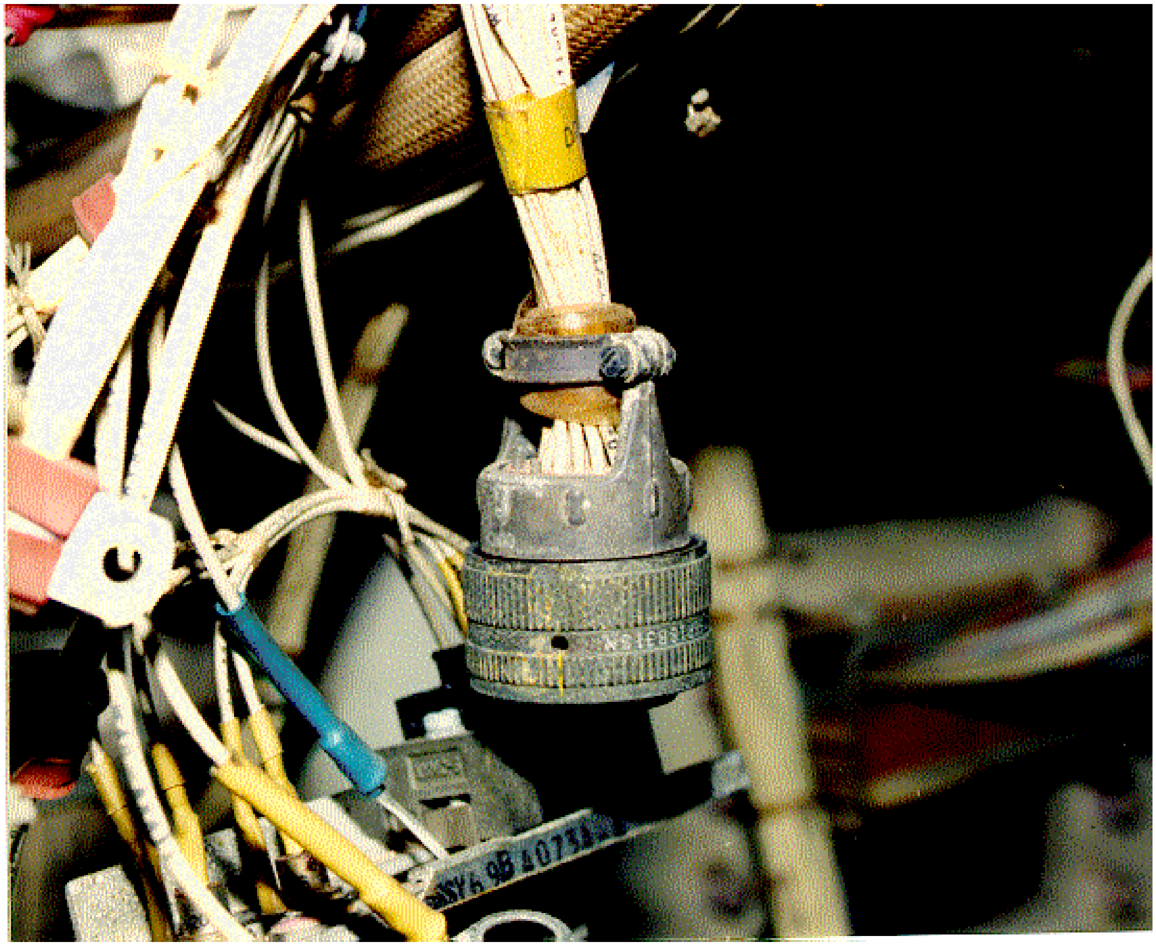


FIGURE 6-16. EXTERNAL MULTI-PIN CONNECTOR CORROSION

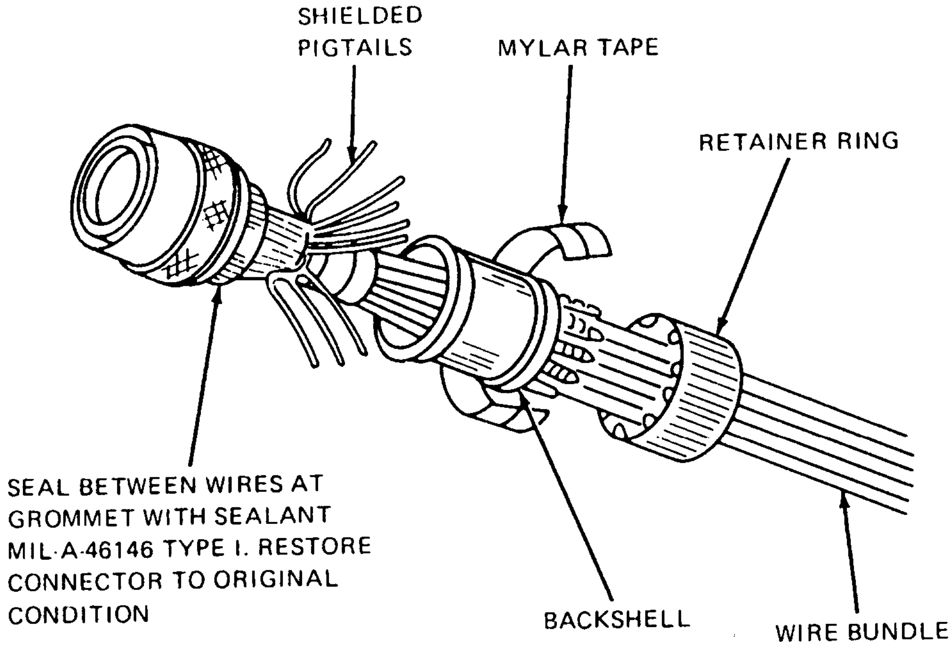
(4) Sealing Connector Backshell. Moisture intrusion into a connector often occurs by way of the backshell. This problem is particularly acute after damage to the seal occurs during pin replacement. The backshell may be sealed as follows:

(a) Verify that sealing plugs ("dog bones") are installed in unused contact cavities.

(b) Remove retainer ring and Mylar tape (if present) from the back of the electrical connector. Slide the backshell and retainer ring in back of the electrical connector up the electrical wire bundle. Refer to figure 6-17.

(c) Tie back shielded wire pigtails, where applicable.

(d) Apply RTV sealing compound, conforming to MIL-A-46146, by inserting the sealant applicator nozzle approximately halfway into the wire bundle at the back of the connector. See figure 6-17. Inject RTV sealing compound by squeezing the applicator tube while slowly withdrawing the nozzle from the wire bundle at the back of the connector. Repeat as many times as necessary at different locations around the connector to achieve a sealing compound thickness of 1/16 inch across the entire rear face of the connector. Position connector in the vertical position until the sealing compound sets. The sealing compound will self-level in approximately 15 minutes.



Procedures:
1. Remove retainer ring.
2. Remove Mylar tape.
3. Peel back shielded pigtails.
4. Remove backshell to expose wiring.
5. Seal between wires.

FIGURE 6-17. CONNECTOR SEALING PROCEDURE

NOTE: For those connectors exposed to fluids (dielectric, coolant, turbine oil, etc.) that adversely affect RTV sealant, conforming to MIL-A-46146, apply Sealing Compound, Synthetic Rubber, Accelerated, conforming to MIL-S-8561, to the connector backshell and wire bundle where temperatures will not exceed 250°F (121°C).

(e) After the connector has self-leveled for the required time, visually inspect the rear of the connector to ensure a complete seal. If areas are void of sealing compound, add additional sealing compound to entirely seal the back of the connector. The maximum depth of the sealing compound should not exceed 1/8 inch. The connector should be kept in the vertical position for a minimum of 30 minutes as the sealing compound cures to the tack-free condition. After the initial 30-minute curing time, the connector may be moved around as required. Curing of the sealing compound will continue for approximately 24 hours.

(f) If a subsequent repair action requires the replacement of a contact (pin), inject a small amount of sealing compound around the replacement contact to restore the watertight seal. Position the electrical connector in the vertical position for 30 minutes to allow the sealing compound to self-level and cure to a stable condition.

(g) Connectors that are exposed to severe environmental conditions, such as externally mounted connectors and those in wheel wells, bilges, etc., should be taped using an electrical insulating tape. After wrapping the connector and wire bundle with electrical tape, RTV Sealing Compound, conforming to MIL-A-46146, should be brushed over the tape.

(5) Water-Displacement and Treatment. After corrosion removal and cleaning, or any time connectors, plugs, or receptacles are disconnected for maintenance, treat as follows:

(a) Apply Isopropyl Alcohol, TT-I-735, liberally to internal and external sections of male and female connectors using an acid brush. Mate and unmate connectors several times to clean. Thoroughly rinse the connector with Isopropyl Alcohol, TT-I-735. Shake out excess solvent and wipe connector with a clean cloth or cheesecloth. Allow connector to air dry.

(b) Spray a thin coating of Water-Displacing Corrosion Preventive Compound, conforming to MIL-C-81309, Type III, to the internal sections of connectors, plugs, and receptacles. Avoid excessive application or overspray of preservative.

(c) If possible, tilt or rotate connector down and around to drain excess preservative. Wipe off any additional preservative with a clean cloth or cheesecloth.

(d) Prior to connecting the threaded sections of the connector, plug, or receptacle backshell, treat threaded areas with Water-Displacing Corrosion Preventive Compound, conforming to MIL-C-81309, Type III.

(e) Mate connector sections. Wipe off excessive preservative with a clean cloth or cheesecloth.

(f) Apply a film of Water-Displacing Corrosion Preventive Compound, conforming to MIL-C-85054, to exterior surfaces of connector plugs and receptacles.

CAUTION: Corrosion Preventive Compound, MIL-C-85054, cures to a hard, permanent finish. Once cured, it is difficult to remove with Isopropyl Alcohol, TT-I-735, or other approved solvents. Repeated application of MIL-C-85054 should be avoided. For connectors requiring frequent disconnecting and connecting, use Corrosion Preventive Compound, MIL-C-81309, Type III, in lieu of MIL-C-85054.

l. Coaxial Connectors. Coaxial connectors require special steps in order to avoid water intrusion. In most cases, water intrusion in fuel/oil quantity indicator and similar capacitance type indicating system connectors will cause erroneous quantity indications on cockpit instruments. Antenna coaxial connectors can generate similar erroneous signals when water intrusion in those connectors occurs. Coaxial connectors should be inspected, cleaned, and treated in accordance with paragraphs 603k(2), (3), and (5).

m. Wire Harnesses and Cables. When corrosion is found at the pin to wire connection on electrical connectors, plugs, and receptacles, the wire harnesses and cables should be inspected for corrosion, cracking, and other damage to the wire insulation. Wire harnesses and cables should be inspected, cleaned, and treated as follows:

(1) If corrosion is apparent at the back of the connector, it may be necessary to remove an inch or two of the wire harness cable cover to inspect for corrosion.

(2) Visually inspect the rear of the connector at the wire to pin connection for corrosion damage. Inspect the wire harness cover for tears and separations, and wiring and wiring insulation for cracks, corrosion, and burn indications.

(3) Apply Isopropyl Alcohol, TT-I-735, with a typewriter brush or toothbrush. Scrub affected area until contaminants are loosened. Reapply Isopropyl Alcohol, TT-I-735, as required, to flush the area of the contaminants.

(4) Shake excess solvent from the wire harness and wipe dry with a clean cloth or cheesecloth.

(5) Where applicable, repair wire harness and cable covering.

(6) Treat, as required, connecting electrical connectors and plugs in accordance with paragraph 603k.

n. PCBs. Edge connectors (and mating plugs) used in miniature and microminiature PCBs should be cleaned and preserved in accordance with paragraph 603h.

o. Filters. The cleaning of air filters is essential to maintaining the cleanliness and reliability of avionics and test equipment. The frequency of cleaning and method used will normally be specified in the OEM's maintenance instruction manual. The frequency of cleaning may need to be increased if local environmental conditions dictate. Filters may be cleaned as follows:

(1) Place filter in a deep sink and flush thoroughly with fresh water.

(2) Scrub rigid or metal filters with a cleaning brush to remove dirt, grime, and lint.

(3) If oil or grease is present in the filter, clean the filter with a solution of 9 parts fresh water to 1 part Cleaning Compound, conforming to MIL-C-85570, Type II. Scrub rigid or metal filters with a cleaning brush. Rinse thoroughly with fresh water.

(4) Blow off excess water with dry air or dry nitrogen at not more than 10 psi pressure.

(5) Allow filter to air dry.

(6) Do not preserve filters.

p. Sensitive Internal Metal Surfaces. Metal surfaces such as resonant cavities, tube covers, and other delicate metal components should be visually inspected for signs of corrosion. Remove corrosion, clean, and preserve as follows:

(1) Remove dirt and contaminants with a nonabrasive cleaning cloth. Scrub affected area until all contaminants are dislodged.

(2) Remove corrosion and tarnish with a typewriter eraser or a pencil eraser. Care should be taken not to remove the thin plating from the surfaces.

(3) Clean part of residue with Isopropyl Alcohol, TT-I-735. Apply with an acid brush or a typewriter brush.

(4) Remove residue with a clean cloth.

(5) Rinse affected area with Isopropyl Alcohol, TT-I-735, and wipe dry with clean cloth. This step will assist in removing any water.

(6) Air dry or dry with a hot air gun as described in chapter 4, paragraph 406d.

CAUTION: Exercise care when using a hot air gun near plastic materials. Excessive heat may decompose the plastic and change its electrical characteristics.

(7) Preserve where circuit function will not be affected as follows:

(a) Spray a thin coating of Water-Displacing Corrosion Preventive Compound, conforming to MIL-C-81309, Type III, on all metal surfaces. Avoid excessive application or overspray of preservative.

(b) Remove excess preservative by wiping with a clean cloth.

q. Static Discharge Wicks. Corrosion, deterioration, or structural damage to the static discharge wicks can result in poor performance from aircraft radios and communication systems, erratic operation of instruments, and potential electrical shock to personnel. When damaged or corroded static discharge wicks are found, replace as follows:

(1) Remove and discard old static discharge wicks.

(2) Remove corrosion and contaminants from mounting area with a nonabrasive pad, conforming to MIL-C-83957. Scrub affected area until all corrosion and contaminants are loosened.

(3) Clean mounting area with Isopropyl Alcohol, TT-I-735, and an acid brush.

(4) Rinse mounting area with Isopropyl Alcohol, TT-I-735, to flush out remaining residue.

(5) Wipe dry with a clean cloth. Allow area to air dry.

(6) Chemically treat mounting surface as described in chapter 5, paragraph 503.

(7) Install replacement static discharge wicks in accordance with the OEM's maintenance instructions.

(8) Spray a thin coating of Water-Displacing Corrosion Preventive Compound, conforming to MIL-C-85054, on all metal surfaces and attachment points. Avoid excessive application or overspray of preservative.

604. thru 700. RESERVED.

CHAPTER 7. CORROSION CONTROL MEASURES FOR ELECTRICAL BONDING/GROUNDING

701. ELECTRICAL BONDING/GROUND CONNECTIONS.

a. General. Electrical bonding provides a low resistance electrical path between two or more conductive units or components. Grounding is a form of bonding that utilizes the primary structure as a portion (return path) of the electrical circuit. Bonding may serve as one or all of the following functions:

(1) Provide a common ground for the proper electrical functioning of the units involved;

(2) Provide a path to minimize lightning strike damage;

(3) Prevent the buildup of static potentials that could result in a spark discharge;

(4) Minimize static and stray currents in units involved;

(5) Prevent a unit from emitting electromagnetic energy that would interfere with itself or other units (refer to chapter 8); and

(6) Shield equipment from outside electromagnetic interference (EMI) sources.

b. Bimetallic Junctions. The connection of two or more diverse electrical objects often results in a bimetallic junction that is susceptible to galvanic corrosion. This type of corrosion can rapidly destroy a bonding connection through physical corrosion damage and the loss of the low resistance electrical path if suitable precautions are not observed. Reference most current AC 43.13-1 Acceptable Methods, Techniques, and Practices—Aircraft Inspection and Repair. Aluminum alloy jumpers (bonding straps) are used in many bonding situations. Copper, tin-plated copper, and stainless-steel jumpers are most often used to bond together aircraft and components parts made of stainless steel, cadmium-plated steel, aluminum, brass, or other metals. Where contact between dissimilar metals cannot be avoided, the choice of bonding material and associated attach hardware is important. When selecting materials for the bonding installation, the material(s) that is the most prone to corrosion (anode) should be the easiest and least expensive to replace. At bimetallic junctions, where finishes are removed to provide a good electrical connection, a preservative or sealant should be applied to the completed connection to prevent corrosion. This chapter describes and illustrates the procedures for the assembly and preservation of bonding or grounding connections. This includes special emphasis on techniques to minimize galvanic corrosion.

c. Hardware Selection. When repairing or replacing existing bonding or grounding connections, follow the original equipment manufacturer's (OEM) parts and maintenance instructions or use the same kind of bonding material and associated attach hardware as the original installation. The bonding material and associated attach hardware have been selected by the OEM for their mechanical strength, electrical requirements, corrosion resistance, and ease of installation. However, when a bonding or grounding connection installation displays evidence of galvanic corrosion after proper assembly, the installation of a sacrificial washer made of an anoxic material between the dissimilar materials will allow that anoxic washer to corrode. Replacement of the corroded washer is easy and the least expensive way of repairing the bonding or grounding connection. Figures 7-1 through 7-6 and their corresponding tables show proper assembly configurations and list hardware and materials in the order of assembly depending on the particular metal(s) of the structural and bonding or grounding connection. For example, a proper installation for the "aluminum terminal and jumper" configuration in figure 7-1 shows a bolt secured as a mounting stud for a bonding or grounding connection through a flat structural surface.

The structure in this case is an aluminum alloy and the bonding or grounding jumper, as mentioned, is also aluminum. The attaching hardware are cadmium-plated steel bolts or screws, aluminum washers, and cadmium-plated lockwashers and nuts.

702. BONDING/GROUNDING SURFACE PREPARATION.

a. Surface Preparation. Procedures for the preparation of metallic surfaces before mating electrical conductor(s) are as follows:

(1) Remove all dirt, oil, grease, and other contaminants from an area slightly larger than the bonding or grounding connection. The area to be cleaned should be a minimum of 1 1/2 diameters the size of the bonding or grounding connection. Use a clean cloth or cheesecloth dampened with an approved solvent or Dry Cleaning Solvent, P-D-680, Type II.

NOTE: Local air pollution regulations may restrict the use of this solvent. Comply with all local air pollution regulations.

(2) If more vigorous contaminant removal is required, scrub with an acid brush and an approved solvent or Dry Cleaning Solvent, P-D-680, Type II.

(3) Wipe area dry with a clean cloth or cheesecloth.

(4) Remove, as required, paint, anoxic coating or conversion coating film, and any corrosion from the attachment area using an abrasive nylon mat, conforming to MIL-A-9962, Type I. Do not exceed the maximum depth allowed by the OEM maintenance instructions.

(5) Wipe area clean with a clean cloth or cheesecloth dampened with Isopropyl Alcohol, TT-I-735. Allow area to air dry.

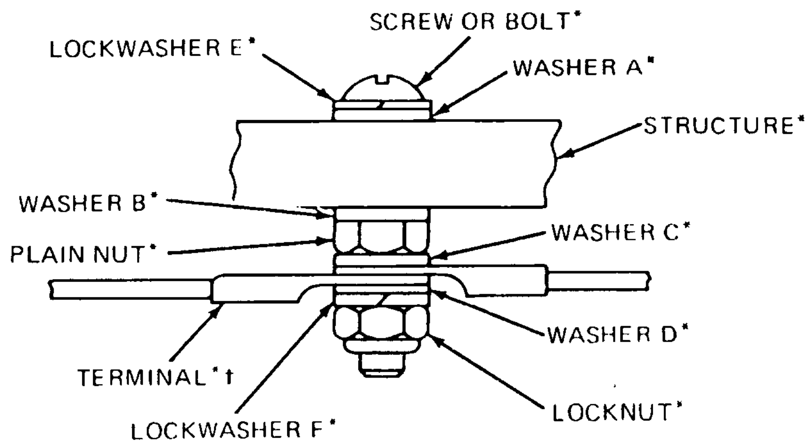
(6) Apply chemical conversion coat to aluminum or magnesium as described in chapter 5, paragraph 503.

(7) Remove all dirt, oil, grease, and other contaminants from the bonding cable terminal with a clean cloth or cheesecloth dampened with Isopropyl Alcohol, TT-I-735.

(8) If more vigorous contaminant removal is required, scrub with an acid brush and Isopropyl Alcohol, TT-I-735.

(9) Assemble bonding or grounding connection(s) and torque in accordance with the OEM's maintenance instructions, or use figures 7-1 through 7-6 as a guide.

(10) Perform an electrical resistance test as described in chapter 6, paragraph 603a (12).



Notes:

* See Table 7-1 for specific materials.

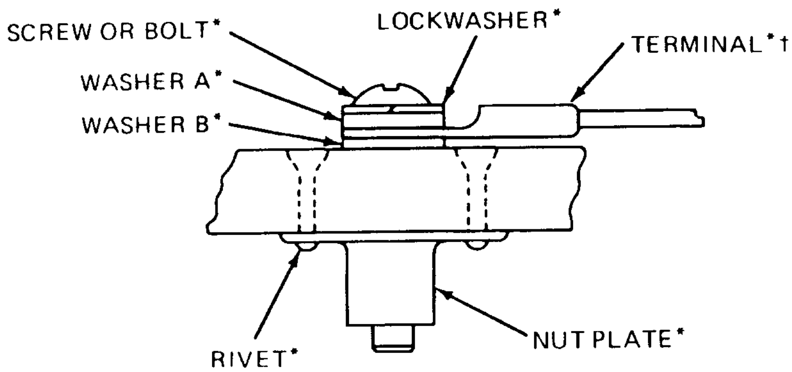
† Limited to a quantity of four (4).

