U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: Inspection, Prevention, Control, and Repair of Corrosion on Avionics Equipment

Date: 8/7/24
Initiated by: AFS-300
AC No: 43-206
Change: 1

1. PURPOSE OF THIS ADVISORY CIRCULAR (AC). This AC contains methods, techniques, and practices acceptable to the Administrator for inspection, prevention, control, and repair of corrosion on avionics systems and equipment. The procedures in this AC are an acceptable means, but not the only means, of inspecting, preventing, controlling, and repairing avionics corrosion. This AC is intended to supplement the Original Equipment Manufacturer's (OEM) published recommendations, or for use when there are no OEM repair or maintenance instructions. Operators having their own Federal Aviation Administration (FAA)-approved maintenance program may also include the guidance contained in this AC in the development of such programs. The contents of this document do not have the force and effect of law and are not meant to bind the public in any way, and the document is intended only to provide information to the public regarding existing requirements under the law or agency policies.

2. PRINCIPAL CHANGES. This change updates all outdated references throughout the AC.

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Hugh Thomas for
Lawrence Fields
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2. BACKGROUND. Today's avionics systems assume a major responsibility for the performance, safety, and success of commercial and general aviation. These avionics systems control the operation of flight-critical and flight-essential equipment, including navigation, communications, power distribution, flight and engine controls, displays, and wiring. The reliability of these complex and often interrelated systems in any environment is critical for safe operation.

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CHAPTER 1. GENERAL

101. PURPOSE OF THIS ADVISORY CIRCULAR (AC). This AC contains methods, techniques, and practices acceptable to the Administrator for inspection, prevention, control, and repair of corrosion on avionics systems and equipment. The procedures in this AC are an acceptable means, but not the only means, of inspecting, preventing, controlling, and repairing avionics corrosion. This AC is intended to supplement the Original Equipment Manufacturer's (OEM) published recommendations, or for use when there are no OEM repair or maintenance instructions. Operators having their own Federal Aviation Administration (FAA)-approved maintenance program may also include the guidance contained in this AC in the development of such programs. The contents of this document do not have the force and effect of law and are not meant to bind the public in any way, and the document is intended only to provide information to the public regarding existing requirements under the law or agency policies.

102. BACKGROUND.

a. Today's avionics systems assume a major responsibility for the performance, safety, and success of commercial and general aviation. These avionics systems control the operation of flight-critical and flight-essential equipment, including navigation, communications, power distribution, flight and engine controls, displays, and wiring. The reliability of these complex and often interrelated systems in any environment is critical for safe operation.

NOTE: In this AC, use of the term "avionics systems" shall refer to any device that uses or conducts electrical power.

b. Corrosion is a major cause of avionics equipment failures, particularly when the equipment is installed in the aircraft. Studies have shown that 20 percent of avionics equipment failures are a direct result of corrosion. Even minute amounts of corrosion can cause intermittent malfunctions or complete equipment failures. Past experience has shown that avionics equipment designers have compromised the corrosion resistance in their designs by selecting incompatible or corrosion-prone materials in order to obtain certain electrical characteristics. These compromises can lead to corrosion problems that are aggravated by the exposure to various environmental conditions, including changes in temperature, pressure, humidity, dust, dirt, and industrial pollutants in the atmosphere.

c. The types of corrosion that occur on avionics equipment are similar to those found on airframe structures. These different types of corrosion are discussed in Chapter 2 and in AC 43-4, Corrosion Control for Aircraft. The primary difference between avionics and airframe corrosion is that a small amount of corrosion in avionics equipment can cause intermittent malfunction or complete failure, while the same amount on the airframe structure usually has little or no immediate effect.

103. MILITARY SPECIFICATIONS (MIL-SPEC).

a. Throughout this AC, materials recommended to prevent, control, and repair corrosion on avionics equipment will be listed. The materials listed will be identified using Military Specifications (MIL-SPEC). Appendices 1 and 2 list MIL-SPEC materials and equivalent commercially available products.

b. MIL-SPEC materials have undergone rigorous testing and qualification at government laboratories, plus years of in-service use on military aircraft and equipment in the harshest environments. These products are capable of providing an acceptable means of preventing and controlling avionics corrosion.

c. MIL-SPEC materials are not the only materials available on the commercial market. New materials are being developed by manufacturers each day. These products may also provide an acceptable means of preventing, controlling, and repairing avionics corrosion. These new products may eventually be qualified to a MIL-SPEC.

104. SCOPE AND ARRANGEMENT. This AC provides basic avionics corrosion prevention and control maintenance information for use by all segments of aviation. The AC consists of ten chapters, three appendices, and an index. Summary of the contents within this AC are as follows:

a. Chapter 1, General.

b. Chapter 2, Corrosion Principles and Description. This chapter explains what avionics corrosion is, why it occurs, and the various forms it can take. Special emphasis is placed on the conditions causing corrosion and the peculiar aspects of environmental damage and fungal growth that apply to avionics equipment.

c. Chapter 3, Corrosion Control Program and Inspection. This chapter outlines a preventive maintenance program, explains how to recognize corrosion, and lists components most affected by corrosion.

d. Chapter 4, Cleaning and Preservation. This chapter describes the materials, equipment, and techniques recommended in the mechanical cleaning and preservation of avionics equipment.

e. Chapter 5, Corrosion Removal, Surface Treatment, Painting, and Sealing. This chapter describes materials and techniques used in the removal of avionics corrosion, and treatments and coatings that can be applied to various external and internal avionics equipment.

f. Chapter 6, Treatment of Specific Avionics Equipment. This chapter describes the materials and techniques recommended to remove corrosion from specific avionics equipment.

g. Chapter 7, Corrosion Control Measures for Electrical Bonding/Grounding. This chapter describes the materials and techniques for repairing or replacing existing bonding and grounding connections.

h. Chapter 8, Effect and Treatment of Corrosion on Electromagnetic Interference Shielding Devices. This chapter describes the electromagnetic environment in which avionics systems and equipment operate. The chapter reviews protection measures and techniques used to minimize electromagnetic interference (EMI).

i. Chapter 9, Effect and Treatment of Corrosion on Electrostatic Discharge Sensitive Equipment. This chapter describes the basic theory surrounding Electrostatic

Discharge (ESD) and outlines some of the methods currently available to keep ESD from occurring.

j. Chapter 10, Emergency Action for Serious Corrosion of Avionics Equipment. This chapter outlines the recommended emergency procedures to be followed after avionics equipment has been exposed to fire extinguishing agents, water immersion, or saltwater.

k. Appendix 1, Consumable Supplies and Materials. This appendix lists corrosion control materials and applications.

l. Appendix 2, Specific Consumable Materials for Cleaning and Corrosion Prevention and Control. This appendix serves as a supplement to 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.

m. Appendix 3, Definition of Terms. Contains a list of defined terms commonly used by avionics corrosion control personnel.

n. Comprehensive Index. The index locates specific subjects in this AC.

105. ENVIRONMENTAL CONCERNS. Federal and State laws concerning the environment and hazardous materials (HAZMAT) are constantly being revised and tightened. Additionally, local ordinances concerning the environment and HAZMAT vary from location to location. Therefore, throughout this AC, when a material is required for a specific task and that material is an ozone depleting substance (ODS), the specific material will not be mentioned. For example, if a specific solvent is required for a cleaning operation, the term "approved solvent" will be used in place of a specific solvent call out.

106. SAFETY.

a. The following general safety precautions are not related to any specific task and may not appear elsewhere within this AC.

(1) Keep away from live circuits. Always remove power from, discharge, and ground a circuit before touching it.

(2) Do not service or adjust equipment alone. Maintenance personnel should not reach into, adjust, or service equipment, except in the presence of other personnel who are capable of rendering aid.

(3) Personnel working with or near high voltages should be familiar with modern methods of cardiopulmonary resuscitation (CPR).

(4) Personnel working in noise hazardous areas should wear proper hearing protection, and not exceed time limits for exposures to various sound intensities. Have periodic hearing ability checks.

(5) Use safety shields and glasses when working with power equipment. Adequate shielding for eyes and face should be used at all times.

b. Warnings and cautions contained within this AC are intended to notify personnel of potential equipment hazards and damage. Warnings are used to alert personnel of potential personal safety and health hazards. Cautions are used to alert personnel of conditions which could result in damage to equipment and property.

c. Responsibilities of supervisory personnel. The supervisor should receive training in and be knowledgeable about:

(1) Recognition and elimination of hazards,

(2) Occupational safety and health laws,

(3) Providing a safe workplace,

(4) Accident investigation and reporting procedures, and

(5) Proper inspection and maintenance methods for personal safety and protective equipment.

d. Supervisors should also review material safety data sheets (MSDS) for characteristics and hazards of the materials employees may be exposed to and ensure that personnel use required protective equipment.

e. Maintenance personnel should use appropriate protective equipment while exposed to hazardous conditions to prevent accidents, injuries, and occupational illness. Maintenance personnel should not use personal safety and protective equipment that is not in satisfactory and serviceable condition. All personnel should review MSDS for characteristics of materials that they may be exposed to. All personnel should review and comply with occupational safety and health requirements.

f. Many of the materials and procedures outlined in this AC are potentially hazardous to personnel and can cause damage to aircraft and equipment if used improperly. When using maintenance chemicals such as paint strippers, detergents, solvents, conversion coatings, and paint, follow the correct procedures and read all warnings, cautions, and notes.

107 through 200. RESERVED.

CHAPTER 2. CORROSION PRINCIPLES AND DESCRIPTION

201. OVERVIEW.

a. Maintenance of avionics equipment requires knowledge of aircraft electrical/electronic systems corrosion control. This knowledge requires the definitions and descriptions of the mechanisms that cause corrosion in avionics equipment. The definition of corrosion is "a chemical or electrochemical deterioration of a material, usually a metal, because of a reaction with its environment." This deterioration can be complex because of the nature of the following:

(1) The different individual types of corrosion,

(2) Simultaneous attack by several types of corrosion, and

(3) The design characteristics and maintenance factors that make avionics systems susceptible to corrosion attack.

b. Corrosion can cause intermittent malfunctions, undesirable changes in electrical characteristics, or complete equipment failures. Avionics equipment does not have to be installed, operated, or located in a particularly harsh environment to be affected by corrosion. Some forms of corrosion will be active in near ideal environments. Corrosion is the natural process of materials returning to their natural state. Avionics maintenance personnel should recognize that corrosion never sleeps and once started, corrosion continues its attack 24 hours a day, 365 days a year. Inadequate corrosion prevention and control will ultimately affect the equipment in down time and overall system reliability. Described in this advisory circular (AC) are methods to prevent and control corrosion of avionics equipment.

202. CORROSION THEORY.

a. Definitions of Terms:

(1) Element. A basic pure chemical substance. There are over 100 elements in nature, such as metals (e.g., titanium, gold, iron) and nonmetals (e.g., hydrogen, sulfur, nitrogen).

(2) Atom. The smallest unit of an element which is made up of a nucleus (protons and neutrons), and orbiting electrons.

(3) Electron. A negatively charged particle which orbits the nucleus of an atom. Electrons flow through an electrolyte only in the presence of ions.

(4) Ions. An atom that is either positively or negatively charged. A charged atom is called an ion. When ions move through an electrolyte, an electric current is produced. Ions cannot move through metal conductors.

(5) Compounds. Substances made up of two or more elements that chemically combine.

(6) Anode. A conductive metal that has a tendency to corrode.

(7) Cathode. A dissimilar conductive material (usually a metal) which has less tendency to corrode.

(8) Electrolyte. A conductive liquid (usually water) that contains ions in solution. For example, saltwater is an electrolyte made up of water containing sodium and chlorine ions. The electrolyte solution is capable of carrying an electric current between the anode and cathode.

(9) Electron Conductor. Electrical contact between the anode and the cathode; for example, the different elements that make up an alloyed metal, or a fastener holding two pieces of metal (anode and cathode) together.

(10) Galvanic Couple. A cell consisting of two dissimilar metals (an anode and a cathode) in contact with each other through an electrolyte solution.

b. When a metal corrodes, electrons are lost from the atoms in the metal part, and these atoms become metal ions in the electrolyte. Once in solution, positively charged metal ions can combine with the negatively charged ions to form corrosion products.

c. A metal will corrode only when all four of the following exist: there is an anode, there is a cathode, there is an electrolyte containing ions, and the anode and cathode are connected by an electron conductor. Elimination of any one of these four items will slow the corrosion process.