FIGURE 7-1. STUD BONDING OR GROUNDING TO FLAT SURFACE

TABLE 7-1. HARDWARE FOR STUD BONDING OR GROUNDING TO FLAT SURFACE

Structure	Screw or Bolt and Lock nut	Plain Nut	Washer A	Washer B	Washer C	Lockwasher E	Lockwasher F
ALUMINUM TERMINALS AND JUMPER							
Aluminum Alloys	Cadmium-Plated Steel	Cadmium-Plated Steel	Aluminum Alloy	Aluminum Alloy	Cadmium-Plated Steel or Aluminum	Cadmium-Plated Steel	Cadmium-Plated Steel
Magnesium Alloys	Cadmium-Plated Steel	Cadmium-Plated Steel	Magnesium Alloy *	Magnesium Alloy *	Cadmium-Plated Steel or Aluminum	Cadmium-Plated Steel	Cadmium-Plated Steel
Steel, Cadmium-Plated	Cadmium-Plated Steel	Cadmium-Plated Steel	None	None	Cadmium-Plated Steel or Aluminum	Cadmium-Plated Steel	Cadmium-Plated Steel
Steel, Corrosion-Resistant	Corrosion-Resistant Steel	Cadmium-Plated Steel	None	None	Cadmium-Plated Steel or Aluminum	Corrosion-Resistant Steel	Cadmium-Plated Steel
TINNED COPPER TERMINALS AND JUMPER							
Aluminum Alloys	Cadmium-Plated Steel	Cadmium-Plated Steel	Aluminum Alloy	Aluminum Alloy	Cadmium-Plated Steel	Cadmium-Plated Steel	Cadmium-Plated Steel or Aluminum
Magnesium Alloys	**Caution: Do not connect copper to magnesium**						
Steel, Cadmium-Plated	Cadmium-Plated Steel	Cadmium-Plated Steel	None	None	Cadmium-Plated Steel	Cadmium-Plated Steel	Cadmium-Plated Steel
Steel, Corrosion-Resistant	Corrosion-Resistant Steel	Cadmium-Plated Steel	None	None	Cadmium-Plated Steel	Corrosion-Resistant Steel	Corrosion-Resistant Steel

* When not available, use aluminum alloy.



Notes:

* See Table 7-2 for specific materials.

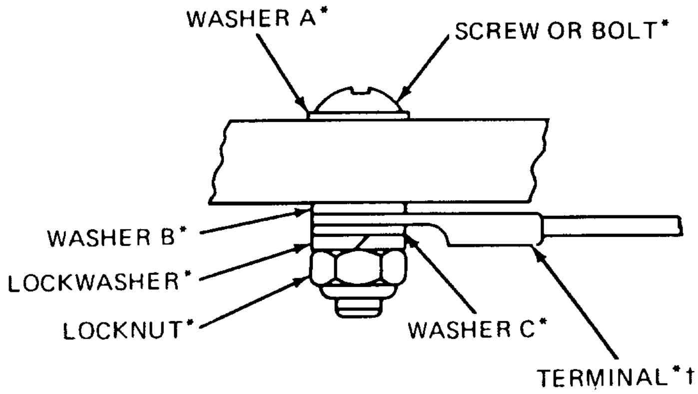
† Limited to a quantity of four (4).

FIGURE 7-2. NUT PLATE BONDING OR GROUNDING TO FLAT SURFACE

TABLE 7-2. HARDWARE FOR NUT PLATE BONDING OR GROUNDING TO FLAT SURFACE

Structure	Screw or Bolt and Nut plate	Rivet	Lockwasher	Washer A	Washer B
ALUMINUM TERMINALS AND JUMPER					
Aluminum Alloys	Cadmium-Plated Steel	Aluminum Alloy	Cadmium-Plated Steel	Cadmium-Plated Steel	Aluminum Alloy
Magnesium Alloys	Cadmium-Plated Steel	Aluminum Alloy	Cadmium-Plated Steel	Cadmium-Plated Steel	Magnesium * Alloy
Steel, Cadmium-Plated	Cadmium-Plated Steel	Corrosion-Resistant Steel	Cadmium-Plated Steel	Cadmium-Plated Steel	Aluminum Alloy
Steel, Corrosion-Resistant	Corrosion-Resistant Steel	Corrosion-Resistant Steel	Cadmium-Plated Steel	Cadmium-Plated Steel or Aluminum Alloy	Cadmium-Plated Steel
TINNED COPPER TERMINALS AND JUMPER					
Aluminum Alloys	Cadmium-Plated Steel	Aluminum Alloy	Cadmium-Plated Steel	Cadmium-Plated Steel	Aluminum Alloy
Magnesium Alloys	**Caution: Do not connect copper to magnesium**				
Steel, Cadmium-Plated	Cadmium-Plated Steel	Corrosion-Resistant Steel	Cadmium-Plated Steel	Cadmium-Plated Steel	Cadmium-Plated Steel
Steel, Corrosion-Resistant	Corrosion-Resistant Steel	Corrosion-Resistant Steel	Cadmium-Plated Steel	Cadmium-Plated Steel	Corrosion-Plated Steel or Corrosion-Resistant Steel

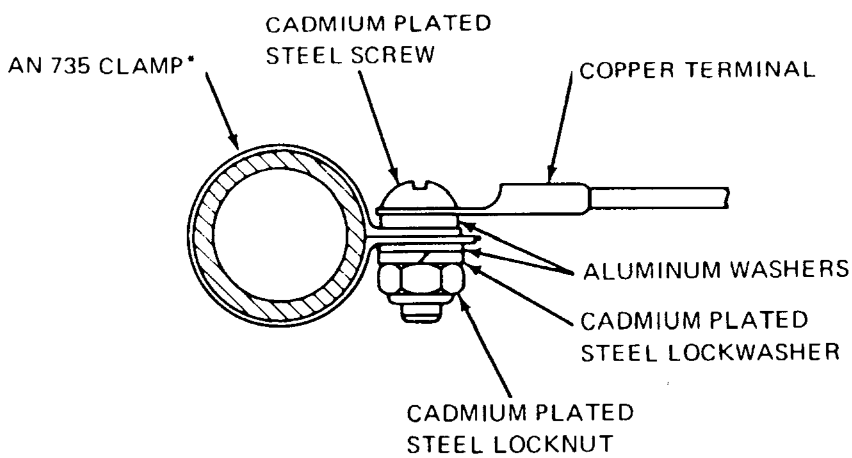
* When not available, use aluminum alloy.



Notes:

* See Table 7-3 for specific materials.
† Limited to a quantity of four (4).

FIGURE 7-3. BOLT AND NUT BONDING OR GROUNDING



Notes:

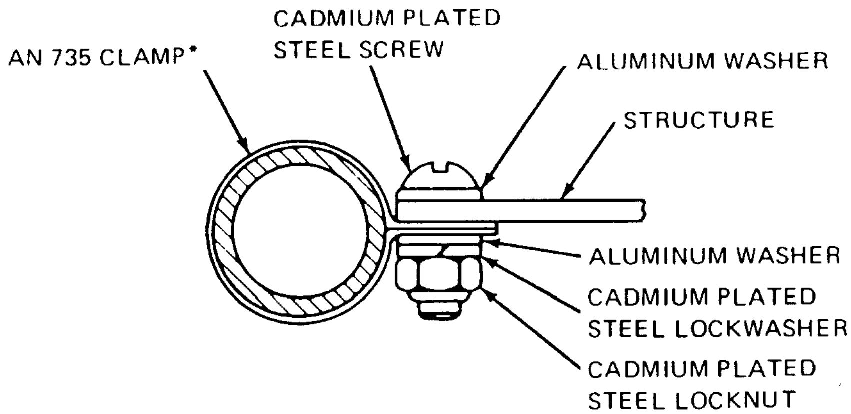
* Inside surface of clamp (conduit) is cylindrical.

FIGURE 7-4. COPPER JUMPER CONNECTOR TO TUBULAR STRUCTURE

TABLE 7-3. HARDWARE FOR BOLT-AND-NUT BONDING OR GROUNDING TO FLAT SURFACE

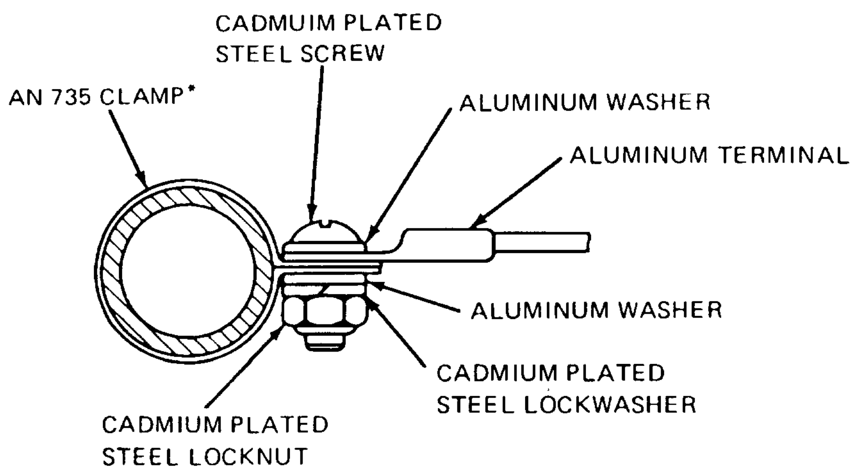
Structure	Screw or Bolt and Nut plate	Rivet	Lockwasher	Washer A	Washer B
		ALUMINUM TERMINALS AND JUMPER			
Aluminum Alloys	Cadmium-Plated Steel	Cadmium-Plated Steel	Cadmium-Plated Steel or Aluminum Alloy	None	Cadmium-Plated Steel or Aluminum Alloy
Magnesium Alloys	Cadmium-Plated Steel	Chromium-Plated Steel	Magnesium Alloys	Magnesium * Alloys	Cadmium-Plated Steel or Aluminum Alloy
Steel, Cadmium-Plated	Cadmium-Plated Steel	Cadmium-Plated Steel	Cadmium-Plated Steel	Cadmium-Plated Steel	Cadmium-Plated Steel *
Steel, Corrosion-Resistant	Corrosion-Resistant Steel	Corrosion-Resistant Steel	Cadmium-Plated Steel	Cadmium-Plated Steel	Cadmium-Plated Steel
		TINNED COPPER TERMINALS AND JUMPER			
Aluminum Alloys	Cadmium-Plated Steel	Cadmium-Plated Steel	Cadmium-Plated Steel	Aluminum Alloy	Cadmium-Plated Steel
Magnesium Alloys	**Caution: Do not connect copper to magnesium**				
Steel, Cadmium-Plated	Cadmium-Plated Steel	Cadmium-Plated Steel	Cadmium-Plated Steel	Cadmium-Plated Steel	Cadmium-Plated Steel
Steel, Corrosion-Resistant	Corrosion-Resistant Steel or Cadmium-Plated Steel	Cadmium-Plated Steel	Cadmium-Plated Steel	Cadmium-Plated Steel	Cadmium-Plated Steel or Corrosion-Resistant Steel

* When not available, use aluminum alloy.



Note: Aluminum alloy or corrosion-resistant steel conduit (inside surface).

FIGURE 7-5. BONDING CONDUIT TO STRUCTURE



Note: Inside surface of clamp (conduit) is cylindrical.

FIGURE 7-6. ALUMINUM JUMPER CONNECTOR TO TUBULAR STRUCTURE

b. Preservation. Preservation provides a nonconductive film to protect the bonding or grounding connection from corrosion by excluding moisture. Three preservation methods are discussed. Refer to chapter 4, paragraph 407 and table 4-4 for more information.

(1) This application is intended for bonding or grounding connections that require protection for up to a year when the connection is covered and protected from the outside environment. Apply a thin film of Water-Displacing Corrosion Preventive Compound to the bonding or grounding connection, conforming to MIL-C-85054.

(2) This application is intended for bonding or grounding connections that may require fairly frequent disassembly. Apply a thin film of Water-Displacing Corrosion Preventive Compound to the bonding or grounding connection, conforming to MIL-C8-1309, Type III, followed by a coating of Corrosion Preventive Compound, conforming to MIL-C-16173, grade 4.

(3) This application is intended for bonding or grounding connections that seldom require disassembly. Using a spatula and Sealing Compound Type II, fully encapsulate the bonding or grounding connection, conforming to MIL-S-81733.

c. Electronic Equipment Shock Mount Bonding and Preservation. This type of electrical bonding uses a bonding wire (jumper assembly) or strips of aluminum or copper. The following corrosion prevention method applies:

(1) Clean base of shock mount and bonding wire (jumper assembly) or strips of aluminum or copper by wiping with a clean cloth or cheesecloth dampened with Isopropyl Alcohol, TT-I-735. Allow components to air dry.

(2) After assembly of the shock mount and bonding wire (jumper assembly) or strips of aluminum or copper, apply a thin film of Water-Displacing Corrosion Preventive Compound over the shock mount and jumper assembly attach area, conforming to MIL-C-81309, Type II. For protection of up to a year and for shock mount and bonding wire assemblies that do not require frequent disassembly, apply an additional coat of Water-Displacing Corrosion Preventive Compound over the shock mount and jumper assembly attach area, conforming to MIL-C-85054.

703. thru 800. RESERVED.

CHAPTER 8. EFFECT AND TREATMENT OF CORROSION ON ELECTROMAGNETIC INTERFERENCE SHIELDING DEVICES

801. DEFINITION/DESCRIPTION OF EMI.

a. Electromagnetic Interference (EMI) is the presence of undesirable voltages or currents which appear in a circuit as a result of the operation of another electrical source. EMI includes effects from lightning, external radiated radio frequency (RF) fields, or conducted and radiated electromagnetic interference between systems in the aircraft. In this section, the term EMI will include all of these effects. Some examples of EMI-related aircraft system malfunctions are microprocessor bit errors, computer memory loss, audio tones on communication systems, and false indications (i.e., alarms, lights, readouts, or power loss). The results of such malfunctions can severely impact system or subsystem operation. EMI may be radiated or conducted. Typical sources of radiated emissions are radio and radar transmitters, power supplies, generators, and transformers. The way in which external EMI intrudes into a circuit is called the coupling mode. Radiated EMI propagates through the air from the source to the victim circuit. An antenna, or a cable which acts as an antenna, couples the EMI to the victim circuit. Conducted EMI is coupled from the source to the victim circuit between common connections, either wiring or metallic structure.

b. Due to the increase in electronic systems installed in modern aircraft, the importance of many of these systems for flight safety, and the decrease in power levels required to upset them, EMI, lightning, and high intensity radiated field (HIRF) protection has become an essential part of aircraft design. The use of electrical and electronic systems for full-authority aircraft flight and engine controls has been a significant factor in increasing the importance of aircraft EMI protection. The aircraft system EMI protection will involve the structure around the system, wire routing, shields over the wires, shield terminations, filters inside and outside the equipment, circuit and equipment grounding, and circuit design. Most of these protection features rely upon low-resistance and low-impedance electrical bonds for wires, shields and structure, which often include dissimilar metals. For this reason, an understanding of the purpose of these devices, where they may be located, and corrosion-control processes are necessary knowledge for the aircraft maintainer.

802. EMI STANDARDS, TEST REQUIREMENTS, AND DOCUMENTS. Electronic components are designed to various specifications, depending on their application and the electromagnetic environments in which they are expected to operate. Most specifications include susceptibility requirements, the level of EMI in which the device is expected to operate successfully, and emission requirements, the limits of EMI that the device may generate. Aircraft and systems manufacturers may have their own EMI standards and requirements, but they are based on the following:

a. RTCA DO-160, Environmental Conditions and Test Procedures for Airborne Equipment.

b. AC 20-136, Protection of Aircraft Electrical/Electronic Systems Against the Indirect Effects of Lightning.

c. AC 20-53A, Protection of Airplane Fuel Systems Against Fuel Vapor Ignition Due to Lightning.

d. DOT/FAA/CT-83/3, User's Manual for AC 20-53A, Protection of Airplane Fuel Systems Against Fuel Vapor Ignition Due to Lightning.

e. FAA Notice 8110.71, Guidance for the Certification of Aircraft Operating in High Intensity Radiated Field (HIRF) Environments.

f. MIL-B-5087, Bonding, Electrical and Lightning Protection for Aerospace Systems.

g. MIL-HDBK-235, Electromagnetic Environment Considerations for Design and Procurement of Electrical and Electronic Equipment.

h. DOT/FAA/CT-86/40, Aircraft Electromagnetic Compatibility.

803. AIRCRAFT SYSTEM EMI PROTECTION REQUIREMENTS. Although electronic and electrical equipment are usually tested individually for lightning, HIRF, radiated and conducted EMI, and EMI susceptibility and emissions, aircraft manufacturers should still ensure that the integrated electronic systems on the aircraft will operate successfully in the electromagnetic environment to which the aircraft will be exposed. Figure 8-1 and the following paragraphs describe some of the aircraft-specific EMI issues that should be addressed.

a. Intrasystem EMI Requirements. Intrasystem EMI refers to electrical or electronic subsystems within an aircraft interfering with one another. Even subsystems designed to similar emission and susceptibility requirements may have EMI problems when integrated in an aircraft. This may be due to the location of the equipment on the aircraft, frequencies involved, cable routing, or bonding and grounding techniques. All of these factors should be addressed by the aircraft manufacturer in order to ensure a compatible design. In a worst case situation, when intrasystem EMI cannot be avoided, operation of one system may not be possible while another is operating. Changes to electronic systems or installation of new systems can impact intrasystem electromagnetic compatibility (EMC) as well.

b. Intersystem EMI Requirements. Intersystem EMI refers to electrical or electronic systems external to the aircraft interfering with aircraft systems. These external systems emit various frequencies and power levels which are not always easily predictable. Protection from intersystem EMI can include various types of shielding for aircraft openings and wiring.

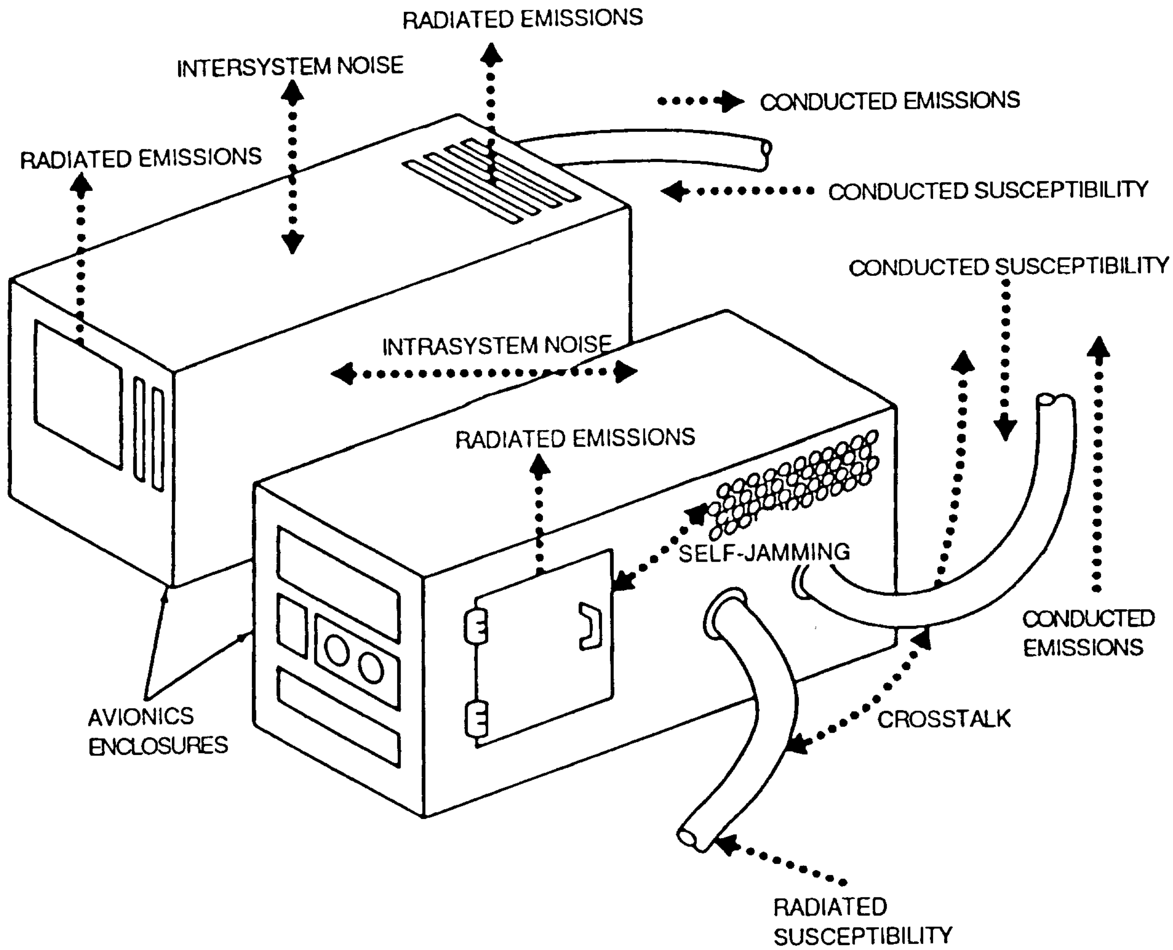


FIGURE 8-1. TYPES OF ELECTROMAGNETIC INTERFERENCE

c. Lightning.