203. FACTORS INFLUENCING CORROSION.

a. Basic Design. There are many design decisions and compromises to be made in the course of developing avionics equipment. The design specifications leave room for a wide range of engineering practices to meet not only the performance, cost, and schedule, but also the reliability and maintainability requirements. Each piece of avionics equipment is designed to withstand its intended operational environment. However, some design compromises have to be made to provide the unique electrical, mechanical, and thermal characteristics of the equipment. These compromises can cause the equipment to be vulnerable to corrosion, especially during inoperative periods. Good design practices include:

(1) Shoe Box Type Lid Construction. When access to the equipment is from the top, use a shoe box type lid construction. Fasteners securing the shoe box lid should be from the sides and not through the top.

(2) Limited Openings in the Equipment Housing. To minimize moisture intrusion, keep the number of penetrations into the equipment to a minimum. When penetration is required, use “O” rings and gaskets for sealing. For wiring entry, use “L” type electrical connectors and mount them horizontally (through the vertical sides), and well above the bottom of the housing.

(3) Proper Electrical Connector Mounting. Electrical and coaxial connectors should be mounted horizontally (through the vertical sides). When electrical and coaxial connectors are mounted on the top of the equipment, there should be a raised area on the upper side of the equipment where the connector is mounted, and an “L” type connector should be used. Electrical wiring should incorporate a drip loop into the wiring harness so the wiring is leading up to the connector.

(4) Proper Printed Circuit Board Mounting. Printed circuit board should be mounted vertically with the electrical connection also in a vertical position.

(5) Low Point Drains. Low point drains should be incorporated so that any moisture will drain from the equipment when the aircraft is in the flight position and when it is parked on the ground.

(6) Eliminating Moisture Traps. Avoid moisture traps or bathtub areas on the interior areas of the equipment. Design in drain paths to the low point drains. Avoid moisture traps in electrical wire bundles where anti-chaffing material or boots are incorporated.

(7) Cooling Air Systems. Cooling air systems should incorporate a system to remove moisture and particulate matter from the conditioned air. This is especially important when the conditioned air is forced directly towards active electronic elements.

(8) Proper Bonding and Grounding. Electrical bonding and grounding should be accomplished using straps rather than sliding housing-to-rack or tapered pin on housing-to-rack electrical contacts. Straps should be located for ease of maintenance and properly sealed because of the dissimilar metal (galvanic) couple.

(9) Proper Equipment Mounting. Avionics equipment should be mounted in such a manner that will allow sufficient airflow around the equipment and keep the equipment at least 1/2 inch above the compartment floor.

b. Material Selections and Uses. Proper material selection is critical for protecting avionics equipment against the environment. Many types of corrosion that occur in avionics equipment also occur in the airframe structure. However, the range of material call outs in avionics equipment is greater than in the airframe. Several new types of corrosion problems are therefore unique to avionics equipment. The following indicate the uses of different materials in the construction of various electrical and electronic components.

(1) Copper and copper-based alloys are generally used in avionics systems as contacts, springs, leads, connectors, printed circuit boards (PCB), conductors, and wire.

(2) Iron and steel are used as component leads, magnetic shields, transformer cores, brackets, racks, and general hardware.

(3) Magnesium alloys are used extensively throughout avionics systems as antenna structures, chassis, supports, and frames (radar).

(4) Nickel and tin plating are used for protective coatings and for material compatibility purposes. Tin is also one of the components of solder. Tin plating is also used on radio frequency (RF) shields, filters, and automatic switching devices.

(5) Silver is used as a protective plating material over copper in wave guides, miniature and microminiature circuit boards, tank circuits, and RF shielding.

(6) Aluminum and aluminum alloys are widely used, because of their light weight, in equipment housings, chassis, mounting racks, supports, and electrical connector shells.

(7) Cadmium is used as a sacrificial coating on ferrous hardware, such as bolts, nuts, washers, and screws.

(8) Ion vapor deposition (IVD) of aluminum is also used as a sacrificial coating on hardware and is a nonhazardous replacement for cadmium.

(9) Gold is commonly used on electrical connectors, contacts, and edge connectors where the lowest electrical resistance is required.

c. Material Compatibility. Due to the complexity of the material process used in modern electronic assemblies, it is sometimes difficult to predict if potential problems will be created by the reaction between two or more nonmetallic materials in a circuit assembly. Incompatibility of materials can result in the release of chemicals or gases that will react with other circuit components. In some cases, the incompatibility of cleaning solutions will cause reactions in substances that are corrosive to associated circuitry. The following list contains several of the potential problems:

(1) The heating of conformal coating for the purpose of removal or repair may cause an outgassing that can be corrosive to metal components.

(2) Some commercial coating strippers contain acids that attack PCB laminates and discolor or corrode copper.

(3) Certain room temperature vulcanizing (RTV) silicone sealants contain acetic acid that is highly corrosive to metal components in avionics circuits. See Chapter 5, subparagraphs 505d(4) through (6), and Table 5-2.

(4) Some potting compounds revert to a liquid form under certain conditions. This reversion process reduces moisture protection in electrical connectors. See Chapter 5, subparagraph 505b.

(5) Degradation of polyvinyl chloride gives off acetic fumes, which are corrosive to most metals used in avionics equipment.

(6) Shrinkable elastomers (heat shrink) tubing, although not a problem directly, can cause damage to adjacent circuitry when heat guns are applied to shrink the tubing.

(7) Some dry film lubricants contain graphite, which is an excellent lubricant, but graphite is also corrosive. Graphite is cathodic to metals and, in the presence of moisture, promotes galvanic corrosion. Other dry film lubricants contain molybdenum disulfide which in the presence of moisture and heat can form a corrosive sulfuric acid.