(1) Effects of Lightning Strikes. The effects of lightning strikes on aircraft may be classified as either direct or indirect. The direct effects are largely structural. They are the burning, eroding, blasting, and structural deformation caused by lightning arc attachment, high pressure shock waves, and magnetic forces produced by the associated high currents. Indirect effects predominantly result from the interaction of lightning fields and currents with electrical equipment or wiring. Fuel ignition may result from either direct arc ignition, or indirect effects creating arcs or sparks. For the purpose of studying lightning effects, aircraft are typically divided into three major lightning attachment zones: direct attachment, swept stroke, and conducted currents or transfer. Testing with simulated high voltage strikes on aircraft scale models using various aspect angles can provide confidence in zone assignment. Zone 1 (direct attachment) includes areas where lightning current enters or exits the aircraft. Zone 2 (swept stroke) includes areas directly behind the direct attach points where the established ionized lightning channel is swept back over the aircraft surface as it flies through or away from the channel. Zone 3 (current transfer) includes areas where there is a low probability of direct attachment and which provide a path for current flow through or across the aircraft from entry to exit points.

(2) Design Goals. One goal of designing for lightning protection is to provide large conductive areas of structure where high concentrations of current may dissipate rapidly. Small metallic parts, such as control surface actuators, or thin structural members separated from larger metallic areas may be vulnerable to damage. Protrusions such as antennas, probes, and light assembly projections are particularly vulnerable to lightning strike attachment. Discontinuities or nonconductive areas may provide points of entry to the interior of the aircraft. It is important to keep the high current out of sensitive electronics, flammable areas such as fuel tanks, controls, and away from personnel. Nonmetallic materials used in aircraft, such as Kevlar, fiberglass, graphite epoxy, Plexiglas, etc., are of particular concern because they do not conduct lightning current-like metallic materials. Direct effects of lightning may include puncture or burning of these materials. In addition, the high current will seek another, more conductive path. Adjacent wiring or electronics subjected to this high current may be damaged or vaporized. Some methods of protecting aircraft from the effects of lightning include providing filters or transient suppression for critical circuits; installing diverters to provide a path for current in areas where nonmetallic materials are used; and bonding of access doors, panels, light fixtures, antennas, probes, landing gear, fuel dumps and fuel vent lines, and electronic components (bonding should be low resistance with high current carrying capability for short duration).

d. High Intensity Radiated Fields (HIRF). Ground-based, shipboard and airborne RF transmitters may create high fields where aircraft operate. The intense fields created by high power transmitters, including some radars, radio transmitters, and satellite communication links, are used to define the HIRF environment. These intense RF fields can cause circuit upset and damage in unprotected aircraft systems. Aircraft electrical and electronic systems that perform flight-critical functions are protected against the effects of HIRF. Aircraft structure shielding, wire shielding, and equipment circuit design are all used to provide the required HIRF protection.

e. Precipitation Static. Precipitation static, or P-static, is the triboelectric charging of the aircraft due to flight through dust, ice, rain, sleet, hail, or snow. When precipitation or dust particles contact the metallic or dielectric surfaces, charge separation occurs. This electric charge can cause radio interference through corona discharge from trailing surfaces, and streaming from dielectric surfaces or from impact charging itself. Discharges can occur between metallic parts that are not electrically bonded together. In addition to bonding, P-static discharges are often installed on trailing edges and tail surfaces. Static discharges decouple corona discharge currents from antenna fields and permit noiseless discharge to occur. Static discharges should have a low resistance bond to the airframe and a high resistance (between 6 and 200 mega-ohms, depending on placement) from tip to base.

804. TYPES OF EMI PROTECTION.

a. Structure Shielding. Structure shielding is a method of protecting susceptible circuits inside the aircraft from lightning, HIRF, and EMI. Metal structures provide a low-impedance path for currents generated by EMI, so that these currents will be minimized on systems and wiring. In addition, enclosed structures, such as the fuselage, provide some shielding for radiated fields. The principle of shielding is derived from the fact that the total charge completely enclosed by a conductive surface will be zero, regardless of electromagnetic fields external to the surface. The completely closed conductive surface is often called a Faraday cage, named after Michael Faraday, the English physicist and chemist who provided experimental data proving the concept. Of course, no aircraft can be a perfect Faraday cage since there must be openings, doors, windows, vents, etc. The goal of the structure shielding is to seal the cracks or holes in the fuselage to make it as close to a Faraday cage as possible with respect to external EMI that may disrupt internal circuits of the aircraft. It is becoming more common to see aircraft structure shielding in new aircraft designs. This is due to several factors, including the increased sensitivity and number of electronic components within the aircraft and aircraft designs that incorporate composite materials in the structure. These lead to greater susceptibility to EMI, especially lightning and

HIRF (radar, radio transmitters, etc). Composites are not as conductive as metal and do not provide the same level of shielding, particularly for lightning. The requirement for structure shielding is dependent upon the external electromagnetic environment and the level of protection designed into the wiring and electronic equipment. If structure shielding is required in the aircraft design, it should consider the effects of seams and joints, such as around avionics bays and between the structure and quick access or removable doors, louvers and vents. Gaskets and spring fingers may be avoided during aircraft design because of the maintenance required for these features. The following provides identification of some common types of shielding:

(1) Gaskets. Conductive gaskets may be used to seal access doors and removable panels from EMI intrusion. They should be electrically conductive, fit snugly between the two surfaces of the joint, and make good electrical contact between the mating conductive surfaces. Gaskets should be used very selectively, because of the likelihood of corrosion of the conductive gasket material or the mating metal surfaces. Some commonly used EMI gaskets are: elastomers filled with silver or nickel plated aluminum particles; neoprene; silicone rubber bulb seals filled with stainless steel particles and wrapped with stainless steel or Inconel wire mesh; and beryllium copper spiral gaskets. An example is shown in figure 8-2. Gaskets are used most often where frequent access is not required, since repeated compression and decompression of the gasket may result in permanent deformation.

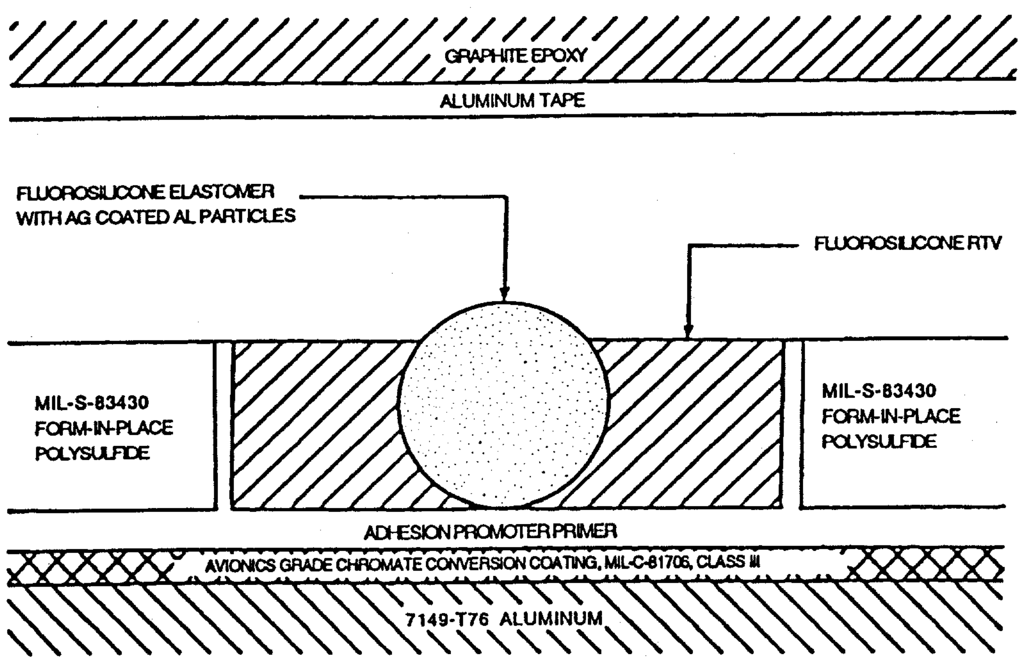


FIGURE 8-2. TYPICAL METAL PARTICLE FILLED ELASTOMER GASKET INSTALLATION

(2) Imbedded Metal Strips. Aircraft panels made of composite materials may require an occurred metallic plate which makes electrical contact with the embedded conductive composite of the door. Another method uses a bonded foil strip or metallic tape to form a capacitance couple with the conductive composite fibers. Corrosion between the imbedded metal and graphite composites is a particular concern if this technique is used.

(3) Contact Strips and Spring Fingers. Beryllium copper contact strips and spring fingers are used to seal joints between doors and structure in areas where frequent access is required. Refer to figure 8-3. The strips have evenly-spaced fingers which are mechanically and electrically fastened (metal to metal or capacitance coupled) to the door or structure and pressed against the mating structure or door (metal to metal contact) to provide electrical conductivity across the joint. As with gaskets, contact strips used in joints between composite materials may require a concurred metal plate, or conductive foil or tape, for contact with the embedded conductive fibers of the composite material. Again, corrosion between the imbedded metal, spring fingers, and graphite composites is a particular concern if this technique is used.

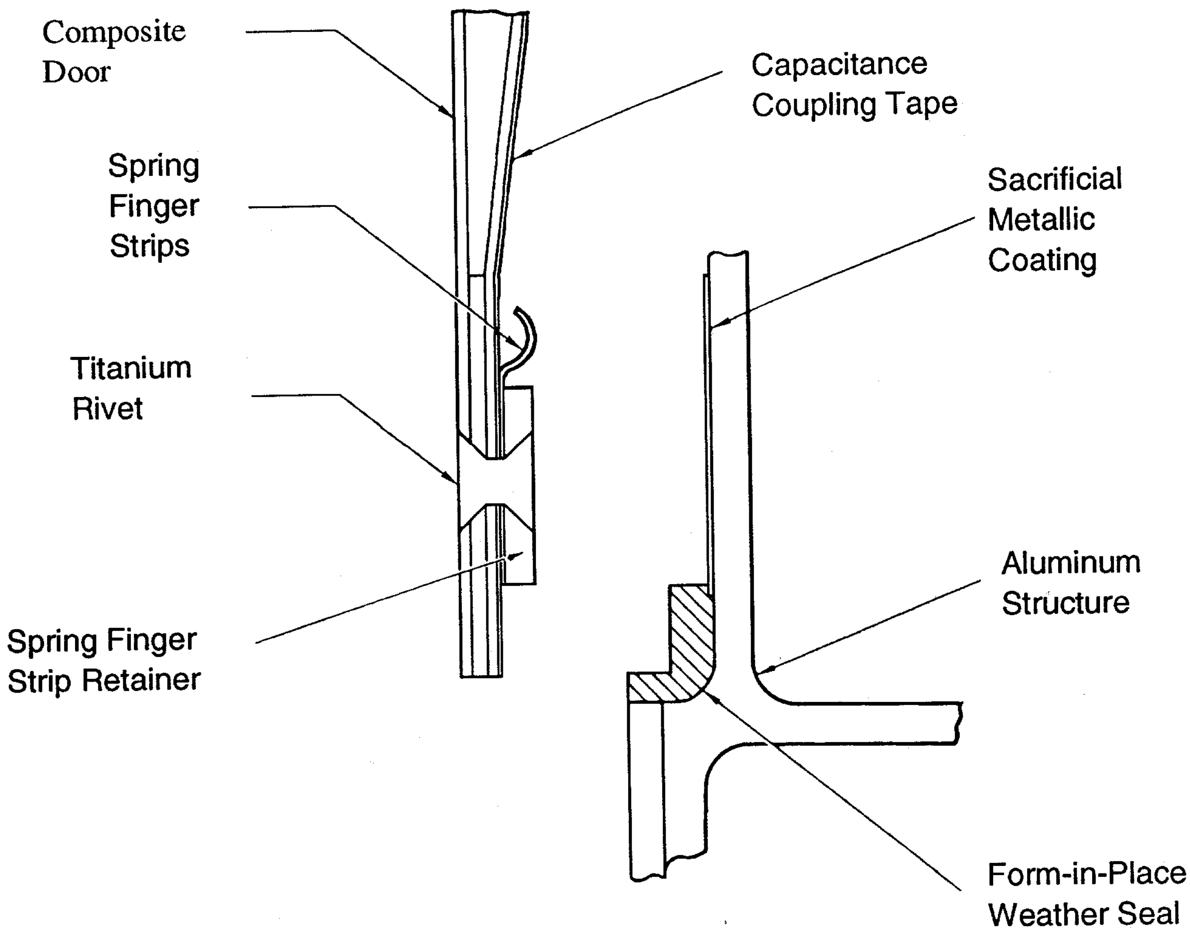


FIGURE 8-3. EMI SPRING FINGER INSTALLATION ON A DOOR

(4) Screens. Screens which cover vents and louvers may be designed to prevent EMI intrusion. The screen mesh should be the correct size to prevent wavelengths of expected EMI from passing through. The screen should also be electrically bonded to the aircraft structure around the entire periphery of the screen.

b. Bonding. Bonding is the process of establishing a low-impedance (good electrical contact) path between two metal surfaces. The purpose of the bond is to allow radio frequency or lightning current to flow between metallic components, preventing a potential difference or voltage which may result in EMI.

(1) Structural bonding of all parts of the aircraft structure is essential for controlling the conducting path currents associated with lightning, HIRF and EMP. In addition, structural bonding is important to eliminating static charge buildup, which can couple into communication systems. Discontinuities in the aircraft skin (skin joints, access doors, etc.) can create a high-impedance boundary (poor electrical contact) across the joint. Therefore, all discontinuities in the aircraft structure should be designed to provide electrical bonding. Since a low-impedance path is the goal of a bond, the best bond is direct metal to metal contact covering a relatively large surface area and as close as possible to the two surfaces to be bonded. For hinged areas, such as leading or trailing edge flaps, a conductive flexible strap or cable is the best bond that can be provided. The bond areas should be clean and unpainted, and the strap should be as short as possible to keep its impedance low.

(2) Bonding of the outer cases of avionics equipment to the aircraft structure is required to ensure maximum operational stability of the equipment and correct functioning of EMI-reducing circuit components, such as filters and shielding. As with the bonding of structural components, the best bond incorporates metal to metal contact covering a relatively large surface area as close to the two surfaces as possible. Beryllium copper pressure-wiper fingers with relatively large surface areas are often used between the equipment and aircraft structure. Figure 8-4 shows a typical metal to metal contact using beryllium copper pressure-wiper fingers. Flexible conductive straps between avionics equipment and structure may also be used, but the impedance of the bond will be higher.

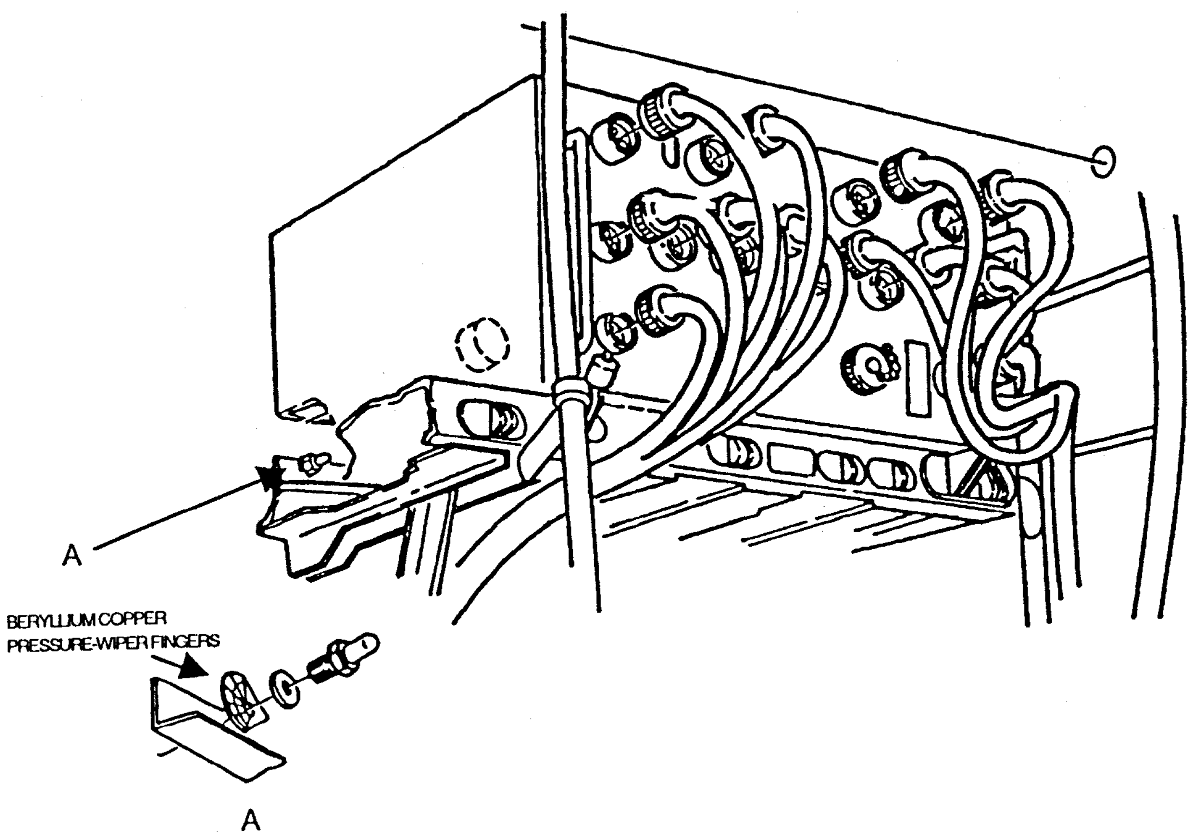


FIGURE 8-4. BONDING USING BERYLLIUM COPPER PRESSURE-WIPER FINGERS

(3) Aircraft external lighting, antennas, probes, fuel vents, and fuel cells are susceptible to lightning, and should be bonded to the aircraft structure. Internal circuitry for any of these may require special isolation or high current carrying design requirements.

c. Electrical Circuits, Avionics Design, and Aircraft Wiring. Most EMI protection is associated specifically with electrical circuits in avionics equipment and the associated aircraft wiring.

(1) The design of aircraft wire routing attempts to avoid both intersystem and intrasystem EMI problems. However, in some cases, physically separating susceptible wiring from other wiring to protect against intrasystem EMI cannot be accomplished. In addition, some wiring in wheel wells, engine bays, cockpit areas, and other open areas may be exposed to lightning, HIRF, or intersystem EMI. In these cases, the use of metal overbraid over the electrical wiring or wire bundle may be the only method to protect the susceptible wiring. Materials for metal overbraid vary. Corrosion is a serious problem for overbraid made of ferrous material, particularly in high moisture areas such as wheel wells. Overbraid of tin-coated copper or Inconel is more commonly used in these areas. Cable overbraid shielding is only effective if the entire cable is completely shielded and both ends have low-impedance terminations. Splice areas and the area where the overbraid terminates at the connector are the most likely to degrade since these areas frequently require maintenance. Most aircraft wire shields are terminated using pigtails, which may be attached to ground studs or to connector backshells. Another method, illustrated in figure 8-5, which ensures complete shielding uses a tightly knitted wire mesh conductive tape which overlaps the overbraid and contacts the connector all the way around the connector circumference. The wire mesh tape is soldered to the overbraid where it overlaps. When wiring must be repaired at the connector, the knitted wire mesh tape can be replaced easily. The connector itself can also be a problem if it incorporates an impedance discontinuity with the wire mesh tape. Connectors used to terminate shields should have good electrical contact between the shield-terminating backshell, the main connector plug, and the mating receptacle. Connectors specifically designed to ensure EMI protection may incorporate conductive contacts between the backshell, main shell, and receptacle around their entire circumference. An EMI connector made of a composite material is available and has the advantages of being lightweight and noncorrosive, however the conductive plating material is still subject to corrosion.

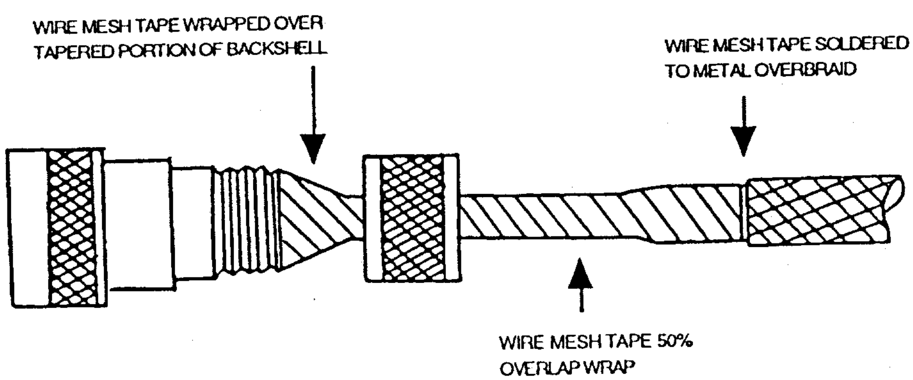


FIGURE 8-5. CABLE OVERBRAID AND KNITTED WIRE MESH TAPE

(2) Grounds. A ground is a common reference for potential in circuit design. In aircraft, the ground for circuits is usually the aircraft structure. Grounding studs are installed in the aircraft near each subsystem to connect ground wires. Similar functions may be grounded on the same grounding stud. Ideally, the ground reference has zero impedance, is at zero potential, and conducts zero current. Since no ground plane is ideal, some potential always exists between ground points, with the possibility of undesirable ground currents coupling into and disturbing the circuits. A good aircraft design minimizes ground currents by keeping ground wires as short as possible, balancing circuits, using twisted signal and return wires to cancel unwanted signals, using coaxial or biaxial lines for RF circuits, and employing a number of other techniques. A ground reference also serves to prevent shock hazard and static charge buildup. Good circuit design relies upon dedicated signal and power return wires, so that the aircraft structure is not used for the return circuit, particularly for highly critical or sensitive systems.

(3) Filtering. Inputs and outputs from avionics equipment usually require filters. These filters may provide EMI noise, lightning transient, and HIRF suppression. This is best accomplished with filters at the connector internal to the equipment. The purpose of a filter is to exclude unwanted frequencies while allowing transmission of the desired signal frequencies. Capacitance or resistor/capacitor filters are often adequate for high-impedance circuits, while inductive filters are needed for low-impedance circuits. In some cases, filters may be grouped on a ground plane behind the interface connector and enclosed in a shielded area. Also, in some cases, filter pin connectors can be used, providing significant weight savings and filtering.

(4) Avionics Enclosures. The avionics enclosures may be designed to minimize conducted and radiated EMI from entering the avionics, and to minimize EMI emissions from the avionics. Conductive gaskets may by used in the avionics enclosures, particularly between the enclosure and the connector receptacle installed on the enclosure. In addition, conductive gaskets may be used between access panels on the avionics enclosure, or between ventilation hole screens and the enclosure. The enclosures may also be designed to segregate the filters for input and output wiring from circuit boards and sensitive electronics within the avionics. The enclosures should also provide a means for bonding the enclosure to the avionics rack or structure. This should not be provided by the power or signal returns.

805. EMI PROTECTION MAINTENANCE.

a. Common Failure Modes. Common failure modes for EMI protection features include breakage, deformation, and corrosion.

(1) Breakage. Aluminum foil and mesh used on composite structure panel may be torn or cut. Bonding straps, particularly attached to moveable surfaces, may break from flexing or aerodynamic forces. Shield-terminating pigtails may be broken during connector mating/dismating. Spring finger contact strips, which are typically 0.005 inch thick, seal joints between panels and structure and are easily broken when panels are removed or during equipment removal and installation. Beryllium copper spiral gaskets, which seal joints between panels and structures, and beryllium copper pressure-wiper fingers, which bond electronic equipment to aircraft structures, are also easily broken if too much pressure is applied to them. Light weight screens and the stainless steel and Inconel mesh around bulb seal gaskets are easily torn if care is not taken with them. Fortunately, most vent screens are heavy stainless steel and not easily damaged.

(2) Deformation. Connector receptacles attached to structure and brackets may be deformed, or the brackets deformed, if the mounting screws are over-tightened, or if the bracket is not thick enough. Beryllium copper spring fingers can also be bent or deformed such that they do not contact the structure with enough pressure to seal the joint against EMI. This can also be true for bulb seals and conductive elastomer gaskets if they are pressed past the point where they can spring back (compression set).

(3) Corrosion. Corrosion is one of the most common problems associated with EMI protection for two reasons: finishes over metal are often removed during bonding preparation to ensure good electrical conductivity, and many conductive materials used for EMI protection system are dissimilar to the aircraft structure. The two types of corrosion which can occur are electrolytic and galvanic. Chapter 2 provides a discussion on these types of corrosion. Electrolytic corrosion occurs when a net DC current is applied between metals in the presence of a conducting fluid (electrolyte). The rate of corrosion depends upon the amount of current and the nature of the electrolyte. Galvanic corrosion occurs when a potential difference exists between two dissimilar metals in the presence of an electrolyte causing a current to flow. The current is made up of electrons sacrificed from one of the metals. The rate of corrosion depends on the electrochemical potential between the two metals and the conditions under which contact is made. Most corrosion associated with EMI protection is galvanic since dissimilar metals are used. Chapter 2, Table 2.3 lists materials with respect to galvanic corrosion potential. The closer together the materials are on the list, the less potential difference can develop between them when they are placed together with an electrolyte. Consequently, corrosion will occur slowly. Materials at the extremes of the list will develop a high potential difference when placed together. The materials at the top of the list will be the ones to sacrifice electrons and will exhibit corrosion. Unfortunately, aluminum, which is used most often in aircraft structure, is higher on the list than materials used in EMI protection devices. Consequently, it is important to inspect areas where EMI protection is installed to ensure structural components are not corroding. In some cases, to protect the aluminum aircraft structure from corrosion, a sacrificial material such as tin/zinc is applied to the structural side of the EMI joint. The EMI gasket or spring fingers contacting this material make the required metal-to-metal contact for EMI protection and at the same time protection is provided to the aluminum structure. Consequently, corrosion at the EMI joint will be slower and the sacrificial material can be replaced before corrosion attacks the aircraft structure. Because an electrolyte is required for corrosion to occur, environmental seals are often used in conjunction with EMI protection to prevent moisture from contacting the metal-to-metal EMI joint. Conductive coatings on aluminum, such alodine coatings, should be used, instead of nonconductive anodize coating.

b. Inspection Procedures. Inspection procedures for EMI protection devices and associated corrosion include visual inspections and EMI testing.

(1) Visual Inspections. The condition of avionics enclosures, bonding straps, shields, shield terminations, structural joints, gaskets, spring fingers, and conductive coatings on composites may be assessed during visual inspections. Wherever EMI protection is installed, it is imperative that periodic visual corrosion inspections be performed. Where sacrificial coatings are used, inspection and re-application will be necessary on a periodic basis as well. It may be necessary to remove some EMI protection to inspect aircraft structure for corrosion if there is a history of it or if the aircraft has been exposed to salt spray. Electronic equipment bonding pressure-wiper fingers and bonding straps should be visually inspected when the equipment is removed and replaced. Broken or damaged bonding devices should be replaced. Metal overbraid on wiring in external areas such as wheel wells should be periodically inspected for corrosion. The limits for corrosion on EMI protection features is very dependent on the aircraft and system design, and should be specified in the aircraft and component maintenance manuals.

(2) EMI Testing. Some EMI protection failures cannot be detected through visual inspection. An example is wire overbraid which is covered with an opaque jacket. Shield corrosion under the jacket cannot be detected visually. Compression set may occur in conductive elastomer gaskets, on avionics enclosures, where the gasket has been deformed to the point that it no longer seals against EMI. Structural bonding for P-static and lightning protection cannot be visually inspected without major aircraft disassembly. High-impedance bonds between electronic equipment and aircraft structure also cannot be visually detected. Circuit components such as filters should be tested to ensure correct operation. Electromagnetic vulnerability testing, in which the aircraft is radiated with EMI and aircraft electronic systems are monitored for failures, is costly and unlikely to be conducted unless major problems are suspected. Even simpler EMI testing requires some specialized equipment. Consequently, unless in-flight EMI problems are reported, testing will probably not be conducted. The following describes some types of testing which may be conducted.

(a) DC Resistance Test. Bonding of electronic equipment to aircraft structure is commonly verified by measuring the DC resistance between the equipment case and the aircraft structure with a low resistance ohmmeter. In order to make an accurate measurement paint must be removed from the equipment case structure where the measurement is taken. These areas must then be refinished. DC resistance is not an accurate indication of how well the bond performs at AC frequencies. Rather than measuring DC resistance to verify a bond, it is recommended that the bond be cleaned of contaminants or corrosion, which may cause high resistance on a regular basis.

(b) Shield Continuity Tests. DC resistance measurements may be used to measure the resistance and continuity of wire shields and shield terminations. Again, in order to make an accurate measurement, the insulation or finishes over the shields and terminations must be pierced or removed. DC resistance measurements may not effectively detect high resistance shields or terminations if there are multiple conductive paths for the shield. This is particularly true for shielded wire bundles with multiple branches and connectors.

(c) Interfering Signal Analysis. For EMI emissions, many times the most effective means of determining the source of the emissions is by using a spectrum analyzer and appropriate probes. The spectrum analyzer is used to measure the frequency and amplitude of the interference. Clamp-on current probes may be used to detect conducted emissions on wires and wire bundles. Small receiving antennas may also be used to detect radiated emissions. The spectrum analyzer may also be connected to the antenna port at the susceptible RF receiver rack connector to measure the level and frequency of the interfering signal. Training is required to properly set up and monitor the spectrum analyzer, and pick out the EMI interference from normal internal and external electromagnetic fields.

(d) P-Static Test. Structural bonding degradation is usually suspected when there is static in communication systems. A P-static test can be conducted to determine where the degradation has occurred. This test deposits a simulated P-static charge on the aircraft using a hand-held ion discharge wand. As the wand is moved slowly across the structure, a receiver detects the noise associated with degraded bonds. Once the area of the bond degradation is located and isolated by visual inspection, a reason for the problem should be determined. The P-static test is a high voltage test which requires special training to ensure aircraft and personnel safety.

(e) Transient Anomalies. Electronic equipment EMI protection circuit component failures usually cannot be isolated on the aircraft and may be transparent to equipment operation if no EMI is present. Periodic anomalies associated with electronic equipment operation may be EMI related, and the equipment should be replaced and sent for diagnostic testing and repair.

c. Repair Procedures. Repair procedures related to EMI protection and associated corrosion depend on the type of EMI protection involved, and the degree and type of corrosion. Beryllium copper gaskets, spring fingers, and bonding pressure-wiper fingers that are broken or damaged beyond tolerable limits should be replaced. Damaged bulb seals and ground straps should also be replaced. Since metal to metal contact is required, surfaces should be cleaned carefully to remove any primer, paint, grease, or corrosion prior to replacement. In some applications, after the replacement of EMI protection, an environmental seal is installed to protect the metal-to-metal joint from corrosion. Torn screens may be repaired by stitching them together as long as none of the metal mesh is missing. Conductive elastomers may have damaged sections replaced without replacing the entire gasket. Sections of metal wiring overbraid can be replaced if corroded or damaged. Maintenance personnel should refer to the applicable Original Equipment Manufactures (OEM) service directives for specific repair information. The following general instructions apply when corrosion is noted:

(1) When corrosion is observed, disassemble or remove only the affected area;

(2) Remove corrosion using the mildest available method; and

(3) Apply protective finishes, and assemble as required.

NOTE: Refer to chapter 4 for cleaning and surface preparation; chapter 5 for corrosion removal, surface treatment, painting, and sealing; and chapter 6 for treatment of specific installations.

806. thru 900. RESERVED.

CHAPTER 9. EFFECT AND TREATMENT OF CORROSION ON ELECTROSTATIC DISCHARGE SENSITIVE EQUIPMENT

901. DEFINITION/DESCRIPTION OF ESD. Electrostatic Discharge (ESD) is a transfer of an electrical charge between bodies of different electrostatic potentials. ESD is caused by direct contact or induced by an electrostatic field. Static electricity is a potential electrical charge at rest. Static electrical charges can accumulate on electrical insulators and ungrounded conductors. A static electrical charge will build up as a result of triboelectric (frictional) activity which transfers electrons from one material to another. When two materials are physically rubbed together or pass close to each other, or where one material flows relative to another (such as a gas or liquid over a solid), electrons are transferred between the materials. One of the materials gains electrons and becomes negatively charged while the other loses electrons and becomes positively charged. A potential difference exists between the negatively and positively charged objects and between the charged objects and ground. This potential difference may increase due to a change in capacitance as the objects are moved. Capacitance is defined as the ratio of the magnitudes of the total charge on either conductor to the potential differences between conductors. The equation, Charge = Capacitance x Potential Difference, illustrates this relationship. Since the charge is constant, the potential difference will increase as the capacitance decreases. For example, when a polyethylene bag is rubbed the potential difference between it and another charged object or ground may be only a few hundred volts while it is laying on a bench. However, when it is picked up the potential difference may increase to several thousand volts due to a decrease in capacitance. As the capacitance of a charged object decreases, the potential difference between it and another object will increase until an electrostatic discharge occurs via an arc. Static charges discharged near sensitive electronic components may cause damage. The electrical potential generated during discharge can be as high as 25,000 volts; more than 1,000 times the minimum voltage required to damage the most sensitive electronic components. The threshold of sensitivity for a human to feel a static discharge is approximately 3,500 volts. Therefore, ESD-sensitive components can be damaged by maintenance personnel without their knowledge.

902. SOURCES OF STATIC CHARGE.

a. Triboelectric Series. A triboelectric series, Table 9-1, is a list of materials and substances in order of positive to negative charging as a result of the triboelectric effect. A substance listed higher on the triboelectric series list develops a positive charge when rubbed with the lower listed substance. This happens because the higher listed substances have more free electrons compared to lower listed substances. Electrons from those substances positioned higher on the list may be transferred to substances positioned lower on the list when the charge is high enough. The order of ranking in a triboelectric series is not always constant or repetitive and the degree of separation of the two substances in the triboelectric series does not necessarily indicate the magnitude of the charges created by triboelectric effect. The magnitude of the charge is dependent upon numerous properties and the nature of the material or substance. These properties can also be modified by other factors such as surface cleanliness, ambient environmental conditions, contact pressure, speed of rubbing or separation, lubrication, and the amount of surface area over which the rubbing occurs. Table 9-2 lists some common sources of static electricity.

TABLE 9-1. TRIBOELECTRIC SERIES (partial)

More Positively Charged
Air
Human hands
Glass
Mica
Human Hair
Nylon
Wool
Fur
Lead
Silk
Aluminum
Paper
Cotton
Steel
Wood
Hard Rubber
Nickel
Copper
Brass
Silver
Gold
Platinum
Acetate
Rayon
Polyester
Celluloid
Orlon
Polyurethane
Polyethylene
Polypropylene
PVC (vinyl)
Silicon
Teflon
More Negatively Charged

TABLE 9-2. TYPICAL PRIME CHARGE SOURCES

Object or Process	Material or Activity
Work Surfaces	Waxed, painted, varnished surfaces, Vinyl, or plastics
Floors	Sealed concrete Waxed, finished wood
Clothes	Clean room smocks, Synthetic personnel garments, Nonconductive shoes Virgin cotton
Chairs	Finished wood, Vinyl, Fiberglass Packaging and Handling
Plastic	bags, wraps, envelopes, tape, Bubble wrap, foam, Plastic trays, totes, boxes, vials, parts bins
Assembly, Cleaning, Test Spray Cleaners, and Repair Areas	Plastic solder suckers, Solder irons with ungrounded tips, Solvent brushes (synthetic bristles), Cleaning or drying by fluid or evaporation, Temperature chambers, Cryogenic sprays, Heat guns and blowers, Sand blasting, Electrostatic copiers

b. People are Prime Sources of ESD. Electrostatic charges generated by rubbing or separating materials are readily transmitted to a person's conductive sweat layer causing that person to be charged. When a charged person handles or comes in close proximity to an ESD-sensitive component, that component can be damaged by a direct discharge when it is touched or by subjecting it to an electrostatic field. Table 9-3 shows typical electrostatic voltages generated by personnel.

TABLE 9-3. TYPICAL ELECTROSTATIC VOLTAGES

Means of Static Generation	**Electrostatic Voltages**	
	10 to 20 Percent Relative Humidity	65 to 90 Percent Relative Humidity
Walking across carpet	35,000	1,500
Walking over vinyl floor	12,000	250
Worker at Bench	6,000	100
Vinyl envelopes for work instructions	7 ,000	600
Plastic bag picked up from bench	20,000	1,200
Chair padded with polyurethane foam	18,000	1,500

903. COMPONENT FAILURE MODES.

a. Intermittent Failures. Intermittent failures of electronic components can occur due to ESD. These upset-type failures are often characterized by loss of information or temporary distortion of functions. No apparent hardware damage occurs, and proper operation resumes automatically after the ESD exposure. In the case of some digital equipment, proper operation resumes after reentry of information or re-sequencing of the equipment. Parts susceptible to intermittent operation due to ESD are those in any logic family that require small energies to switch states or small changes of voltage in high-impedance lines. For example:

(1) E-channel metal oxide semiconductor (NMOS),

(2) P-channel metal oxide semi-conductor (PMOS),

(3) Complementary oxide semi-conductor (CMOS), and

(4) Low power transistor transistor logic (TTL) items.

b. Catastrophic Failures. Catastrophic failures due to ESD are characterized by permanent damage to components which prevents them from operating. Most, but not all, catastrophic failures occur immediately after the ESD event. Catastrophic failures can be subdivided into two different categories:

(1) Direct Failures. Direct catastrophic failures are the result of an electrical overstress of electronic parts from ESD; a low voltage discharge from a person or object, an electrostatic field, or a high voltage discharge through a spark or arc. In some cases, catastrophic failures may not occur until a period of time has passed after the ESD exposure. Such may be the case when normal operating stresses and time are required to sufficiently damage a component and cause it to fail completely. Experience has shown that certain components seem to be susceptible to this type of failure mode. For example, an ESD discharge could result in an aluminum short circuit of SiO_2 in the dielectric layer of an integrated circuit. Subsequent use, in time, could allow high currents flowing through the circuit to vaporize the aluminum and block current flow.

(2) Latent Failures. Latent failures due to ESD occur when a component is sufficiently damaged which shorten its operational life. The component may only be marginally damaged by the ESD event and continue to operate for some time. Degradation continues due to the damaged condition of the component and ordinary operational stress. When the component does fail, it may not be obvious that ESD was the original cause. In some cases, intermittent failures in which a component exhibits degradation may in fact be a catastrophic failure due to ESD in which physical damage has caused it to fail to operate throughout its design range.

904. IDENTIFICATION OF ESD-SUSCEPTIBLE EQUIPMENT.

a. Classes of Devices. Any component which can be damaged by 16,000 volts or less is considered sensitive to ESD. These components include microelectronics devices, discrete semiconductors, film resistors, resistor chips, other thick and thin film devices, and piezoelectric crystals. The three ESD-sensitive classifications are as follows:

(1) Class 1: Extremely sensitive Ranges from 0 to 2 kilovolts (kV)

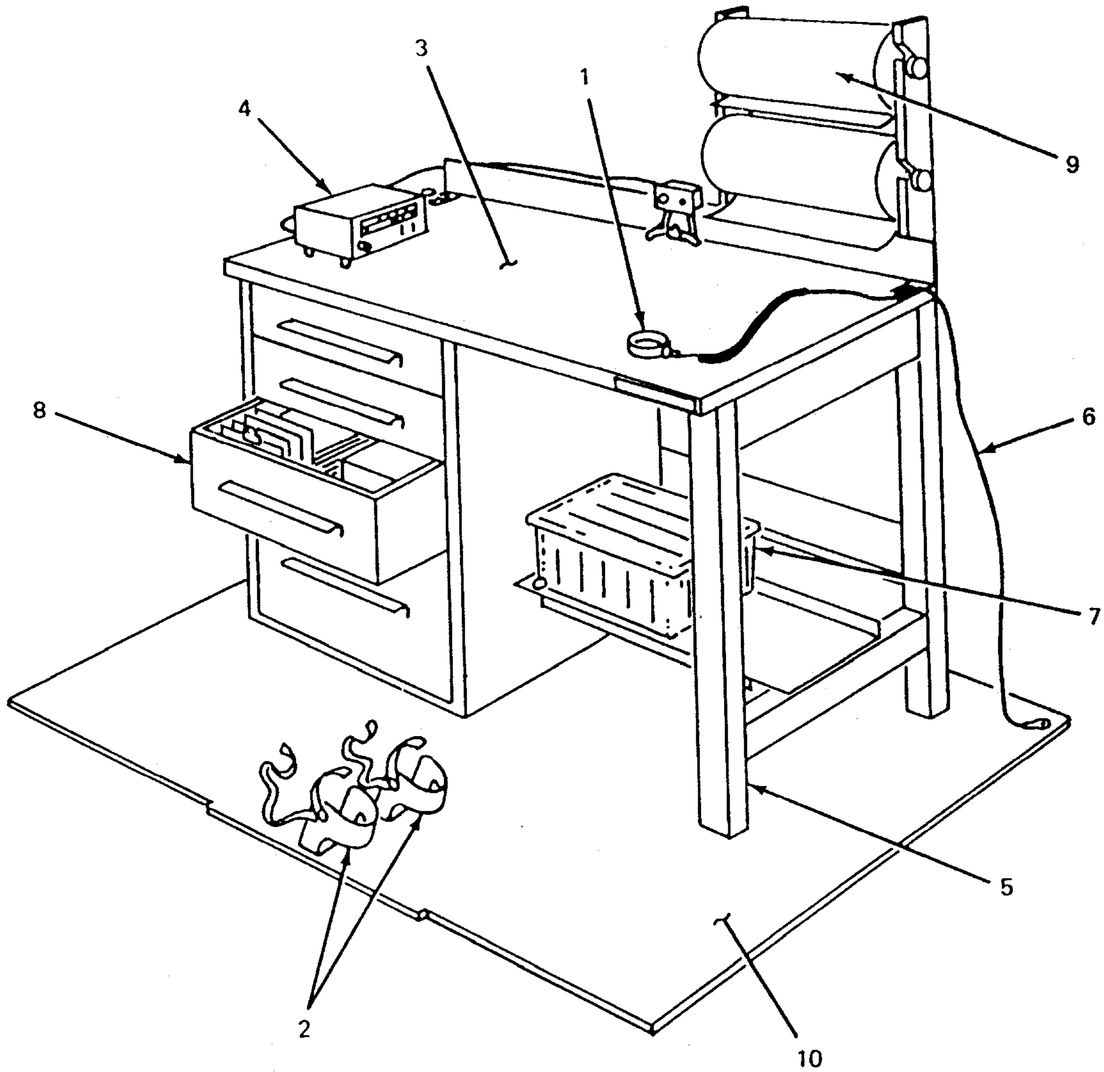
(2) Class 2: Sensitive Ranges from 2 to 4 kV

(3) Class 3: Less sensitive Ranges from 4 to 16 kV

b. Circuit Cards. ESD-sensitive components installed on circuit cards are still susceptible to ESD. For that reason, circuit card assemblies are treated as ESD sensitive. Equipment containing circuit cards with ESD-sensitive components, such as computers, receiver/transmitters, digital display units, encoder/decoders, etc., require special treatment to prevent ESD from entering through connector receptacles and damaging sensitive components.