(8) Certain oils, especially silicones and greases, creep as temperature increases, causing contamination of organic coatings and attraction of dust.

d. Moisture Intrusion. Moisture intrusion can take several forms: accidental dousing, or immersion; or normally as a gas in the form of water vapor (i.e., humidity), or finely divided droplets of liquid (i.e., mist or fog). The normal type of moisture often contains pollutants such as particulates, smog, industrial contaminants, and chlorides from salt laden air. Except for hermetically sealed or pressurized avionics equipment, most avionics equipment breathes. This allows the free passage of this polluted moisture in and out of the equipment. The polluted moisture collects on the internal electrical and structural components through condensation. The following are methods of minimizing moisture intrusion.

(1) Hermetic Sealing. Hermetic sealing provides the greatest resistance to moisture intrusion by providing adequate seals (solder or glass fusion joints) on the equipment and filling the interior compartment with a dry inert gas. Hermetically sealed avionics equipment provides for a seal integrity check by a built-in visual indicator. Cooling requirements, size, and container penetrations will often preclude this type of moisture intrusion protection.

(2) Pressurization of Equipment. The next best avionics equipment moisture intrusion protection is through pressurization of the equipment or the equipment compartment. The introduction of pressurized dry air into a semi-sealed area greatly reduces the intrusion of moisture. However, the additional weight required to achieve the necessary equipment rigidity largely precludes the use of this method of moisture intrusion reduction.

(3) Sealing of Equipment. For avionics equipment that cannot be hermetically sealed or pressurized, protection from moisture intrusion can best be achieved by applying a sealant. Two types of sealant are available. Current technology uses polysulfide and RTV silicone sealants. Polysulfide sealants are two part component sealants, whereas RTV sealants are single component. For avionics equipment, RTV sealants that have a vinegar odor are not authorized. This type of sealant contains an acetic acid used for curing the sealant. The acid will cause corrosion.

e. Manufacturing Process.

(1) Surface Treatments. Avionics equipment cases are manufactured from aluminum, and occasionally magnesium, because of weight considerations, cooling efficiency, and cost. Surface treatments, commonly called pre-treatments, are an important first step in the overall protection of the equipment. The most common surface treatments for aluminum are anodizing and chemical conversion coating. Anodizing is normally applied by the original avionics equipment manufacturer on interior and exterior surfaces. Chemical conversion coating is normally a pre-treatment process applied by repair facilities. The MIL-SPEC for chemical conversion coating is MIL-C-5541, Class II and Class III. Class II is used for aircraft structural components, avionics cases, and at any location where electrical bonding is not a consideration. Class III is an avionics grade chemical conversion coating and provides adequate electrical continuity while providing some corrosion protection. The pre-treatment for the repair of magnesium is a chemical conversion coat conforming to SAE-AMS-M-3171, Type VI.

(2) Organic Coatings. The exterior paint system on avionics equipment consists of a primer and a topcoat. The primer promotes adhesion and contains corrosion inhibitors. The topcoat provides durability to the paint system, including weather and chemical resistance. Environmental concerns, as well as local and state air pollution regulations have implemented strict controls on the amount of volatile organic compounds (VOC) (solvent) contained in primers and topcoats. The majority of all new avionics equipment is painted with VOC compliant water-based primers and topcoats.

(3) Conformal Coatings. Conformal coatings offer the same protection to electrical components within the avionics equipment as the primer and topcoat offer to the exterior of the same equipment. Conformal coatings are generally a clear plastic coating applied over the electrical components, conforming to MIL-SPEC MIL-I-46058, as revised. Conformal coatings offer several advantages: protection from moisture and corrosion, and enhanced resistance to shock and vibration. Generally, there is no field level repair for conformal coated components.

(4) Plating Systems. Metal plating is used in avionics equipment to provide sacrificial protection, barrier protection, and as a neutral nonreactive metal between two dissimilar metallic surfaces. Gold and tin are the two most widely used plating metals. Gold plating requires another metal (base) to be plated under the gold, usually nickel, silver, or copper. A nonporous gold plating is required to eliminate galvanic corrosion with the base-plated metal. Special corrosion conditions can be set up between gold and silver-copper plating if damaged. This special galvanic corrosion condition for gold is referred to as red plague. A special galvanic corrosion condition, known as purple plague, can form between gold and aluminum in the presence of silicone.

204. ENVIRONMENTAL CONDITIONS.

a. Within the Aircraft. Maintenance personnel often assume that, once installed within the aircraft cockpit, cabin, and/or equipment bays, avionics equipment will be protected from water or fluid intrusion and, therefore, free of significant corrosion. In-service use has shown that this is not the case. Airframe flexing combined with in-service use and handling damage can lead to seal deterioration and violation of the water tightness of the airframe and avionics equipment.

b. Operational Environments. The operational environment of today's aircraft consists of two main conditions: periods of in-service use and periods of non-operation. When avionics equipment is operating, the heat generated by the equipment tends to drive off or at least minimize moisture intrusion or entrapment. The ability of corrosion to start or continue will be reduced. Conversely, when avionics equipment is not in operation moisture can collect on the electrical components, increasing the opportunity for corrosion to start.

205. CORROSIVE CONDITIONS.

a. General. Corrosion is a major contributing cause to the reduction of avionics equipment reliability. Moisture is the single most important contributor to corrosion in avionics systems. The following paragraphs discuss environmental factors that have a major effect in the amount of corrosion on the equipment.

b. Moisture. Moisture can be either a gas, water vapor (humidity), or finely divided droplets of liquid (mist or fog). This moisture generally contains industrial pollutants, particulates, smog, and chlorides from salt laden air. Moisture enters all areas of an aircraft and avionics equipment exposed to air. All enclosed areas that are not sealed allow moisture laden air to enter and leave while the difference in pressure between the inside and outside of the equipment changes. These pressure differences occur when the aircraft changes altitude, when atmospheric weather changes occur, and when the temperature changes within the equipment. Cooling air can also introduce moisture into the equipment.

c. Condensed Moisture. Airborne moisture will condense when the air temperature drops below the dew point or when the air comes in contact with any surface colder than the dew point temperature. Water droplets on the outside of a cold drinking glass are an example of this condition. Condensed moisture usually evaporates as the surrounding air warms. When this occurs, the contaminants that were brought in by moisture-laden air and distributed on the equipment during condensation are left behind.