905. ESD PROTECTION REQUIREMENTS.

a. General. Electronic components are classified into three groups depending on ESD sensitivity. Each group has different handling requirements. In facilities where numerous types of electronic assemblies and circuit cards are repaired, it is not always evident to which ESD-sensitivity group a particular assembly belongs. Consequently, most repair facilities use standard ESD protection procedures based on the most susceptible device they expect to repair. The ESD workstation is an essential part of ESD protection and is the only safe location to repair, package, or handle ESD-sensitive components or circuit cards. The purpose of the workstation is to keep potential differences below the level that can damage ESD-sensitive components. This is accomplished in several ways. The bench top, floor mat, and a personnel wrist strap are electrically connected together through resistors to ground. In addition, the floor mat, bench top, chair, component containers, and all other materials in the area are made from static dissipative material. No static generators such as plain plastic wrap, Styrofoam, plastic coffee cups, etc., are allowed in the area. Humid air helps to dissipate electrostatic charges by keeping surfaces moist and increasing surface conductivity. The workstation and surrounding area should be kept between 40 and 60 percent relative humidity for this purpose. Ionized air generators which produce both positive and negative ions may be used at the ESD workstation to dissipate any static charge. Personnel are often required to wear static dissipative smocks and should avoid wearing synthetic clothing under the smock. Figure 9-1 shows an ESD workstation. ESD workstations should be periodically monitored to ensure all components are functional.



1. Wrist Strap with Resistor
2. Heel Straps/Grounders
3. Static-Dissipative Work Surface
4. Ionizer/Monitor
5. Bench
6. Ground Cords
7. Lined Antistatic Tote with Cover
8. Materials Drawers Labels, Pouches, Bags, Accessories
9. ESD-Protective Roll Materials
10. Static-Dissipative Floor Mat

* Special chairs/stools and garments are not shown.

FIGURE 9-1. TYPICAL ESD WORKSTATION

b. Packaging. Circuit cards and components should be packaged in ESD-protective packaging prior to leaving the ESD workstation. Static shielding bags which have a static-dissipative inner layer and a conductive outer layer are used for this purpose. They should be noncorrosive and should zip-lock or heat seal closed. All static shielding bags are identified with an ESD caution sticker over the closed seals, so that broken stickers will become indicators of opened bags. Figure 9-2 shows typical ESD caution labels. Cushion wrap (bubble wrap) used around circuit cards should also be made of static-dissipative material. Circuit cards may be packaged in reusable ESD fast pack containers. At the equipment level, conductive connector receptacle dust caps are used to prevent ESD from entering the equipment through the connector receptacle and damaging sensitive components. In cases where conductive dust caps are unavailable, a conductive grid tape may be used to cover connector receptacles.

c. ESD Protection Guidelines. Procedures to prevent ESD damage should start at the time electronic equipment is removed from the aircraft and continue through the packaging, shipping, inspection, repair, testing, storage, and eventual reinstallation to the aircraft.

(1) When removing ESD-sensitive equipment from the aircraft, the aircraft should be grounded and power removed. Prior to disconnecting the cables from the equipment, personnel should touch the metal case of the equipment to equalize any electrostatic potentials. Once the cables are disconnected, conductive dust caps or conductive grid tape should be placed on the connector receptacles. The conductive dust caps or grid tape should not be removed until the equipment is at an ESD workstation or test station where ESD protection is in place. When installing ESD-sensitive equipment on the aircraft, the outer shell of the cable connector should be touched to the outer shell of the equipment mating connector to equalize electrostatic potentials. ESD-sensitive equipment should not be opened to expose circuit cards anywhere other than an ESD workstation.

(2) Testing and repair of ESD-sensitive circuit cards and equipment at an ESD workstation should include the following ESD protection procedures:

(a) Ensure work areas, equipment, and wrist strap assembly are grounded.

(b) Attach wrist strap and place metal tools and accessories on grounded bench surface.

(c) Place conductive container on bench. Remove components and circuit cards from ESD protective packaging by unzipping or heating to open. Remove shorting device if present. Avoid touching leads on components. Place components and circuit cards on conductive work surface/test fixture.

(d) Compressed gases will not be used to cool fixtures.

(e) Test through connectors or tabs only.

(f) After testing, replace shorting packages and protective packaging.

(g) Only high input impedance multimeters and test instruments should be used (to avoid sharp current transients).

(h) Dielectric strength tests are prohibited.

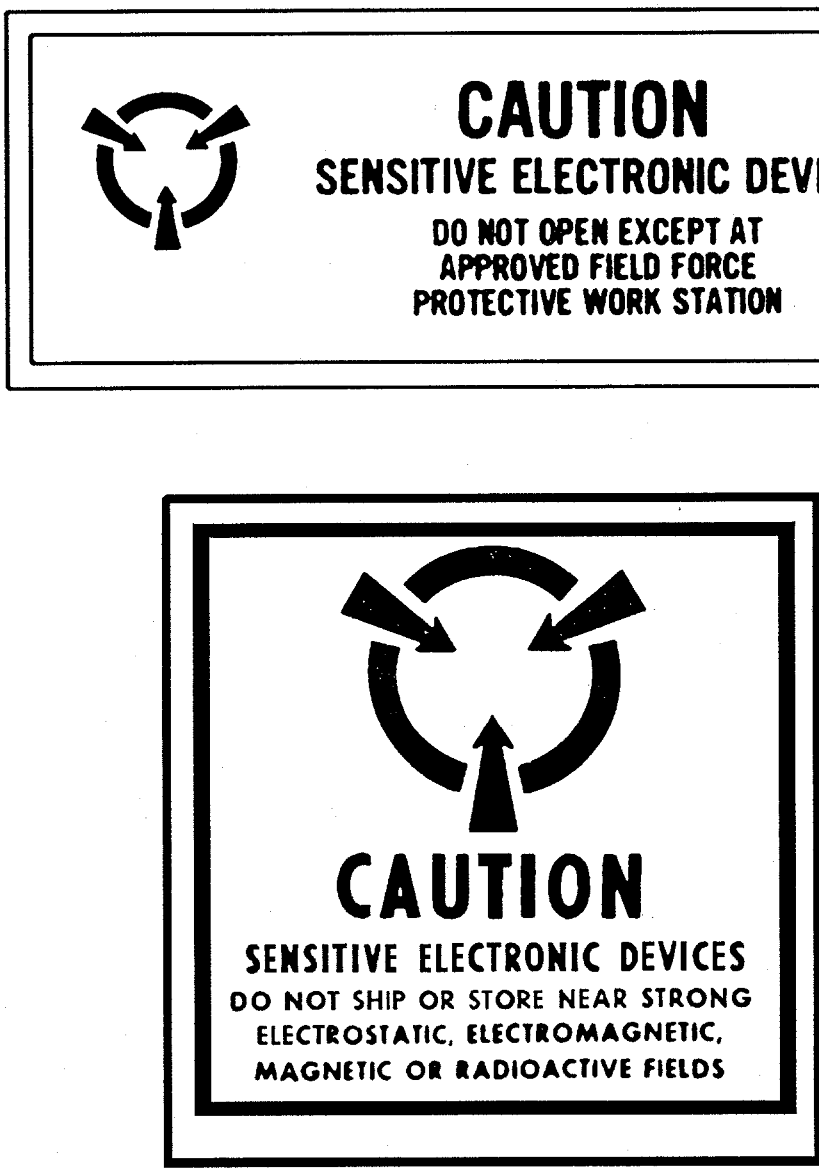


FIGURE 9-2. TYPICAL ESD CAUTION LABELS

(i) Use only static-dissipative type solvents.

(j) Heat guns for test or curing are prohibited.

(k) Drying lamps, photo spots, and thermal probes are allowed.

(1) Do not remove components or assemblies from their sockets with power applied.

(m) The use of air to clean equipment or circuit cards is prohibited unless a filtered ionizing air gun is used.

(n) Do not use a solvent ultrasonic cleaning bath for component assemblies.

(o) Cure conformal coating materials in accordance with OEM instructions either by normal ambient curing or in an oven that contains grounding provisions to prevent static charge buildup. Oven temperature adjustments should be precise and accurate to prevent needless eddy flow of coating during curing.

(p) Compressed carbon dioxide or nitrogen should not be used to cool the test chamber or oven without grounding provisions.

(3) ESD Packaging Guidelines. Correct packaging for shipment or storage of ESD-sensitive components and circuit card assemblies should be accomplished at the ESD workstation. A conductive tote may be used to carry ESD-sensitive components and assemblies from the repair workstation to the packaging workstation if required. At no time during shipment or storage should packaging identified by an ESD symbol be opened unless at an ESD workstation. ESD-sensitive equipment should be shipped or stored with conductive dust caps or conductive grid tape over connector receptacles.

(4) ESD Repair Personnel Guidelines. All personnel who repair, package or handle ESD-sensitive components, circuit card assemblies or equipment should have formal ESD training. The most extensive and costly ESD workstations will not provide protection if people are not properly trained in correct practices. Manufacturers and repair station facilities should require some type of ESD training certification for their personnel.

906. CORROSION CONTROL PRACTICES FOR ESD-SENSITIVE DEVICES.

a. General. Some types of ESD packaging can be corrosive and should be avoided. ESD dustcaps for connector receptacles made from carbon should be avoided due to corrosive tendencies. To identify these dustcaps, rub the dustcap on a piece of paper. If a mark is made on the paper, the dustcap contains carbon and should not be used.

b. Corrosion Inspection and Repair. Corrosion inspection and repair of circuit card assemblies and ESD-sensitive equipment should be conducted at an ESD workstation where proper ESD precautions may be taken. Corrective action depends on the size, the degree, and type of corrosion, in the damaged area. Maintenance personnel should refer to the applicable OEM's service directives for specific repair procedures or the treatment of specific avionics equipment identified in chapters 6 and 8.

907. thru 1000. RESERVED.

CHAPTER 10. EMERGENCY ACTION FOR SERIOUS CORROSION OF AVIONICS EQUIPMENT

1001. GENERAL.

a. This chapter describes emergency corrosion cleaning and treatment procedures to be followed after aircraft or equipment accidents and incidents, particularly those involving exposure to large amounts of saltwater, fire extinguishing agents, industrial pollutants, soot, etc. Immediate action must be taken to remove, clean, dry, and preserve all affected avionics equipment to reduce corrosion damage. When removal of avionics equipment is impractical, in-place cleaning, drying, and preserving should be accomplished.

b. The emergency action procedures outlined in the beginning of this chapter are normally used by the operator only to prevent further corrosion damage. Equipment that has received initial emergency treatment should be forwarded to an avionics repair station for cleaning, drying, inspection, operational checks, and preservation, or returned to the Original Equipment Manufacturer (OEM) for disposition as described later in this chapter.

1002. EMERGENCY RECLAMATION TEAM.

NOTE: In cases involving aircraft accidents, permission to remove equipment must be obtained from the senior Department of Transportation (DOT) member of the accident investigation team prior to the start of emergency reclamation procedures.

a. Goal of an Emergency Reclamation Team. Each organization that operates, stores, maintains, or repairs avionics equipment should have a team identified to handle emergency reclamation situations. The primary goal of the emergency reclamation team is to accomplish those tasks that are necessary to salvage the affected equipment and perform appropriate corrosion control efforts to minimize damage.

b. Emergency Reclamation Team Organization. An emergency reclamation team should consist of a senior team member whose responsibility include directing the salvage, removal priority, and corrosion control efforts for the equipment involved. The size and composition of the remainder of the emergency reclamation team will depend upon the urgency of the situation, type of reclamation effort, and the size of the reclamation task.

1003. EMERGENCY PREPARATIONS.

a. Removal Priority. Each organization that operates, stores, maintains, or repairs avionics equipment should publish an instruction that defines the role and purpose of the emergency reclamation team. The instruction should provide general guidelines for the team to accomplish their task in a safe and efficient manner. It should be reviewed by the emergency reclamation team members on a regular basis, and should include a priority list for the removal and reclamation of equipment and a list of all anticipated tools and materials necessary to accomplish the reclamation task. Table 10-1 provides a recommended guide for a priority removal list.

TABLE 10-1. PRIORITY GUIDE FOR EMERGENCY REMOVAL OF AVIONICS EQUIPMENT

Priority	Type Equipment
1.	Avionics Equipment (radios, computers, radar equipment, etc.)
2.	Instruments (aircraft instruments, meters, etc.)
3.	Electrical Equipment (switches, wiring, indicator light panels, etc.)
4.	Miscellaneous Equipment (mounting racks, etc.)

b. Required Tools, Materials, and Equipment. Immediate availability of the necessary corrosion control tools, materials, and equipment will help to significantly reduce additional damage to the affected equipment. In addition to the corrosion control products listed in Appendix 1, other special support equipment that will be useful and should be readily available are:

(1) Dry nitrogen source,

(2) Dry air source,

(3) Vented drying oven (forced air),

(4) Vented drying oven (bulb-type),

(5) Hot air blowers,

(6) Pump, backpack-style, and

(7) Clean empty 55-gallon drums (removable lid).

c. Production Planning. Whenever possible, all salvaged components of the aircraft or equipment should be treated simultaneously. The most experienced personnel on the emergency reclamation team should be assigned to disassemble and process the affected equipment. This effort will reduce the corrosion potential and other damage to the equipment and ensure that the work is accomplished in a thorough and competent manner. Whenever possible, personnel that normally examine and evaluate this type of equipment should work closely with the disassembly and preservation personnel. This enables non-reclaimable items to be scrapped immediately and only usable components that were exposed to corrosive agents to be disassembled and treated. The time saved by this procedure may be used in preserving salvageable components.

1004. EMERGENCY CLEANING PROCEDURES.

CAUTION: Cleaning compounds and solvents identified in Appendix 1 may react with some encapsulants or plastics used to form wire harness tubing, wire coatings, conformal coatings, gaskets, seals, etc. Test these compounds and solvents on a small area for softening or other adverse reactions prior to general application. Refer to chapter 4, Table 4-3, for further restrictions on these materials.

a. General. Where possible, the primary method of emergency cleaning described in paragraph 1004b, should be used. When a sufficient quantity of fresh water is not available, use one of the alternate emergency cleaning methods described in paragraph 1004c, steps (1) through (3).

b. Primary Method. The primary method for the removal of saltwater, fire extinguishing agents, etc., should be used when a sufficient quantity of fresh water is available. The primary method procedures are:

(1) Flush all internal and external areas with clean fresh water. Whenever possible, units or subcomponents that have been removed should be immersed and flushed thoroughly in clean fresh water. A 55-gallon drum may be used for this purpose. Tilt the unit or subcomponent back and forth to aid in draining off the excess water.

(2) Blow off excess water with not more than 10 psi air pressure or dry nitrogen. Deflect jet of air off interior, back, and sides of enclosure to diffuse.

(3) If there is any evidence of salt or fire extinguishing agents, a second cleaning action should be initiated using a solution of 1 part Aircraft Cleaning Compound to 10 parts of fresh water, conforming to MIL-C-85579, Type II. Scrub the effected areas with the cleaning solution using a brush. Flush thoroughly with fresh water and drain excess. The equipment may be immersed in fresh water to aid in removing hidden contaminants. Tilt the unit or equipment back and forth to aid in draining off the excess water.

(4) Blow off excess water as specified in paragraph 1004b(2).

c. Alternate Methods. The following describes alternate cleaning methods when sufficient fresh water is not available.

(1) Solvent Method.

NOTE: Local air pollution regulations may restrict the use of this and other solvents. Comply with all local air pollution regulations.

(a) Clean exterior of equipment using a brush and dry cleaning solvent, P-D-680, Type II.

(b) Collect waste solvent from exterior cleaning and dispose of by recycling or as a hazardous waste.

CAUTION: Properly dispose of all hazardous waste in accordance with local regulations.

(c) Disassemble equipment as required. Clean and dry interior surfaces in accordance with instructions of paragraph 1004b(3) and (4).

(2) Aircraft Cleaning Compound Method.

(a) Apply a solution of 1 part Aircraft Cleaning Compound to 9 parts of fresh water, conforming to MIL-C-85570, Type I. Scrub or wipe interior and exterior surfaces of equipment using a brush or clean cloth until contaminants become intermixed or emulsified. Wipe off all surfaces thoroughly with a clean cloth removing contaminants and cleaner.

(b) Blow off excess solution with not more than 10 psi dry air pressure or dry nitrogen. Deflect the jet of air off interior, back, and sides of enclosure to diffuse.

(3) Water-Displacing Method. The water-displacing method should be used as the last choice of the alternate cleaning methods. Additionally, the water-displacing method is considered only temporary preservation until proper cleaning methods can be accomplished. After application of the water-displacing compound, tag equipment with an appropriate marking indicating the component has been temporarily preserved with Water-Displacing Corrosion Preventive Compound, conforming to MIL-C-81309, Type II, but still requires cleaning.

(a) Blow off excess water and other contaminants from component with not more than 10 psi dry air pressure or dry nitrogen. Deflect the jet of air off interior, back, and sides of enclosure to diffuse.

(b) Totally immerse equipment in a 55-gallon drum of Water-Displacing Corrosion Preventive Compound, conforming to MIL-C-81309, Type II. Tilt the unit or equipment back and forth to aid in removing any water. Immerse the equipment a second time, repeating the tilting to thoroughly coat all surfaces. If total immersion is not practical, spray, brush, or wipe the interior and exterior of equipment with Water-Displacing Corrosion Preventive Compound.

(c) Blow off excess Water-Displacing Corrosion Preventive Compound from component with not more than 10 psi dry air pressure or dry nitrogen. Deflect the jet of air off interior, back, and sides of enclosure to diffuse.

1005. EMERGENCY DRYING AND PRESERVATION.

a. General. Drying and preservation are essential to eliminate any traces of water and to control corrosion until the equipment can be disassembled, inspected, and repaired at an authorized repair station.

b. Drying and Preservation Procedures. The following drying and preservation procedures should be used with the listed drying equipment after cleaning in accordance with paragraph 1004b.

(1) Vented Drying Oven (Forced Air).

(a) Blow off excess liquid from component with not more than 10 psi dry air pressure or dry nitrogen. Deflect the jet of air off interior, back, and sides of enclosure to diffuse.

(b) Dry the equipment in a vented forced air oven at a temperature of not more than 130°F (54°C) for 1 to 2 hours.

(c) For all avionics components and electrical connectors, apply (by spraying) a coating of Water-Displacing Corrosion Preventive Compound, Ultra Thin Film, conforming to MIL-C-81309, Type III.

(2) Vacuum Oven Drying.

(a) Blow off excess liquid from component with not more than 10 psi dry air pressure or dry nitrogen. Deflect the jet of air off interior, back, and sides of enclosure to diffuse.

(b) Dry the equipment in a vacuum oven with a temperature of not more than 130°F (54°C) and a minimum pressure of 25 inches of Hg for 1 to 2 hours.

(c) For all avionics components and electrical connectors, apply (by spraying) a coating of Water-Displacing Corrosion Preventive Compound, Ultra Thin Film, conforming to MIL-C-81309, Type III.

(3) Vented Drying Oven (Bulb-Type).

(a) Blow off excess liquid from component with not more than 10 psi dry air pressure or dry nitrogen. Deflect the jet of air off interior, back, and sides of enclosure to diffuse.

(b) Dry the equipment in a vented bulb-type drying oven at not more than 130°F (54°C) for 4 to 6 hours.

(c) For all avionics components and electrical connectors, apply (by spraying) a coating of Water-Displacing Corrosion Preventive Compound, Ultra Thin Film, conforming to MIL-C-81309, Type III.

(4) Hot Air Blower.

(a) Blow off excess liquid from component with not more than 10 psi dry air pressure or dry nitrogen. Deflect the jet of air off interior, back, and sides of enclosure to diffuse.

(b) Dry the equipment with a hot air blower until dry.

(c) For all avionics components and electrical connectors, apply (by spraying) a coating of Water-Displacing Corrosion Preventive Compound, Ultra Thin Film, conforming to MIL-C-81309, Type III.

(5) Heated Compartment.

(a) Blow off excess liquid from component with not more than 10 psi dry air pressure or dry nitrogen. Deflect the jet of air off interior, back, and sides of enclosure to diffuse.

(b) Dry the equipment in a heated compartment with proper air circulation at a temperature between 100°F (38°C) and 130°F (54°C) until dry.

(c) For all avionics components and electrical connectors, apply (by spraying) a coating of Water-Displacing Corrosion Preventive Compound, Ultra Thin Film, conforming to MIL-C-81309, Type III.

1006. OPERATOR LEVEL EMERGENCY CLEANING PROCEDURES.

WARNING: Ensure that all electrical power internal and external to the aircraft or equipment is disconnected. Disconnect all batteries. Ensure that all safety devices are installed.

a. Removable Avionics Equipment. Equipment or components that are removed at the operator's facility should be inspected for smoke, heat, fire damage, or damaged seals. Equipment and components that are forwarded to the operator's facility should have their background researched to determine the extent, cause of damage, and previous cleaning and preservation procedures that may have been accomplished. Most avionics equipment contain dissimilar metals and particular attention should be paid to these areas for evidence of corrosion during the inspection. If contaminated avionics equipment can be forwarded immediately and inducted into an avionics repair station for expeditious cleaning, inspection, and repair of damage, then the drying and preservation identified in paragraph 1005 is not necessary. When immediate induction into the avionics repair station is not possible, proceed with the drying and preservation procedures of paragraph 1005. When the aircraft or equipment has been exposed to saltwater intrusion, fire extinguishing agents, or water immersion, the aircraft or equipment should be cleaned, dried, and preserved as follows:

(1) Electrically ground the aircraft or equipment.

WARNING: Ensure that all electrical power sources, including batteries, are disconnected from the aircraft or equipment and all other powered systems (hydraulic, pneumatic, and mechanical) are deactivated.

(2) Ensure all external electrical power and batteries are disconnected. Remove hydraulic and pneumatic power and install safety struts in hydraulic, pneumatic, and mechanic actuated devices.

(3) Remove installed avionics equipment. Removal priority should be determined from the developed priority list for emergency reclamation of equipment or as directed by the emergency reclamation team leader. Refer to paragraph 1003 and Table 10-1.

(4) Remove all covers, modules, and components authorized at this level.

(5) Tilt the equipment back and forth to allow accumulated water or other liquids to drain off.

(6) Examine the individual items thoroughly for evidence of saltwater, fire extinguishing agents, smoke, oily films, corrosion, etc.

(7) Items that are contaminated should be cleaned using the primary cleaning method described in paragraph 1004b.

(8) If the primary method cannot be performed for lack of available fresh water, use one of the alternate cleaning methods described in paragraph 1004c.

(9) Tag all components, identifying date, cleaning and drying method, and type of preservation applied.

b. Removal and Cleaning of Identification and Modification Plates. Identification and modification plates can trap contaminants, allowing corrosion to start. The following procedures are applicable for the cleaning of identification and modification plates:

(1) Visually examine for the presence and the condition of a fillet seal along the edge of the identification and modification plates. Identification and modification plates with sealed edges that appear intact and undamaged do not have to be removed at this maintenance level. Identification and modification plates with missing or damaged edge seals should be removed.

(2) Remove the affected identification and modification plate as required.

(3) Thoroughly clean both sides of the identification and modification plate and the adjacent mounting areas on the equipment using the primary cleaning method described in paragraph 1004b.

(4) Installation of the identification and modification plates will depend on any additional processing of the avionics component at another level of maintenance. To maintain correct identity and configuration control, reinstall the identification and modification plates. If the avionics component will be repaired at the operator level and returned to service, proceed as follows:

(a) Visually examine the identification and modification plate and the adjacent mounting areas for evidence of corrosion. Clean, treat, and reapply any protective finish in accordance with chapter 4, paragraph 405, and chapter 5, paragraphs 502, 503, and 504 as required.

(b) After cleaning and surface treatment, lightly coat the seal by applying a coating of Sealing Compound to the underside of the identification and modification plate and the adjacent mounting areas, conforming to MIL-S-8802. Install identification and modification plate within the working time of the sealant. Ensure sealant squeezes out around the periphery of the plate.

c. Hermetically-Sealed Avionics Equipment. When removing hermetically-sealed units, pay particular attention to cable clamp areas, bindings securing wire harnesses, and cable connectors. These are areas where salt and fire extinguishing agents can become entrapped. Immerse the unit in a container of fresh water to test for airtight integrity of the seal. The presence of air bubbles will indicate a faulty seal. Clean hermetically-sealed avionics equipment as follows:

(1) Clean the equipment in accordance with paragraph 1004b or c.

(2) Dry and preserve the equipment in accordance with one of the methods described in paragraph 1005b.

(3) Units that indicate a faulty seal should be forwarded to an avionics repair station for disposition.

d. Electric Motors and Generators. Cleaning is an essential preliminary procedure in salvaging electric motors, generators, inverters, and miniature synchro transmitters and receivers.

(1) Clean the equipment in accordance with paragraph 1004b or c.

(2) Dry and preserve the equipment in accordance with one of the methods described in paragraph 1005b.

(3) Thoroughly inspect the equipment to determine whether it may be returned to serviceable condition or must be forwarded to an avionics repair station. Equipment with sealed bearings should be forwarded to an avionics repair station for replacement.

(4) Equipment that is determined serviceable should have the Corrosion Preventive Compound removed using Dry Cleaning Solvent, P-D680, Type II.

(5) Blow off excess liquid from component with not more than 10 psi dry air pressure or dry nitrogen. Deflect the jet of air off interior, back and sides of enclosure to disuse.

e. Cockpit Area Components. The cockpit area contains various types of components. Non-removable components and equipment should be cleaned, dried and preserved in accordance with paragraphs 1006i through 1006k. Removable components should be cleaned and preserved as follows:

(1) Remove all removable components, control boxes, equipment, relay boxes, indicators, etc., in accordance with the OEM maintenance instructions.

(2) Visually examine all removed components for evidence of saltwater, fire extinguishing agents, smoke, oily films, etc.

(3) Clean contaminated equipment in accordance with paragraph 1004b.

(4) Dry and preserved the equipment in accordance with paragraph 1005b.

(5) Special attention should be given to cockpit electrical connectors. Clean and preserve in accordance with paragraph 1006m.

(6) Cockpit circuit breakers, toggle, rotary, interlock, and push-button switches should be cleaned and preserved in accordance with paragraph 1006f.

f. Switches and Circuit Breakers. Most aircraft and aircraft-related test equipment switches are enclosed in a sealed case. Cleaning of internal parts is generally not possible. Exposed areas such as terminal posts, toggles, push buttons, or rotary switches should be cleaned and preserved as follows:

(1) Remove contamination with fresh water while scrubbing with an acid brush. Thoroughly rinse with fresh water.

(2) Blow off excess liquid from component with not more than 10 psi dry air pressure or dry nitrogen. Wipe with a clean cloth to help reduce drying time.

(3) Use Dry Cleaning Solvent, P-D-680, Type II, applied with an acid brush, to remove stubborn oil and grease stains and clean sliding contacts, contact points, and circuit breaker points. Rinse with Dry Cleaning Solvent, P-D-680, Type II. Ensure removal of any contamination from sliding contacts, contact points, and circuit breaker points. Wipe with a clean cloth.

(4) Dry in accordance with one of the methods described in paragraph 1005b. **Do not apply Water-Displacing Corrosion Preventive Compounds as directed in that paragraph**.

(5) If required, preserve exterior of switch in accordance with chapter 4, paragraph 407.

g. Antennas. Antennas should be cleaned and preserved as follows:

(1) Remove the antenna in accordance with OEM maintenance instructions.

(2) Visually examine antennas, insulators, and electrical connectors for damage. Repair or replace as required.

(3) Brush or spray a mixture of 1 part Aircraft Cleaning Compound conforming to MIL-C-85570, Type I, to 9 parts of fresh water. Clean surfaces with a clean cloth dampened with cleaning solution.

(4) Rinse with clean fresh water. Wipe excess water with a dry, clean cloth.

(5) Preserve antenna in accordance with chapter 4, paragraph 407.

h. Mounting Racks and Shock Mounts. Mounting racks and shock mounts should be cleaned and preserved as follows:

(1) Remove the mounting racks, shock mounts, and associated hardware in accordance with the OEM maintenance instructions.

(2) Clean the detailed parts or components in accordance with paragraph 1004b.

(3) Dry the mounting racks, shock mounts, and associated hardware in accordance with one of the methods described in paragraph 1005b.

(4) Tag the equipment to be forwarded to the avionics repair station. The tag should indicate date, cleaning and drying method, and preservation type applied. Include any additional notes that may be helpful.

i. Non-removable Avionics Equipment. Non-removable avionics equipment exposed to saltwater or fire extinguishing agents should be cleaned and preserved as follows:

(1) Ensure aircraft or equipment is electrically grounded.

WARNING: Ensure that all electrical power sources, including batteries, are disconnected from the aircraft or equipment and all other powered systems (hydraulic, pneumatic, and mechanical) are deactivated.

(2) Ensure all external electrical power and batteries are disconnected. Remove hydraulic and pneumatic power and install safety struts in hydraulic, pneumatic, and mechanic actuated devices.

(3) Open all equipment bay doors.

(4) After all removable components have been removed in accordance with the OEM maintenance instructions and in the order determined by the priority established in the emergency reclamation list or Table 10-1, examine all non-removable components for evidence of saltwater, fire extinguishing agents, smoke, oily films, etc.

(5) Contaminated items should be cleaned in accordance with paragraph 1004b whenever possible. Ensure that areas behind and under mounting structure and components are thoroughly cleaned. When the primary cleaning method cannot be accomplished, use one of the alternate cleaning methods described in paragraph 1004c.

(6) For all non-removable avionics components and electrical connectors, dry and preserve in accordance with paragraph 1006k.

j. In-place Cleaning. Where access is limited, use a backpack hand pump for one of the cleaning methods described in paragraph 1004c, **except the solvent method described in paragraph 1004c(1).** Dry and preserve limited-access components in accordance with paragraph 1006k.

k. Drying and Preservation of Non-removable Avionics Equipment. Dry and preserve non-removable avionics components as follows:

(1) Blow off excess liquid from component with not more than 10 psi dry air pressure or dry nitrogen. Deflect the jet of air off interior, back, and sides of enclosure to diffuse.

(2) Where authorized, dry the equipment with a hot air gun. Where the hot air gun is not authorized, wipe the area with a dry, clean cloth and allow to air dry.

(3) For all avionics components and electrical connectors, apply (by spraying) a coat of Water-Displacing Corrosion Preventive Compound, Ultra Thin Film, conforming to MIL-C-81309, Type III. Wipe off excess preservative with a dry, clean cloth.

1. Terminal Boards, Junction Boxes, Relay Boxes, and Circuit Breaker Panels. Terminal boards, junction boxes, relay boxes, and circuit breaker panels not normally removed from the aircraft or equipment should be cleaned as follows:

(1) Ensure aircraft or equipment is electrically grounded.

WARNING: Ensure that all electrical power sources, including batteries, are disconnected from the aircraft or equipment and all other powered systems (hydraulic, pneumatic, and mechanical) are deactivated.

(2) Ensure all external electrical power and batteries are disconnected. Remove hydraulic and pneumatic power, and install safety struts in hydraulic, pneumatic, and mechanic actuated devices.

(3) Remove covers and access panels.

(4) Examine all components for evidence of saltwater, fire extinguishing agents, smoke, oily films, etc.

(5) Contaminated components should be cleaned in accordance with the primary cleaning method described in paragraph 1004b whenever possible. Ensure that all areas behind and under mounting structure and components are thoroughly cleaned. When the primary cleaning method cannot be accomplished, use one of the alternate cleaning methods described in paragraph 1004c.

(6) For all non-removable avionics components and electrical connectors, dry and preserve in accordance with paragraph 1006k.

m. Electrical Connectors and Receptacles. Electrical connectors and receptacles require special procedures for cleaning and preserving. Connectors and receptacles that cannot be opened and separated for cleaning should be cleaned, inspected, and preserved in place as follows:

(1) Disconnect and disassemble connector and receptacles to the extent possible to release entrapped contaminants.

(2) Thoroughly rinse connector and receptacles with fresh water.

(3) Blow off excess liquid from connector and receptacles with not more than 10 psi dry air pressure or dry nitrogen. Wipe with a clean cloth to help reduce drying time.

(4) To remove stubborn oil and grease contaminants, use Dry Cleaning Solvent, P-D-680, Type II, applied with an acid brush, followed by wiping with a solvent-dampened cleaning cloth.

(5) Apply (by spraying) a light coating of Water-Displacing Corrosion Preventive Compound, Ultra-thin Film, conforming to MIL-C-81309, Type III, to remove any trapped liquid. Wipe off excess preservative with a dry, clean cloth.

(6) Dry and preserve in accordance with one of the methods described in paragraph l005b, (1) through (5). Whenever these drying methods are not applicable, allow connector to air dry.

n. Wire Harnesses and Cables. Wire harnesses and cables exposed to saltwater, fire extinguishing agents, smoke, etc. should be cleaned and preserved as follows:

(1) Remove cable clamps, straps, hangers, wire ties, etc. to allow wire harness and cable wiring to be separated.

(2) Separate wiring, open and separate connectors. Rinse with fresh water to wash away entrapped contaminants. If the wire harness, cables, or connectors are encased, the exteriors should be rinsed with fresh water.

(3) Blow excess water from wiring and connectors with not more than 10 psi dry air pressure or dry nitrogen. Wipe with a clean cloth to help reduce drying time.

(4) Wire harnesses and cables that can be readily removed from the aircraft or equipment should be dried by one of the methods in paragraph 1005b.

(5) Wire harnesses and cables that cannot be readily removed from the aircraft or equipment should be dried using a hot air gun.

(6) Apply (by spraying) to metal components a light coating of Water-Displacing Corrosion Preventive Compound, Ultra-thin Film, conforming to MIL-C-81309, Type III.

1007. AVIONICS REPAIR STATION EMERGENCY CLEANING PROCEDURES.

a. General. The initial emergency salvage and reclamation steps taken by the operator or unit level are designed to prevent further corrosion damage. Immediate induction of avionics equipment into an avionics repair station for cleaning, drying, inspection, preservation, repair, and functional testing after an accident can be delayed for many reasons. These can include the delayed access due to an ongoing accident investigation, field disassembly problems, shipping distance, and work contracts. It is, therefore, essential that the avionics repair station be ready to provide services when the equipment does arrive.

b. Emergency Reclamation Team. Each avionics repair station that operates, stores, maintains, or repairs avionics equipment should have a team identified to handle emergency reclamation situations. The team should be composed of a team leader and the necessary number of avionics technicians required to accomplish the assigned task. The primary goal of the emergency reclamation team is to accomplish those tasks that are necessary to salvage the affected equipment and perform appropriate corrosion control efforts to minimize damage and, where possible, return the equipment to usable service. Repairable equipment damaged beyond the capability of the avionics repair station may be returned to the OEM for disposition.

NOTE: Units or components that will be returned to the original equipment manufacturer for cleaning, inspection, and repair should be tagged to indicate date of cleaning, cleaning method and materials used, and type of preservation applied.

c. Initial Screening Procedure. Avionics equipment that is damaged beyond the capability of the operator or operating unit to clean, inspect, repair, test, and preserve will normally be forwarded to an avionics repair station for disposition. Upon receipt, the avionics repair station should screen the affected equipment and records to determine the following:

(1) Extent of damage (reported or observed),

(2) Local repair capability,

(3) Cleaning methods used at operator/unit activity,

(4) Drying methods used at operator/unit activity, and

(5) Preservation methods used at operator/unit activity.

d. Cleaning Priority. After initial screening, the cleaning priority needs to be established by the emergency reclamation team leader. Table 10-1 will aid in determining the cleaning priority.

e. Disassembly Inspection Procedures. The extent of damage from saltwater, fire extinguishing agents, smoke, fire, heat, etc. must be determined. Most avionics equipment contains dissimilar metals and particular attention should be given to those dissimilar metal couples. Avionics equipment exposed to saltwater, fire extinguishing agents, smoke, fire, heat, etc. should be cleaned, disassembled, and visually examined as follows:

(1) Remove Corrosion Preventive Compounds, dirt, and grime with Dry Cleaning Solvent, P-D-680, Type II, to facilitate inspection.

(2) Remove all covers, access panels, modules, and normally-removed components.

(3) Visually examine the individual items thoroughly for evidence of saltwater intrusion, fire extinguishing agents, smoke, fire, heat damage, etc.

(4) Visually examine the individual items for evidence of corrosion. Particular attention should be focused on areas of dissimilar metal couples.

(5) Visually examine encapsulated and conformal-coated laminated circuit boards for damage caused by saltwater intrusion, fire extinguishing agents, and cleaning solvents. Pay particular attention to conformal coatings and circuit board laminates that are discolored, softened, or deformed.

(6) Visually examine electrical cables, wires, and harnesses for signs of damage and deterioration from cleaning solvents. Pay particular attention to any signs of discoloration, softening, or cracked wire coating.

(7) Disassemble and inspect electrical connectors and receptacles for damage and signs of corrosion. Pay particular attention to seals and gaskets.

(8) Visually examine hermetically-sealed components for signs of broken seals and corrosion damage. Units with broken seals should be disassembled for further inspection or forwarded to the OEM for disposition.

(9) Visually examine electrical motors, generators, inverters, miniature synchro transmitters and receivers for damage. Pay particular attention to lubricated fittings and sealed bearings.

(10) Visually examine control boxes and instruments for damage and corrosion. Pay particular attention to areas around switch toggles and knobs, hardware, interior components, and under faceplates, rubber boots, and mounting areas.

(11) Visually examine component identification and modification plates for evidence of corrosion. Pay particular attention to the condition of the fillet seal around the periphery of the plates.

(12) Visually examine shock mounts, mounting racks, cases, chassis, and cover plates for corrosion. Pay particular attention to evidence of buckling and heat damage. Check painted surfaces for cracks, nicks, and peeling. Pay particular attention to the condition of rubber shock mounts.

f. Undamaged Items. Avionics components that show no visual signs of damage should be functionally checked in accordance with the OEM maintenance instructions. The avionics component may be returned to the operator level in accordance with established procedures.

g. Damaged Items. Avionics components that show signs of damage should be repaired and functionally checked per the OEM maintenance instructions in accordance with established procedures.

h. Emergency Cleaning and Preservation Procedures. Cleaning and preservation procedures are as follows:

(1) Avionics equipment exposed to saltwater, fire extinguishing agents, smoke, fire, heat, field-applied cleaning solutions, etc. and cleaned and decontaminated at the operator or unit level should be inspected for damage in accordance with paragraph 1007e. Corrosion removal, treatment, restoration of protective finishes, and preservation should be in accordance with chapters 4 and 5.

(2) Avionics equipment exposed to saltwater, fire extinguishing agents, smoke, fire, heat, etc. that were not cleaned and decontaminated at the operator or unit level should be cleaned, inspected, repaired and preserved as follows:

(a) Clean using the primary cleaning method detailed in paragraph 1004b.

(b) Inspect for damage in accordance in paragraph 1007e, and the OEM maintenance instructions.

(c) Disposition in accordance with established procedures and the OEM maintenance instructions.

(d) Preserve in accordance in chapter 4, paragraph 407.

(3) Avionics equipment that requires disposition and repair by the OEM should be cleaned, dried, preserved, and tagged in accordance in paragraphs 1004b, 1005, and 1006a(9).

1008. thru 1100. RESERVED.

APPENDIX 1. CONSUMABLE SUPPLIES AND MATERIALS

1-1. INTRODUCTION.

This appendix lists many of the acceptable type consumable supplies and materials available for avionics corrosion control.

1-2. SCOPE.

Table 1-1 provides consumable supplies and materials used for avionics cleaning and corrosion control. The table contains the product nomenclature/specification, application, and manufacturer's designation. Items in this table are located by function in the following groupings:

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TABLE 1-1.
AVIONICS CLEANING AND CORROSION REMOVAL CONSUMABLE MATERIALS

ITEM NO.	NOMENCLATURE/ PRODUCT SPECIFICATION	APPLICATION
	ABRASIVES	
1.	Abrasive Mat. Aluminum Oxide Abrasive, MIL-A-9962, Type I, Grade A, Class 1 (Very Fine), or MIL-A-9962, Type I, Grade B, Class 1 (Fine)	Removal of dirt and corrosion products from external avionics chassis, covers, mountings, hardware, antennas, electrical connector shells, etc.
2.	Cleaning and Polishing Pad, Nonabrasive, MIL-C-83957	Removal of dirt and contaminants from internal avionics structures, laminated circuit boards, wave-guides, TR tubes, cavities, circuit components, relay contacts, control box face plates, etc.
3.	Cloth, Abrasive Aluminum Oxide P-C-451, 320-Grit, Type 1, Class 1	Removal of heavy corrosion products from steel, iron, aluminum, and magnesium structures, mountings, racks, chassis, covers, etc. Scuff sanding of avionics boxes prior to painting, etc. **CAUTION: Do not use Silicon Carbide Abrasive Cloth, P-C-451.**
4.	Eraser, Magic Rub, Plastic, A-A-132-14, 2-1/4 x 7/8 x 7/16", (Block Shape, Beveled Ends)	Removal of light tarnish on silver. Removal of light corrosion on copper, zinc, nickel, etc. For brightening of gold. **CAUTION: Use only on components that are sufficiently rigid to resist rubbing motion.**
5.	Eraser, Ruby Red A-A-132-3, 2-3/4 x 3/4 x 1/4 inch, (Rectangular Shape, Beveled Ends)	Removal of light tarnish on silver. Removal of medium corrosion on copper, zinc, nickel, etc. For brightening of gold. **CAUTION: Use only on components that are sufficiently rigid to resist rubbing motion.**
6.	Eraser, Wood or Paper Encased, A-A-132-13 6 inch x 3/16 inch diameter, (Pencil Shape)	Removal of medium tarnish and corrosion products in tight areas. **CAUTION: Care should be taken not to remove thinly plated surfaces.**
7.	Eraser, Typewriter A-A-132-9, 7 inch x 3/16 inch diameter, (Pencil Shape)	Removal of heavy tarnish on silver. Removal of heavy corrosion on copper, zinc, nickel, etc. **CAUTION: Care should be taken not to remove thinly plated surfaces.**

TABLE 1-1.
AVIONICS CLEANING AND CORROSION REMOVAL CONSUMABLE MATERIALS (Continued)

ITEM NO.	NOMENCLATURE/ PRODUCT SPECIFICATION	APPLICATION
CLEANING COMPOUNDS, SOLVENTS, AND THINNERS		
CAUTION: Cleaning solvents may react with coatings and circuit components. When in doubt as to the reaction, test the affected area prior to wholesale application of solvent. **NOTE: Local air pollution regulations may restrict the use of the listed solvents. Comply with all local air pollution regulations.**		
8.	Detergent, Liquid Nonionic, MIL-D-16791, Type I	For cleaning and polishing transparent plastic and glass. Note: Mix per mfr's instructions or not more than 1 oz. per gal. of water. Also used for detergent in aqueous ultrasonic cleaners and aqueous spray cleaning booths.
9.	Cleaning Compound, MIL-C-85570, Type II	General cleaning. For removal of soil and fire extinguishing chemicals. Excellent cleaner for light oils and hydraulic fluids.
10.	Cleaning Compound, Solvent, Trichlorotrifluoroethane, MIL-C-8 1302, Type II	For use only in vapor degreasers.
11.	Cleaning Compound, Solvent Trichlorotrifluoroethane, MIL-C-81302, Type I (Ultra-clean)	For use only in vapor degreasers.
12.	Dry Cleaning Solvent, P-D-680, Type II	For general purpose cleaning of structural hardware, cases, covers, mountings, etc. For removal of heavy dirt, smoke damage, contaminants, fire extinguishing chemicals, and water displacing preservatives. **WARNING: P-D-680, Type I has a lower flash point of 100°F (38°C) and is not authorized for avionics cleaning.**
13.	Naphtha, Aliphatic, TT-N-9SB, Type II	For removal of polychlorinated biphenyl and silicone contaminants. **WARNING: Aliphatic Naphtha has a flash point of 60.8°F (16°C).**
14.	Isopropyl Alcohol, TT-I-735	For removal of fungus and bacteria. For removal of Van Waters and solder flux residue. For removal of contaminants on microminiature circuit components. For general cleaning and removal of salt residue and contaminants from circuit components. **WARNING: Isopropyl Alcohol has a flash point of 53°F (12°C).**
15.	Spray Cleaning Lubricating Compound, MIL-C-83360, Type I	Cleaner and lubricant for use on small switches and potentiometers where a residual lubricant is required after cleaning. Contains 5% silicone.