d. Residual Contaminants. Residual contaminants usually consist of industrial pollutants, dusts, and salts. Industrial pollutants include: carbon from internal combustion engines, nitrates from agricultural fertilizers, ozone from electrical motors and welding processes, sulfur dioxide from turbine engines, industrial and ship exhausts stacks, and sulfates from automobile exhausts. Dusts include sand, dirt, and volcanic ash. Figure 2-1 shows dust and dirt accumulation. The contaminants found in industrial areas often contain a number of tar products, ashes, and soot. The primary sources of salt are the world's oceans. The oceans contain between 3.5% and 3.9% salt. Normal sea winds can carry from 10 to 100 pounds of sea salt per cubic mile of air inland up to 100 miles.

e. Other Fluids. Many fluids can be present in various areas of an airframe. Table 2-1 lists the type of fluid intrusion and possible effects. Fluids can be from external sources, internal leaks, or servicing spills. Some of these fluids are corrosive to metals, while others are destructive to seals. Destruction of seals can lead to fluid intrusion into areas that were considered, by the design, protected from corrosive fluids.

FIGURE 2-1. DUST AND DIRT ACCUMULATION ON TERMINAL STRIP

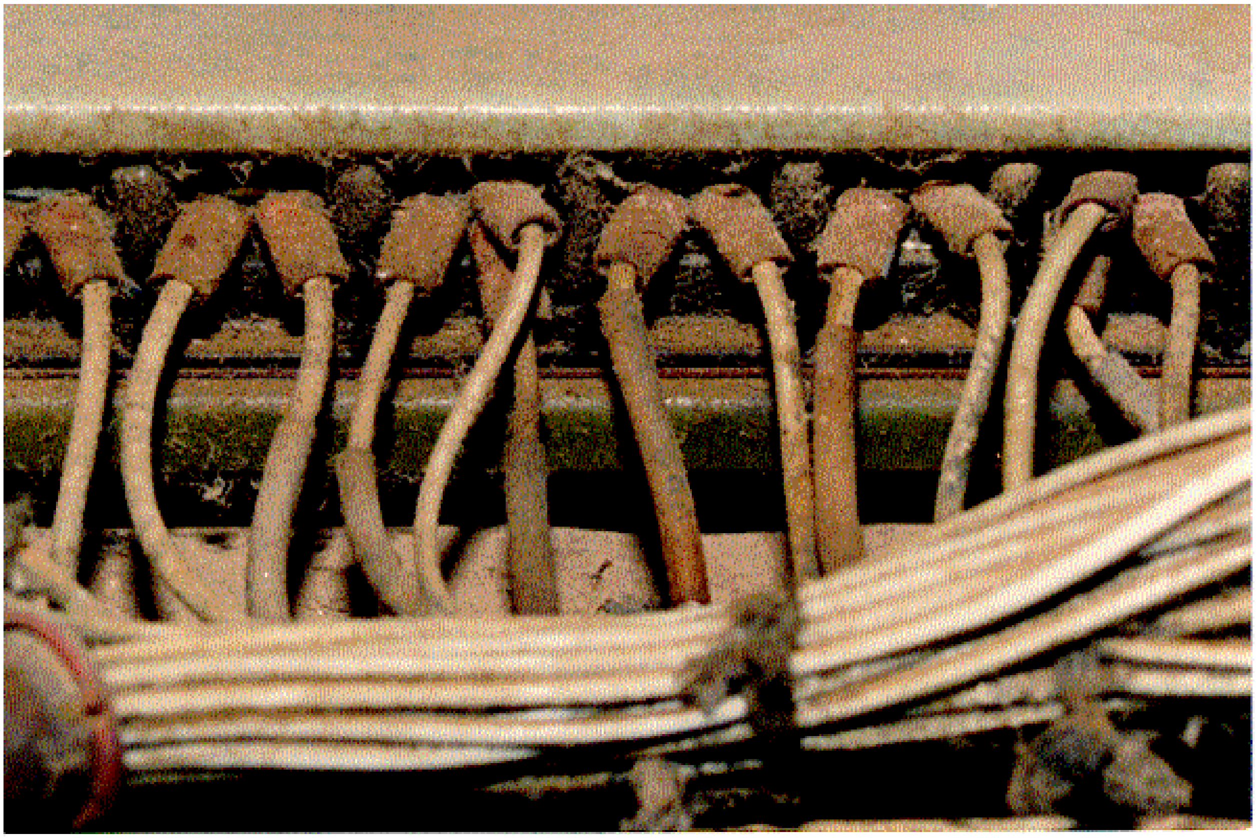


TABLE 2-1. EFFECTS OF AIRFRAME FLUID INTRUSION

Type of Fluid Intrusion	**Effects or Deterioration**
Engine fuel	Softening or swelling of some polymers.
Hydraulic fluid	Reduced paint adhesion, and introduction of insulated films on electrical connector contact surfaces.
Lubricants	Attack some seal and gasket material.
Dielectric Coolant	Attacks organic seals.
Anti-icing fluids	Increased condensation and attacks on electrical wiring.
Aqueous contaminates (free water, urine, condensation, desiccants)	Increased condensation causing pooling of fluids in bilge areas; corrosive attack of unprotected dissimilar metal couples; introduction of insulated films on electrical contact surfaces.
Maintenance fluids (solvents, detergents, cleaners, strippers)	Softening and/or reduced adhesion of some organic coatings and cracking of insulation on some electrical wiring.

f. Temperature. High temperature may improve or impair the performance of avionics equipment, depending on other conditions. Corrosion and other harmful processes (e.g., outgassing, decomposition, etc.) increase as the temperatures rise. In some instances, moderate rises in temperature prevent condensation of moisture laden air. Most fungal growth is inhibited by temperatures above 104 °F (40 °C). Low temperatures pose no direct threat of corrosion, except that as temperature drops, relative humidity rises. Extremely low temperatures can cause shrinkage and embrittlement of seals and gaskets, resulting in leakage and fluid intrusion.

g. Pressure. Most avionics equipment is designed to operate at low pressure (high altitude). Low pressure causes outgassing of plastics and other organic materials, which can change the physical and chemical properties of those materials. Another problem created by pressure is pressure cycling (high altitude/low altitude). These varying pressure changes can cause breathing from leaky seals and gaskets. Breathing promotes condensation of moisture laden air and creates a corrosive environment.