TABLE 1-1.
AVIONICS CLEANING AND CORROSION REMOVAL CONSUMABLE MATERIALS
(Continued)

ITEM NO.	NOMENCLATURE/ PRODUCT SPECIFICATION	APPLICATION
16.	Thinner, Acrylic Nitrocellulose Lacquer, MIL-T-19544	Thinner for Lacquer, Acrylic Nitrocellulose MIL-L-19538, MIL-C-22750, epoxy topcoats, Item No. 59 and 60, and MIL-P-23777 primer, Item No. 58.
17.	Thinner, Paint, Petroleum Spirits TT-T-291, Type III	Removal of preservative compounds. **CAUTION: Do not use on lacquers or synthetic resin base enamels.**
18.	Thinner, Synthetic Resin, Enamels TT-T-306	Used for thinning varnish, MIL-V-173C, Item No. 51. **CAUTION: Do not use in lacquers.**
19.	Thinner, Aliphatic Polyurethane Coating, MIL-1-81772, Type I (Polyurethane) Type II (Epoxy) Type III (Lacquer)	For thinning urethane and polyurethane topcoats, MIL-C-83286, and MIL-C-85285, Item No. 61 and 63; epoxy polyamide coatings, MIL-C-22750, Item No. 60; acrylic nitrocellulose lacquers, MIL-L-19S38, Item No. 59; and primer, MIL-P-23377, Item No. 58.
CORROSION PREVENTIVE COMPOUNDS (PRESERVATIVE)		
WARNING: Do not use Corrosion Preventive Compounds around oxygen, oxygen fittings, or oxygen regulators, since fire or explosion may result.		
20.	Corrosion Preventive Compound, Water-Displacing, Ultra-Thin Film, Avionics Grade, MIL-C-81309, Type III, Class 2 (Aerosol)	For use on highly critical electrical connectors' metal surfaces. For use in interior areas. Not intended for exterior areas exposed to the elements.
21.	Corrosion Preventive Compound, Water-Displacing, Ultra-Thin Film, MIL-C-81309, Type II, Class 2 (Aerosol), Class 1 (Bulk)	For use on all exposed metal and hardware on external chassis, covers, etc. Not intended for exterior areas exposed to the elements.
22.	Corrosion Preventive Compound, Water-Displacing, Clear, MIL-C-85054 Type I (Aerosol)	Water-displacing corrosion preventive. For use on all external surfaces exposed to elements and moisture. For use on chassis, mounting racks, terminal boards, hardware, bus bars, ground straps, etc.
23.	Corrosion Preventive Compound, Solvent Cutback, Cold Application MIL-C-16173, Grade 4 (Transparent Film)	For use on equipment racks, mounts, exposed hardware, etc. For use on exterior surfaces of electrical plugs and connectors. Not intended as a water-displacing compound.
LUBRICATING OILS AND GREASES		
24.	Lubricating Oil, General Purpose, Preservative (Water-Displacing), VV-L-800	General lubricating and protection of avionics components, hinges, and quick release devices. Suitable for use where a general purpose lubricating oil with low temperature and corrosion preventive properties is desired.

**TABLE 1-1.
AVIONICS CLEANING AND CORROSION REMOVAL CONSUMABLE MATERIALS
(Continued)**

ITEM NO.	NOMENCLATURE/ PRODUCT SPECIFICATION	APPLICATION
25.	Grease, Instrument, Ultra-clean, MIL-G-81937	For lubrication of bearings in instruments and related components such as synchros and gyros. Ideally suited for bearings having small tolerances with respect to clearance.
26.	Lubricating Oil Instrument, Ball Bearing, High Flash Point, MIL-L-81846	For use in precision instruments and miniature ball bearings. Temperature range of -65°F (-54°C) to 302°F (150°C).
27.	Grease, Aircraft, General Purpose, Wide Temperature Range, MIL-G-81322	For use on blower motors, servomotors, and gyro spin motors.
28.	Lubricating Solid Film, Air-Cured, Corrosion Inhibiting, MIL-L-23398	For use on aluminum alloys, copper and copper alloys, steel, stainless steel, titanium, and chromium and nickel bearing surfaces. For use on sliding motion applications such as locks, small internal cables, plain and spherical bearings, tracks, hinges, threads, and cam surfaces. For use in mechanisms that are “lubricated for life,” and in mechanisms operated at infrequent intervals. **CAUTION: Not to be used in operations consisting of rotary motion over 100 RPM under heavy loads where the possibility of conventional fluid lubricant contamination exists. Not to be used on bearings containing rolling elements.**
CLEANING CLOTHS		
29.	Cloth, Cleaning, Non-Woven Fabric, CCC-C-46, Class 7	No lint, extra heavy duty, moderate wet strength, good absorbency, and disposable. For use when good wet strength and short term rewetting is required, and for wiping critical avionics equipment. **WARNING: Not approved for use in wiping plastic and acrylic surfaces with solvents having a flash point of less than 100°F (38°C).**
30.	Cloth, Cleaning, Lint-Free, MIL-C-85043, Type I or Type II	Very low lint, relatively low absorbency, good wet strength, intended for wash and reuse. For use on critical surfaces where low contamination levels are required. Type I preferred for clean room applications. **CAUTION: Not authorized for use with solvents having a flash point of less than 100°F (38°C).**
31.	Cloth, Cheesecloth, Cotton, CCC-C-440, Type II, (28 x 24 weave), Class 1, Unbleached, or Class 2, Bleached	Moderate lint, high absorbency, high wet strength, reusable after washing, and disposable. For general cleaning on exterior surfaces of avionics equipment. For use as a tack rag and final wipe prior to painting.

TABLE 1-1.
AVIONICS CLEANING AND CORROSION REMOVAL CONSUMABLE MATERIALS
(Continued)

ITEM NO.	NOMENCLATURE/ PRODUCT SPECIFICATION	APPLICATION
32.	Cotton, Flannel, CCC-C-458, Type II (plain weave, unbleached, napped both sides, 4.6 oz. weight)	High lint, high absorbency, high wet strength, reusable after washing, and disposable. For use on cockpit indicator glass covers, plastic and acrylic control panels. **NOTE: Only authorized cloth for use in cleaning plastic and acrylics with solvents that have a flash point of less than 100°F (38°C).**
	SEALANTS	
33.	Adhesive-Sealant Silicone, RTV, Noncorrosive, 3145 RTV, MIL-A-46146, Type III	For use on sensitive metals and avionics equipment. Sealing areas where temperature is expected to be between 250°F (121°C) and 350°F (177°C).
34.	Sealing Compound, Polysulfide, MIL-S-81733, Type I (Brush Application) Type II (Spatula Application)	Contains corrosion inhibitors. For use in sealing gaps, seams, etc. For use up to 250°F (121°C).
35.	Sealing Compound, MIL-S-83318	A quick-cure sealant that contains corrosion inhibitors. For use in sealing gaps, seams, etc. during extreme cold weather activities.
36.	Sealing Compound, Temperature-Resistant, Integral Fuel Tanks, MIL-S-8802, Type A, Class 2 (Brush Application) or Type B, Class 2 (Spatula Application)	Sealing of gaps, seams, and faying surfaces. For use up to 250°F (121°C). Use when MIL-S-81733 is not available.
	POTTING COMPOUNDS	
	CAUTION: Potting Compounds Pro-Seal 777A/B (green) and EC-2273 (black) have experienced reversion to a liquid after 2 to 4 years of service depending on the environment. Not recommended for use in electrical connectors and avionics equipment.	
37.	Sealing Compound, Synthetic Rubber, Accelerated, MIL-S-8516 Class 1 (24 hr. cure) or Class 2 (48 hr. cure) or Class 3 (72 hr. cure)	For sealing low voltage electrical connectors, wiring, and other electrical apparatus against moisture and corrosion where temperature will not exceed 200°F (93°C). Good resistance to gasoline, oils, grease, water, and humidity. **CAUTION: Not authorized for use in engine bays, keel areas, or areas adjacent to bleed air ducts.**
38.	Sealing Compound, Silicone Rubber, Room Temperature Vulcanizing (RTV), MIL-S-23586, Type II, Class 2, Grade A	For sealing small electrical connectors in well ventilated areas where the operating temperature normally exceeds 200°F (93°C), but does not exceed 450°F (232°C). Good resistance to weathering and moisture, and withstands ozone. **CAUTION: Restricted to well ventilated areas due to volatile cure.**

TABLE 1-1.
AVIONICS CLEANING AND CORROSION REMOVAL CONSUMABLE MATERIALS (Continued)

ITEM NO.	NOMENCLATURE/ PRODUCT SPECIFICATION	APPLICATION
39.	Sealing Compound, Silicone Rubber, RTV, MIL-S-23586, Type I, Class 1, Grade B-1	For sealing or encasement of electrical connectors and electronic components where the operating temperature normally exceeds 200°F (93°C), but does not exceed 450°F (232°C). Good resistance to weathering and moisture, and withstands ozone. **NOTE: Does not contain cure volatiles as MIL-S-23586, Type II, Class 2, Grade A.**
MASKING MATERIALS AND TAPES		
40.	Preservation and Sealing Tape, Pressure Sensitive Adhesive, MIL-T-22085, Type II	For holding barrier material in place during shipping. Treated, noncorrosive, non-fungus supporting. For use on equipment without overcoating.
41.	Tape, Pressure Sensitive Adhesive, Paper Masking, Non-staining, MIL-T-21595, Type I	For masking of undamaged areas during paint touch-up on equipment cases, covers, mounting racks, etc. For masking electrical and electronic components during replacement of conformal coatings and varnishing. **CAUTION: Use only if component is sufficiently rigid to withstand application and removal of tape.**
42.	Tape, Pressure Sensitive Adhesive, MIL-T-23397, Type II	For masking during paint stripping operations on avionics equipment and airframe structure.
43.	Tape, Pressure Sensitive, MIL-T-23142	For isolating dissimilar metals where galvanic action may take place in avionics equipment.
44.	Insulating Tape Electrical, Self Bonding, Silicone	Used to wrap electrical wire bundles and connectors exposed to harsh environments.
45.	Paper, Kraft, Untreated, Wrapping, UU-P-268	Protection of surrounding areas during paint spray operations. General-use masking.
CONFORMAL COATINGS		
NOTE: Materials listed are for general purpose use on conformal coated circuit boards. For special applications on highly critical components, refer to the OEM's maintenance manual.		
46.	Epoxy Coating, Two-Part Application	For coating and patching epoxy- and parylene-coated circuit boards and components.
47.	Polyurethane Coating (Brush Application)	For coating and patching polyurethane and varnish coated circuit boards and components.
48.	RTV Coating, Nonflowable (Brush Application), 738 RTV (White) MIL-A-46146, Type I	For coating and patching RTV coated circuit boards and components. **NOTE: Will not flow into crevices or other hard to reach places.**
49.	RTV Coating, Flowable (Brush Application), 3140 RTV (Clear) MIL-A-46146, Type III	For coating and patching RTV coated circuit boards and components. **NOTE: Use in applications where a flowable material is required, such as potting connectors.**

TABLE 1-1.
AVIONICS CLEANING AND CORROSION REMOVAL CONSUMABLE MATERIALS (Continued)

ITEM NO.	NOMENCLATURE/ PRODUCT SPECIFICATION	APPLICATION
50.	Acrylic Coating	For coating and patching of acrylic and lacquer coated circuit boards and components.
51.	Varnish, MIL-V-173C	Moisture and fungus resistant for electrical equipment and for clear coating on copper. For coating and patching of varnish coated circuit boards. **NOTE: Thinner: see Item No. 18.**
NEUTRALIZING AGENTS		
52.	Sodium Biocarbonate, Technical, O-S-576	For neutralizing spilled sulfuric acid (electrolyte) in lead acid battery installations. For neutralizing leaking tantalum capacitors in avionics equipment.
53.	Sodium Phosphate, Monobasic, Anhydrous, Technical, MIL-S-13727	For neutralizing spilled potassium hydroxide (electrolyte) in nickel-cadmium and silver-zinc battery installations. Also used as an abrasive material in miniabrasive cleaning units.
CHEMICAL CONVERSION COATINGS		
54.	Boric Acid, O-C-265	For neutralizing electrolyte leakage from nickel-cadmium batteries.
55.	Chemical Conversion Material for Coating Aluminum and Aluminum Alloys. MIL-C-81706, Class 1A or Class 3	Used to conversion coat bare aluminum. Class 1: used for general conversion coating of aluminum. Class 3: used for conversion coating of aluminum where lower electrical resistance is required.
56.	Chemical Conversion Material for Coating Magnesium Alloys, MIL-M-3171, Type Vl	Used to conversion coat bare magnesium.
PAINT, PRIMERS, AND STRIPPERS		
57.	Epoxy Primer, Water Reducible, MIL-P-85582, Class II, Class I	Covers low-moisture sensitivity, corrosion-inhibited primer. Intended for spray application on surface treated metal. Low Volatile Organic Compound (VOC).
58.	Primer Coating, Epoxy Polyamide, MIL-P-23377, Type II	Covers low-moisture sensitivity, corrosion-inhibited primer. Intended for spray application on surface treated metal.
59.	Lacquer, Acrylic Nitrocellulose, MIL-L-19538 (Lusterless)	Used for cockpit instrument, control box, and avionics box touch-up. For equipment markings.
60.	Coating, Epoxy-Polyamide, MIL-C-22750	Used as a topcoat an all avionics equipment. **NOTE: Mix only materials from the same kit (the brand and batch numbers on the pigmented compound can must be the same as those on the converter can).**
61.	Coating, Urethane, Aliphatic, Isocyanate, MIL-C-83286	Used as a topcoat on all avionics equipment. Touch-up of polyurethane paint systems. (Noncompliant.)

**TABLE 1-1.
AVIONICS CLEANING AND CORROSION REMOVAL CONSUMABLE MATERIALS
(Continued)**

ITEM NO.	NOMENCLATURE/ PRODUCT SPECIFICATION	APPLICATION
62.	Coating, Aliphatic Polyurethane, Single Component, MIL-C-53039	Used as a topcoat on all avionics equipment.
63.	Coating, Polyurethane High Solids, MIL-C-85285, Type I and Type II	Type I used as a topcoat on all avionics equipment. 420 grams/liter maximum VOC. Type II used as a preferred topcoat for ground support equipment. 340 grams/liter maximum VOC.
64.	Coating Compound, Bituminous Solvent Type, Black, MIL-C-450, Low Solids Spraying Consistency or Medium Solids Brush and Spray Consistency	Petroleum asphalt base. Excellent acid resistance. For use on wood or metal battery boxes. Drying time: 30 to 60 minutes. **NOTE: Thinner: Petroleum Spirits, TT-T-291, Item No. 18.**
65.	Epoxy Paint Remover, MIL-R-1294	Removal of paint finishes.
66.	Polyethylene Foam, PPP-C-1752, Type II 1/2" x 4' x 125', in rolls	For cushioning equipment and protection against shock, on shelves, work benches, pallets, etc. **NOTE: Use double layers for heavy equipment.**
	PACKAGING MATERIALS	
67.	Cushioning Material, Plastic Open Cell, PPP-C-1842, Type III, Style A; Type III, Style B Width 12", 24", and 48" in rolls	To protect ESD-sensitive items from damage due to shock, vibration, corrosion, and abrasion during handling and shipment.
68.	Cushioning Material, Cellular Plastic Film (Bubble Wrap), PPP-C-795, Class 1 or Class 3 Width 12", 24", and 48" in rolls	For cushioning equipment and protection against shock. Provides limited protection against moisture. Seal with pressure sensitive tape, MIL-T-22085, Item No. 40.
69.	Unicellular Polypropylene Packaging Foam, PPP-C-1797 Width 12", 24", and 48" in rolls	Lint-free, non-dusting, nonabrasive. For cushioning equipment and protection against shock. Provides protection against moisture. Use in conjunction with Barrier Material, Water Vapor Proof, MIL-B-131, Item No. 72. Seal with pressure sensitive tape, MIL-T-22085, Item No. 40.
70.	Bags, Plastic (General Purpose), PPP-B-26	For protecting miniature and microminiature circuit components and laminated circuit boards against moisture and contamination. Considered for short-term, temporary protection during maintenance operation.
71.	Barrier Material, Water Vapor proof, Greaseproof, Flexible, Heat-Sealable, MIL-B-131, Class 1, 48" x 200 yd. roll	For protecting miniature and microminiature circuit components and laminated circuit boards against moisture and contamination. Heat-sealable. Protects material during transportation, storage, and in all weather conditions.

**TABLE 1-1.
AVIONICS CLEANING AND CORROSION REMOVAL CONSUMABLE MATERIALS
(Continued)**

ITEM NO.	NOMENCLATURE/ PRODUCT SPECIFICATION	APPLICATION
72.	Barrier Material, Water Vapor proof, Protective, Electrostatic and Electromagnetic Shielding, MIL-B-81705, Type I	Provides ESD and EMI packaging protection for hardware and components. May be used for long or short-term protection. Can be heat-sealed.
73.	Barrier Material, Water Vapor proof, Protective, Electrostatic and Electromagnetic Static Dissipative, MIL-B-81705, Type II	Provides ESD and EMI packaging protection for hardware and components. May be used for long or short-term protection. Can be heat-sealed.
	TRACERS	
74.	Indicator, Thymol Blue Reagent, MIL-T-17412	For detecting reverse voltage damage to wet-slug tantalum capacitors. Also used as a Nicad electrolyte indicator.
75.	Desiccant, Bagged, MIL-D-3464, Grade A	Absorbs moisture, lowers relative humidity when sealed in container.
76.	Humidity Indicator, MS-20003	Used to determine that desiccant within a package is sufficiently active to maintain a relative humidity below that at which corrosion will occur.
77.	Water, Distilled	Used for cleaning in critical soldering operations.
78.	Ammonium Hydroxide, Technical, O-A-451	Used to assist in dissolving indicator, Thymol Blue Reagent, O-C-265.
79.	Glass Beads, MIL-G-9954	Used as abrasive in handheld tool in blast cleaning cabinet.
80.	Silver Nitrate, O-C-265	Used to identify magnesium metal.
81.	Silver Nitrate, Solution, MIL-W-535	Used to identify magnesium metal.

APPENDIX 2. SPECIFIC CONSUMABLE MATERIALS FOR CLEANING AND CORROSION PREVENTION AND CONTROL

2-1. INTRODUCTION AND SCOPE.

This appendix supplements Appendix 1 by providing a more detailed listing of selected products by product numbers (P/N) and manufacturer(s) of acceptable consumable materials for avionics cleaning and corrosion prevention and control. Table 2-1 provides product numbers and manufacturer's name. Table 2-2 provides a listing of the manufacturers and addresses of their main plants.