h. Microorganism, Insect, and Animal Attacks. Condensed moisture can cause conditions that promote the growth of mold, bacteria, and fungi. Once mold, bacteria, and fungi are established, they absorb and hold moisture. As living creatures, they secrete wastes which are acidic. This acid is a strong electrolyte which corrosively attacks metal. Non-metals, such as sealants, provide nutrients which can accelerate their growth. Many factors determine the degree of the fungal attack. Table 2-2 lists materials and the deterioration from microbial attack. Damage to avionics systems and equipment can also be caused by small insects and animals. This condition is most prevalent in tropical environments. Avionics equipment in storage is also susceptible to this condition. Insects and animals may enter through vent holes, open cabinets, or torn packaging material. Once inside the equipment, they can build nests which will hold moisture. This moisture plus excretions can cause corrosion. Another type of damage possible on the interior of the avionics equipment happens when an insect or animal eats electrical insulation, varnishes, or conformal coatings. This removes the environmental protection coating, allowing direct corrosive attack on the underlying surface.

i. Man-Made Environments. Man-made environments include repair station work, equipment handling, packaging, storage, and shipment. Avionics equipment undergoing repair can be contaminated by the surrounding environment. Fumes and vapors from adjacent repair operations such as soldering, paint spraying, and solvent cleaning can become trapped in the equipment. Failure to remove soldering flux residues after a repair can cause corrosion. Removal of avionics equipment from an aircraft for maintenance or inspection can expose the equipment to various environments. Removal of components from the equipment without proper protection from the environment can subject that component to corrosion. Improper shipping containers such as in wooden or fiberboard containers can subject that material to corrosion from vapors released by the container. Changes in temperature and pressure while en route can allow the intrusion of moisture. Finally, the improper storage of avionics equipment awaiting installation can cause corrosion. Storage of avionics equipment on wooden shelving can subject the equipment to vapors released by the shelving material.

TABLE 2-2. EFFECTS OF MOISTURE AND FUNGI ON VARIOUS MATERIALS

Part of Material	Effects of Moisture and Fungi
Fiber: washers, supports, etc.	Moisture causes swelling that can lead to misalignment and binding of parts. Destroyed by fungi.
Fiber: terminal strips and insulators	Electrical leakage paths are formed causing flashovers and crosstalk. Insulating properties are lost. Destroyed by fungi.
Laminated plastics: terminal strips and boards, switchboard panels, etc., tube sockets and coil forms	Insulating properties are lost. Leakage paths cause flashovers and crosstalk. Delamination occurs and fungi grow on surface and around edges. Expansion contraction under extreme temperature changes.
Molded plastics: terminal boards, switchboard panels, connectors, tube sockets and coil forms, etc.	Machined, sawed, or ground edges of surfaces support fungi, causing shorts and flashovers. Fungi growth can reduce resistance between parts mounted on plastic to such an extent that the parts are useless.
Cotton linen, paper, and cellulose derivatives: insulation covering webbing, belting, laminations, dielectrics, etc.	Insulating and dielectric properties are lost or impaired, causing arcing, flashovers, and crosstalk. Destroyed by fungi.
Wood: cases, houses, plastic fillers, masts, etc.	Dry rot, swelling, and delaminated housings caused by moisture and fungi.
Leather: straps, cases, gaskets, etc.	Moisture and fungi destroy tanning and protective materials, causing deterioration.
Glass: lenses, windows, etc.	Fungi grow on organic dust, insect track, insect feces, dead insects, etc. Dead mites and fungi growth on glass obscure visibility and corrode nearby metal parts.
Wax: for impregnation	Fungi-inhibiting waxes that are not clean support the growth of fungi, cause destruction of insulating and protective qualities, and permit entrance of moisture that destroys parts and unbalances electrical circuits.
Metals	High temperature and moisture vapor cause corrosion, etching of surfaces, and oxidation. This interferes with the operation of moving parts, screws, etc., and causes dust between terminals, capacitors, plates, or air conductors, etc., which in turn leads to noise, loss of sensitivity, and arc-over.
Metals, dissimilar	Metals may have different corrosion potentials. When moisture is present, one of the metals (anode) corrodes.
Soldered joints	Residual soldering flux on terminal boards holds moisture which speeds up corrosion and growth of fungi.

206. TYPES OF CORROSION.

a. General. Many different forms of corrosion occur on avionics equipment, depending on the type of material, configuration of the materials, and their environment. The rate and magnitude of the corrosion attack is also dependent upon those same materials and environment. A corrosion attack on equipment may involve several types of corrosion occurring simultaneously. This section describes the individual types of corrosion common to most avionics equipment.

b. Uniform Surface Corrosion. Uniform surface corrosion is probably the most common type of corrosion and results from a direct chemical attack on a metal surface. This type of corrosion appears uniform because the chemical elements that make up an alloyed metal are different and thereby become anodes and cathodes. These anodes and cathodes are very small and constantly shift from one area of the surface to another. A dull or etched surface is usually the first indication of uniform surface corrosion. Continued attack is followed by roughness and a frosty or powdered surface.

c. Crevice Corrosion. Crevice corrosion, also called concentration cell corrosion, occurs between the two mating surfaces in the presence of an electrolyte that has a different concentration/potential from one area to another. The electrolyte inside the crevice has a lower oxygen level and a higher metal ion concentration than the area just outside the crevice. As a result, the metal surfaces, even though they may be of the same material, have different potentials, and corrosion occurs. Figure 2-2 shows evidence of crevice corrosion on a lower fuselage skin at an antenna mounting. This type of corrosion may also occur when one of the mating surfaces is nonmetallic. There are three types of crevice/concentration cell corrosion: metal ion concentration cells, oxygen concentration cells, and active passive cells.

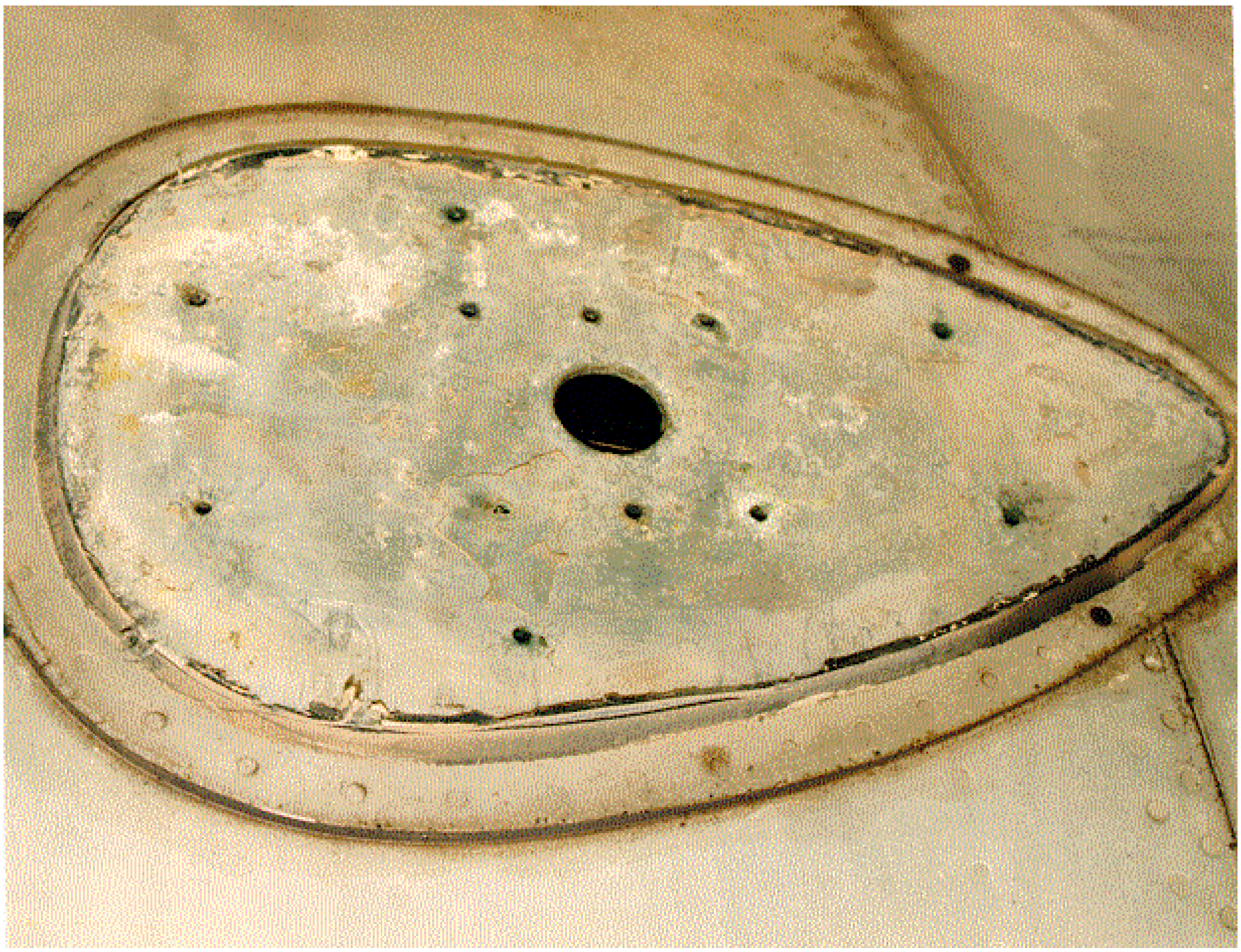
(1) Metal Ion Concentration Cells. Stagnant electrolytes under mating/faying surfaces normally have a high concentration of metal ions compared to the metal just outside the mating/faying surface. The area of high metal ion concentration will be cathodic, while the area with a lower concentration will be anoxic and suffer corrosion.

(2) Oxygen Concentration Cells. Electrolytes normally contain dissolved oxygen. Stagnant electrolytes under mating/faying surfaces contain less dissolved oxygen and are more anoxic than the adjacent area outside the mating surface. Corrosion occurs in the area of lower oxygen concentration.

(3) Active Passive Cells. Metals which depend on tightly adhering oxide films for corrosion protection, such as an anodized surface on aluminum, are prone to a rapid corrosion attack by active passive cells. An active passive cell occurs when the oxide film is broken from a scratch. The difference in potential between the small area of exposed parent metal (anoxic area) and the larger oxide film (cathodic area) is high and the onset of corrosion is rapid.

d. Pitting Corrosion. Pitting corrosion is a severe form of concentrated cell corrosion and is localized to a specific area. Pitting corrosion can be found on thin sheets of metal, such as plated PCB paths. The attack can be so severe that perforation of the plated PCB paths can occur. Pitting usually occurs along grain boundaries and at porous finished areas on the metal. Porous gold plating on copper contacts is a common location for pitting corrosion. The plating pores create small corrosion cells that continue to expand and deepen until a pit is created.

FIGURE 2-2. EVIDENCE OF CREVICE CORROSION ON LOWER FUSELAGE SKIN AT AN ANTENNA MOUNTING



e. Fretting Corrosion. Fretting corrosion occurs when there is slight relative movement between two materials (usually metals) and an electrolyte is present. This corrosion is typical of close fitting, highly loaded interfaces. Fretting corrosion can occur on all metals, with aluminum, stainless steel, and titanium alloys being the most susceptible. These metals depend on an oxide surface film to inhibit further corrosion. With small movements between the two mating surfaces under pressure, the exposed oxide surface film is abraded away, exposing new parent metal. This new metal surface oxidizes again and the cycle repeats. The oxides that were abraded away locate themselves in the crevices of the parent metal. The oxides are harder than the parent metal, and, as the abrasion continues, they will act as an abrasive grit which further attacks the parent metal.

f. Galvanic Corrosion. Galvanic corrosion occurs when different metals are in contact with each other in the presence of an electrolyte. Galvanic corrosion is characterized by a buildup of corrosion deposits on the mating active (anoxic) surface. The rate of corrosion of a galvanic couple is a function of the difference between the reactivity of the metals. The galvanic series for metals with saltwater as the electrolyte is outlined in Table 2-3. The farther apart two metals are on the galvanic series chart, the faster the active (anode) metal will corrode in the presence of the electrolyte. In contrast, the closer the two metals are on the galvanic series chart, the slower the active (anode) metal will corrode in the presence of the electrolyte.