TABLE 2-1.
AVIONICS CLEANING AND CORROSION REMOVAL CONSUMABLE MATERIALS

ITEM NO.	PRODUCT TYPE	MANUFACTURER'S DESIGNATION	MANUFACTURER
CLEANING COMPOUND, MIL-C-85570			
9	Type II	Leeder 1140-F	Ardrox, Inc.
9	Type II	8505	B&B Tritech, Inc.
9	Type II	Calla 855	Calla Chemical Operations
9	Type II	Aerowash NV	Diversity, Inc.
9	Type II	AC-17 8	Ecolab, Inc.
9	Type II	ED-4 10	Eldorado Chemical Co., Inc.
9	Type II	EZE-445	EZE Products, Inc.
9	Type II	MA-102	JAD Chemical Co., Inc.
9	Type II	CeeBee R-682	McGean-Rohco, Inc.
9	Type II	8002-2-SD	F.J. Morse & Co., Inc.
9	Type II	Octagon 855702	Octagon Process, Inc.
9	Type II	LD-38	Omnitech International, Inc.
9	Type II	PENN AIR M5572B	Penetone Corp.
9	Type II	93-1	Space Chemicals, Inc.
9	Type II	Turco 6692	Turco Products, Inc.
CORROSION PREVENTIVE COMPOUND, MIL-C-81309, Class 1 (Bulk), Class 2 (Aerosol)			
20	Type III	2080-MLCO	Bulk Chemical Corp.
20	Type III	So-Sure 0964-000	LHB Industries
20	Type III	LPS-814A	LPS Laboratories, Inc.
20	Type III	22028C2-3	Steven Industries, Inc.
20	Type III	Ardrox 3205 Aerosol	Ardrox, Inc.
20	Type III	CRC 3-36	CRC Chemicals Europe NV

TABLE 2-1.
AVIONICS CLEANING AND CORROSION REMOVAL CONSUMABLE MATERIALS
(Continued)

ITEM NO.	PRODUCT TYPE	MANUFACTURER'S DESIGNATION	MANUFACTURER
CORROSION PREVENTIVE COMPOUND, MIL-C-81309, Class 1 (Bulk), Class 2 (Aerosol) (Cont'd)			
20	Type III	ACF-50 Aerosol	Lear Chemical Research Corp.
21	Type II Class 1	Alox 2028C	Alox Corp.
21	Type II Class 1	Aidchim Alox 2080	Aidchim Ltd.
21	Type II Class 1	2028 BC-BULK	Bulk Chemical Corp.
21	Type II Class 1	Nox Rust 212	Daubert Chemical Co., Inc.
21	Type II Class 1	2775	Fine Organics Corp.
21	Type II Class 1	So-Sure 813	LHB Industries
21	Type II Class 1	LPS-813 Bulk	LPS Laboratories, Inc.
21	Type II Class 1	Octoil 5068	Octagon Process, Inc.
21	Type II Class 1	Omni 4150A	Omnitech Int'l, Inc.
21	Type II Class 1	97-SX092	Selig Chemical Industries
21	Type II Class 1	22018CM-Bulk	Steven Industries, Inc.
21	Type II Class 1	Ardrox 3204	Ardrox, Inc.
21	Type II Class 1	BATCO Rust Preventive	Battenfield Grease and Oil Corporation of NY
21	Type II Class 1	706 P.D.R.P. Bulk	Sprayon Products
21	Type II Class 1	D-5026 Bulk	Zip-Chem Products, Inc.
21	Type II Class 1	Ardrox 3204 Aerosol	Ardrox, Inc.
21	Type II Class 2	2028-BCCO Bulk	Chemicals Corp.
21	Type II Class 2	So-Sure 0954-000	LHB Industries
21	Type II Class 2	LPS-813A	LPS Laboratories, Inc.
21	Type II Class 2	706 P.D.R.P	Sprayon Products
21	Type II Class 2	22028C2	Steven Industries, Inc.
CORROSION PREVENTIVE COMPOUND, MIL-C-16173			
23	Grade 4	TECTYL 846	Ashland Industrial Products, Inc.
23	Grade 4	846-BC	Bulk Chemical Corp.
23	Grade 4	Braycote 194	Castrol, Inc.
23	Grade 4	CONVOY 734	Convoy Oil Corporation
23	Grade 4	Nox-Rust X-110	Daubert Chemical Company, Inc.
23	Grade 4	F & L 5846	F & L Company, Inc.
23	Grade 4	Steelgard MS-31	Harry Miller Corp.
23	Grade 4	Poly Oleum 5000	Poly Oleum Corporation
23	Grade 4	ST 1846	Steven Industries
23	Grade 4	No-Rust X-10	Steven Industries

TABLE 2-1.
AVIONICS CLEANING AND CORROSION REMOVAL CONSUMABLE MATERIALS
(Continued)

ITEM NO.	PRODUCT TYPE	MANUFACTURER'S DESIGNATION	MANUFACTURER
SEALANTS MIL-S-81733, Type I (Brush Application), Type II (Spatula Application)			
NOTE: Dash number following Type gives working time of the sealant in hours.			
34	Type I-1/2	P/S 870 A-1/2	Courtalds Aerospace
34	Type I-1/2	PR 1440G A-1/2	
34	Type I-2	P/S 870 A-2	
34	Type I-2	PR 1440G A-2	
SEALANTS MIL-S-81733, Type I (Brush Application), Type II (Spatula Application) (Continued)			
34	Type II-1/2	P/S 870 B-1/2	
34	Type II-1/2	PR 1440G B-1/2	
34	Type II-2	P/S 870 B-2	
34	Type II-2	PR 1440G B-2	
34	Type II-2	PR 1436G B-2	
34	Type II-4	P/S 870 B-4	
34	Type II-4	PR 1440G B-4	
SEALANTS MIL-S-8802, Class A (Brush Application), Class B (Spatula Application)			
NOTE: Dash number following Class gives working time of the sealant in hours.			
36	Class A-1/2	PR-1422	Courtaulds Aerospace
36	Class A-2		
36	Class B-1/2		
36	Class B-1		
36	Class B-2		
36	Class B-2	BR 4005	D Aircraft Products
36	Class B-1/2	FR 1072	Fiber Resin Corp.
36	Class B-2		
36	Class A-1/2	CS-3204	Flamemaster Corp.
36	Class A-1		
36	Class A-2		
36	Class B-1/2		
36	Class B-1		
36	Class B-2		
36	Class B-1	WS-8020	J&R Industries
36	Class B-2		
36	Class B-4		

TABLE 2-1.
AVIONICS CLEANING AND CORROSION REMOVAL CONSUMABLE MATERIALS
(Continued)

ITEM NO.	PRODUCT TYPE	MANUFACTURER'S DESIGNATION	MANUFACTURER
SEALANTS MIL-S-8802, Class A (Brush Application), Class B (Spatula Application), (Continued)			
36	Class B-1/2	MC-236	Morton International
36	Class B-1		
36	Class B-2		
36	Class B-2	PR-1440	Courtaulds Aerospace
36	Class A-1/2	PR-1440	
36	Class A-1	PR-1440	
36	Class A-2	Pro-Seal 890	
36	Class A-2	PR-1440	
36	Class B-1/2	Pro-Seal 890	Courtaulds Aerospace
36	Class B-1/2	PR-1440	
36	Class B-1	PR-1440	
36	Class B-2	Pro-Seal 890	
36	Class B-2	PR-1440	
36	Class B-4	Pro-Seal 890	
36	Class B-4	PR-1440	

TABLE 2-2.
MANUFACTURERS AND ADDRESSES

CLEANING COMPOUND, MIL-C-85570	
Ardrox, Inc. 16961 Knott Ave. La Mirada, CA 90638	JAD Chemical Co., Inc. PO Box 6786 Rancho Palos Verdes, CA 90734
B&B Tritech, Inc. PO Box 660-776 Miami, FL 33266-0776	McGean-Rohco, Inc. 9520 East Ceebee Drive Downey, CA 90241-7000
Calla Chemical Operations 3920 Essex Lane PO Box 27714 Houston, TX 77227	F.J. Morse & Co., Inc. 541 North Wheeler St. St. Paul, MN 55104-1733
Cole-Chem Corporation 11123 Rolling Springs Drive PO Box 621 Carmel, IN 46032	Octagon Process, Inc. 596 River Rd. Edgewater, NJ 07020
Ecolab, Inc. 70 Wabasha St. St. Paul, MN 55102-1307	Omnitech International, Inc. 800 North Acadia Ave. Thibodaux, LA 70301
Eldorado Chemical Co., Inc. PO Drawer 34837 San Antonio, TX 78265	Penetone Corp. 4 Hudson Ave. Tenafly, NJ 07670
EZE Products, Inc. PO Box 5744 Greenville, SC 29606	Space Chemicals, Inc. PO Box 1228 Indiana, PA 15701
Fine Organics Corp. 205 Main St. Lodi, NJ 07644	Turco Products, Inc. 7300 Bolsa Ave. Westminster, CA 92684-3600
CORROSION PREVENTIVE COMPOUND, MIL-C-81309	
Aidchim Ltd. PO Box 103 Roanana, 43100, Israel	Alox Corp. PO Box 517 Niagara Falls, NY 14302
Ardrox, Inc. 16961 Knott Ave. La Mirada, CA 90638	Octagon Process, Inc. 596 River Rd. Edgewater, NJ 07020

TABLE 2-2.
MANUFACTURERS AND ADDRESSES (Continued)

CORROSION PREVENTIVE COMPOUND, MIL-C-81309 (Continued)

Bulk Chemical Corp. 80 First St. Gretna, LA 70053	Omnitech International, Inc. 800 North Acadia Ave. Thibodaux, LA 70301
Battenfield Grease and Oil Corporation of NY 1174 Erie Ave. PO Box 728 North Tonawanda, NY 14120	Selig Chemical Industries 840 Selig Drive SW Atlanta, GA 30336-2240
Daubert Chemical Co., Inc. 4700 S. Central Ave. Chicago, IL 60638	Sprayon Products 6830 Cochran Rd. Solon, OH 44139-3908
Fine Organics Corp. 6935 West 62nd St. Chicago, IL 60638	Steven Industries, Inc. 39 Avenue C Bayonne, NJ 07002
LHB Industries 10440 Trenton Ave. St. Louis, MO 63132	Technolube Products 5814 East 61st St Los Angeles, CA 90040
LPS Laboratories, Inc. 4647 Hugh Howell Rd. Tucker, GA 30084	Zip-Chem Products, Inc. 1860 Dobbin Dr. San Jose, CA 95638

CORROSION PREVENTIVE COMPOUND, MIL-C-16173

Ashland Industrial Products, Inc. PO Box 14000 Lexington, KY 40512	Oakite Products, Inc. 50 Valley Road Berkeley Heights, NJ 07922
Bulk Chemical Corp. Div. of Malter International 80 First St. Gretna, LA 70053	Lion Oil Co. PO Box 7005 1000 McHenry St. El Dorado, AR 71730
Convoy Oil Corporation 1410 North Front St. Philadelphia, PA 19122	Jesco Resources, Inc. 1437 Gentry St. N. Kansas City, MO 64116
Castrol, Inc. Specialty Products Division 16715 Von Karman Ave. Suite 230 Irvine, CA 92714	LPS Laboratories, Inc. 4647 Hugh Howell Rd. Tucker, GA 30084

TABLE 2-2.
MANUFACTURERS AND ADDRESSES (Continued)

CORROSION PREVENTIVE COMPOUND, MIL-C-16173 (Continued)

Daubert Chemical Company, Inc.
4700 S. Central Ave.
Chicago, IL 60638

Deutsche Veedol GmbH
Hauptabteilung
Großverbraucher
Esplanade 39
2000 Hamburg 36, Germany

Esgard, Inc.
PO Box 2698
Lafayette, LA 70502

Franklin Oil Corp. (Ohio)
40 South Park St.
Bedford, OH 44146

F & L Company, Inc.
1537 E. Del Amo Blvd.
Carson, CA 90746

Harry Miller Corp.
4th & Bristol Sts.
Philadelphia, PA 19140

Poly Oleum Corporation
Elm and Lee Streets
Conshohocken, PA 19428-0809

Royal Lubricants Co., Inc.
River Road
E. Hanover, NJ 07936

Steven Industries
PO Box 8-39 Avenue C
Bayonne, NJ 07002

APPENDIX 3. DEFINITION OF TERMS

Acetic Acid
An organic acid that can form when a microorganism (acetobacteraceti) reacts with ethyl alcohol in the presence of oxygen. Characteristic of vinegar.

Acidic
Acid forming or having acid characteristics.

Active Metal
A metal ready to corrode or being corroded.

Additive
A compound added for a particular purpose. For example, additives in fuel and lubricants can prevent corrosion, gum formation, varnishing, sludge formation, and knocking.

Aerobic
A process which is incapable of occurring in the absence of oxygen.

Alkaline
Having a pH greater than 7.

Alloy
A combination of two or more metals.

Anaerobic
A process which is capable of occurring in the absence of oxygen.

Anion
A negatively-charged ion of an electrolyte which migrates toward the anode. The chloride in sea water is an anion.

Anode
The electrode of a corrosion cell at which oxidation or corrosion occurs. It may be a small area on the surface of a metal or alloy, such as that where a pit develops, or it may be the more active metal in a cell composed of two dissimilar metals, (i.e., the one with the greater tendency to go into solution). The corrosion process involves the change of metal atoms into actions with a liberation of electrons that migrate through the metal to the cathode of the cell.

Anodize
Application of a protective oxide film on a metal (such as aluminum) through an electrolytic process. This layer provides protection from corrosion and is a good base for paint.

Aqueous
Made from, with, or by water.

Austenitic
A term applied to that condition of iron associated with a change in crystal structure that makes it nonmagnetic. This occurs with ordinary iron at an elevated temperature. When sufficient chromium and nickel are present, lead becomes austenitic (nonmagnetic) at atmospheric temperatures. This is the case with many stainless steels that combine about 18% chromium and 8% or more nickel.

Bilge
The lowest point of an aircraft's inner hull. This is the area where cable runs, wire bundles, and coaxial cables are routed, and lights and antennas are often mounted.

Capillary Action
The action by which the surface of a liquid in contact with a solid is advanced or retarded (raised or lowered). This is caused by the relative attraction of the liquid molecules to each other (surface tension) and those of the solid. The "wicking" of fluid up a cloth is an example of capillary action.

Carbonize
To convert into carbon residue, usually by high heat.

Cathode
The less-active electrode of a corrosion cell, where the action of the corrosion current causes a reduction reaction.

Cation
A positively-charged ion of an electrolyte which migrates toward the cathode. Metal ions, such as iron or copper, are cations.

Caustic Embrittlement
The result of the combined action of tensile stress and corrosion in an alkaline solution. This can occur in riveted lap joints where there is a concentration of an alkali solution.

Cell
In the corrosion process, a cell is a source of an electrical current that is responsible for the corrosion. It consists of an anode and a cathode immersed in an electrolyte and electrically joined together. The anode and cathode may be separate metals or dissimilar areas on the same metal.

Chemical Conversion Coating
A chemical treatment of a metal surface, such as aluminum or magnesium, which results in a protective (corrosion resistant) film on the metal's surface. The coating also greatly enhances paint adhesion.

Chloride
A compound of chlorine. Many varieties of this compound are present in seawater and contribute to making the seawater an electrolyte (electrical conductive).

Clear Water
Colorless water containing no visible suspended particles.

Compound
Substances containing two or more elements.

Concentration Cell
An electrolytic cell, consisting of an electrolyte and two electrodes of the same metal or alloy, that develops a difference in potential as a result of a difference in concentration of ions (most often metal ions) or oxygen at different points in the solution.

Conformal Coating
A closely adhering moisture and gas barrier applied to circuit boards to prevent corrosion and breakdown of electrical insulation.

Corona
A faint glow adjacent to the surface of an electrical conductor at high voltage.

Corrosion
The deterioration of a substance (usually a metal) because of a reaction with its environment.

Corrosion Fatigue
A reduction in the ability of a metal to withstand cyclic stress by its exposure to a corrosive environment.

Corrosion Rate
The speed or rate of a corrosion attack expressed in material weight loss per unit of time.

Couple
Two or more metals or alloys in electrical contact with each other. These usually act as the electrodes of a cell if they are immersed in an electrolyte.

Critical Avionics Components
Miniature or microminiature circuits including the components, printed circuit boards, tunable coils, tuned circuits, and devices with gold-or silver-plated connectors or contacts.

Critical Humidity
The relative humidity, under a specific set of conditions, at which a metal or an alloy will begin to corrode. In the presence of hygroscopic (moisture-absorptive) solids or corrosion products, the critical humidity will be lowered. For example, steel will not corrode if the relative humidity is less than 30% in a marine atmosphere.

Deionized Water
Water which has had various minerals and inorganic materials removed by means of an ion exchange process.

Desiccant
A drying agent which acts by absorbing moisture.

Distilled Water
Water which has various organic and inorganic materials removed by means of an evaporation and condensation (distillation) process.

Durability
Ability of avionics equipment or components to function and sustain stress in field service for a specific period of time with economical maintenance. The durability is measured in terms of minimum acceptable failure free lifetime (MFL) and expected maximum lifetime (EML), including repairs.

Elastomer
A synthetic material with elastic properties.

Electrode
A metal or alloy that is in contact with an electrolyte and serves as the site where electricity passes in either direction between the electrolyte and metal. The current in the electrode itself is a flow of electrons, whereas, in the electrolyte ions carry electrical charges, and it is their orderly movement in solution which constitutes a flow of current in the electrolyte.

Electrolyte
Any substance which, in solution or fused, exists as electrically-charged ions that render the liquid capable of conducting a current. Soluble acids, bases, and salts, such as those in seawater, are electrolytes.

Element
Substances which cannot be decomposed by ordinary chemical changes or made by these changes.

Embrittlement
Severe loss of ductility of a metal alloy.

Emulsified
One liquid dispersed throughout another liquid with which it will not mix to form a homogeneous solution.

Encapsulant
The general term describing materials used to envelop or fill a void to prevent the entrance of moisture or fungus. Conformal coatings, fungus-proof coatings, and potting compounds are all forms of encapsulants.

Ester/Diester Oils
Oils containing synthetic materials known as esters or diesters, which are chemically formed by the reaction of an alcohol and an acid. These synthetic oils can attack certain plastics and paints.

Exfoliation
The breaking away of a material from its surface in flakes or layers. A thick layer-like growth of corrosion products.

Expected Maximum Lifetime
The expected maximum period of time over which an avionics system, subsystem, module, or component performs satisfactorily. This includes acceptable availability, operation, and support cost (specific number of repair cycles).

Fatigue
Tendency of a material to fracture in a brittle manner under repeated cyclic stressing or load at stress or load levels below its tensile strength.

Faying Surface
The common surface between mating surfaces of parts.

Fungus
A group of celled organisms (eukaryotic) that get their nutrients by secreting enzymes that break down organic matter in the tissue of other living or dead organisms. They then absorb the resulting nutrients. Includes mold, mildews, smut, mushrooms, and some bacteria.

Galvanic Couple
Two electrically-connected dissimilar metal conductors (may be a single metal in alloy) immersed in an electrolyte.

Galvanic Series
A list of metals and metal alloys arranged in an order of their relative electrical potentials for a given environment. The order of their arrangement in one list may be different in another environment.

Hydrogen Embrittlement
Loss of ductility of a metal caused by the entrance or absorption of hydrogen ions.

Hygroscopic
The property of readily absorbing and retaining moisture.

Inorganic Coating
A coating composed of matter other than of plant or mineral origin (i.e., electroplating, chemical conversion coating, anodize, phosphate, or oxide, etc.).

Ion
An electrically-charged atom or group of atoms. The sign of the charge is positive in the case of cations and negative in the case of anions.

Malfunction
The improper operation of a component or system.

Microbes
Microscopic living plants or organisms such as germs, molds, bacteria, and fungi.

Mil
A unit of length equal to one thousandth of an inch (0.001 inch).

Minimum Failure Free Lifetime (MFL)
The minimum period of time that an avionics system, subsystem, module, or component performs satisfactorily without failure.

Nitrates
Compounds including certain combinations of nitrogen and oxygen. Present in many industrial pollutants.

Noble Metal
A metal usually found as uncombined metal in nature. Platinum, gold, and silver are noble metals.

Noncritical Avionics Components
Components such as tube sockets, mechanical devices, knobs, and hardware.

Non-Destructive Inspection
A method used to check the soundness of a material or a part without diminishing the strength, value, quality, or serviceability of the part.

Organic Coating
A coating composed of matter derived from living organisms or carbon based compounds (i.e., paint, plastic, grease, preservative).

Outgassing
Emission of a gas during the cure or decomposition of organic material. Usually increases with a rise in temperature.

Passivation
The process or processes that cause a metal to become inert in a given corrosive environment.

pH
A measure of hydrogen ions in concentration of a solution (pH 7 is neutral; below 7 is acidic; above 7 is basic or alkaline).

Phantom Gripe
An intermittent malfunction or failure which cannot be verified, identified, or duplicated for corrective action.

Pitting
A form of corrosion that develops in highly localized areas of a metal surface that is not attacked elsewhere to any great extent. This corrosion attack results in the development of cavities or pits. Pits may vary from deep cavities of small diameter to relatively shallow depressions.

Plasticizer
A chemical added to rubber or resins to impart flexibility.

Polyethylene
A thermal plastic (softens when heated) characterized by its high impact strength, high electrical resistively, nontoxicity, and combustibility. One of several plastics used in wire coating.

Potting Compound
A rubber-like material, usually poured, which cures to a hard consistency and provides moisture and vibration resistance to the item.

Primer Coat
The first coat of a protective paint system. Improves adhesion of the succeeding topcoat and usually contains a corrosion inhibitor.

Reduction Reaction
Gain of electrons by a constituent of a chemical reaction.

Relative Humidity
The ratio of the amount of water vapor in the air at a specific temperature to the maximum amount that the air could hold at that temperature, expressed as a percentage.

Reversion
The situation wherein a cured material reverts toward its original pre-cured condition, (e.g., a cured potting compound that reverts to a sticky, liquid-like consistency).

Stress
Force divided by cross-sectional area.

Symbols
The following definitions apply to warnings, cautions, and notes found throughout this AC:

> **WARNING:** An operation or maintenance procedure, practice, condition, statement, etc., which if not strictly observed, could result in injury to or death of personnel or long term (chronic) health hazards to personnel.
>
> **CAUTION:** An operation or maintenance procedure, practice, condition, statement, etc., which if not strictly observed, could result in damage or destruction of equipment or loss of mission effectiveness.

NOTE: An operating procedure, practice, or condition, etc., which is essential to emphasize.

Tensile Strength
Stress at which a material fails.

Total Environment
The circumstances and conditions which surround and influence the equipment. The total environment includes manufacturing, handling, storage, shipping, mission, maintenance, and repair.

Ultraviolet Light
Light in a wavelength band ranging from the invisible wavelengths of about 4 nanometers to the border of the x-ray region at about 380 nanometers, just beyond the violet end of the visible spectrum.

Unacceptable Response
A detrimental abnormality in system performance.

Undesirable Response
A tolerated interruption of normal performance.

Wicking
See Capillary Action.

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