TABLE 2-3. GALVANIC SERIES OF METALS AND ALLOYS IN SEAWATER

CORRODED END (ANOXIC, ACTIVE, OR LEAST NOBLE)

Magnesium Alloys
Zinc (plate)
Beryllium
Cadmium (plate)
Uranium (depleted)
Aluminum Alloys
Indium
Tin (plate)
Stainless Steel 430 (active)
Lead
1010 Steel
Cast Iron
Stainless Steel 410 (active)
Copper (plate)
Nickel (plate)
AM 350 (active)
Chromium (plate)
Stainless Steel 350, 310, 304 (active)
Stainless Steel 430, 410 (passive)
Stainless Steel 13-8, 17-7 PH (active)
Brass, Yellow, Naval
Stainless Steel 316L (active)
Bronze 220
Copper 110
Stainless Steel 347 (active)
Copper-Nickel 715
Stainless Steel 202 (active)
Monel 400
Stainless Steel 201 (active)
Stainless Steel 321, 316 (active)
Stainless Steel 309, 13-8, 17-7 PH (passive)
Stainless Steel 304, 301, 321 (passive)
Stainless Steel 201, 316L (passive)
Stainless Steel 286 (active)
AM355 (active)
Stainless Steel 202 (passive)
Carpenter 20 (passive)
AM355 (passive)
Titanium Alloys
AM350 (passive)
Silver
Palladium
Gold
Rhodium
Platinum
Carbon/Graphite

PROTECTED END (CATHODIC, PASSIVE, OR MORE NOBLE)

g. Stress Corrosion. Stress corrosion or stress corrosion cracking occurs when stresses on a metal part and corrosion combine to produce damage greater than either one applied separately. The stresses on the part can be internal (residual) or externally applied. Stress corrosion cracking of metal parts occurs along (intergranular) or across (transgranular) boundaries. Stress corrosion failures can be catastrophic and occur without warning. For example, cracking can occur in stressed copper alloys exposed to ammonia and its compounds.

h. Corrosion Fatigue. Corrosion fatigue is normal fatigue combined with corrosion. Normal fatigue, in a non-corrosive environment, is caused by repeated stress cycles at a level below the maximum stress the material can withstand. The fatigue (endurance) limit is the maximum cyclic stress at which a material will not sustain any fatigue damage (i.e., will not fracture). The combination of corrosion and fatigue reduces the fatigue limit of a material. Corrosion fatigue will eventually produce a failure regardless of how minimal the applied stress.

i. Intergranular Corrosion. Intergranular corrosion is a chemical attack that occurs at the grain boundaries of a metal. A highly magnified view of a metal surface shows individual grains. Along the grain boundaries of the primary metal are individual grains of the metallic elements that make-up the alloy. These other metals have a different corrosion potential than the primary metal. Often, the grain boundaries are anoxic and tend to corrode more easily than the grains of the primary metal. When an electrolyte is present, rapid selective corrosion at the grain boundary occurs.

j. Exfoliation Corrosion. Exfoliation corrosion is an advanced form of intergranular corrosion. Exfoliation corrosion causes the metal grains to separate at the grain boundaries due to the force of the expanding corrosion products. This type of corrosion is most often visible as a swelling or lifting of an exposed edge in extruded sections of metal. It is primarily found in aluminum sheets around steel fasteners.

k. Nonmetallic Deterioration. Nonmetallic materials also deteriorate. This deterioration includes: swelling, distortion, disintegration, cracking, out gassing, and changes in electrical characteristics. The deterioration is caused by a change in the environment of the avionics equipment. These changes include: weather, moisture intrusion/entrapment, heat, ultraviolet (UV) light, fungal growth, etc.

207 through 300. RESERVED.

CHAPTER 3. CORROSION CONTROL PROGRAM AND INSPECTION

301. GENERAL. Investigations over the past ten years have revealed that corrosion is a major factor in avionics equipment failures. As much as 20 percent of commercial/general aviation avionics failures are attributable to corrosion, and that figure rises to between 30 and 40 percent for the military. This excessive failure rate continues despite continued improvement in the overall reliability of avionics equipment and systems. The scope of this problem outlines the need for an effective preventive maintenance program.

FIGURE 3-1. DUST AND LINT ACCUMULATION IN THE CROWN AREA

302. PREVENTIVE MAINTENANCE PROGRAM.

a. Program Requirements. Successful avionics cleaning and corrosion prevention/control efforts depend on a coordinated, comprehensive preventive maintenance program. Everyone involved with the operation, repair, and maintenance of avionics equipment must take an all hands approach to cleaning, inspection, and corrosion prevention and control. Figure 3-1 shows dust and lint accumulation in the crown area. The basic philosophy of a preventive maintenance program should consist of the following:

(1) Personnel adequately trained in the recognition of corrosion, including conditions, detection and identification, cleaning, treatment, and preservation;

(2) Thorough knowledge of corrosion identification techniques;

(3) Proper emphasis on the concept of all hands responsibility for corrosion control;

(4) Inspection for corrosion, deteriorated seals, and proper routing on a scheduled basis;

(5) Routine cleaning of all wiring and the exterior surfaces of components;

(6) Keeping drain holes open;

(7) Early detection and repair of damaged protective coatings;

(8) Prompt corrosion treatment after detection;

(9) Accurate record keeping and reporting of material or design deficiencies; and

(10) Use of appropriate materials, equipment, and technical publications.

b. Corrosion Prevention Philosophy. Corrosion and environmental conditions are natural phenomena that adversely affect avionics equipment. Although they can never be totally eliminated, the problems these phenomena cause can be minimized so that they are more manageable. This can be achieved only by understanding the equipment failure mechanisms, implementing a preventive maintenance program, and using corrosion control techniques and materials.

303. CORROSION-PRONE AREAS.

a. General. There are certain corrosion-prone areas common to all aircraft. For example, bilge areas are particularly susceptible to moisture intrusion/entrapment. The bilge area is where cables run, and where wire bundles, coaxial cables, lights, and antennas are installed. It is almost impossible to prevent moisture intrusion/entrapment in these areas. Other corrosion-prone areas include areas in and around the engine exhaust, battery compartments, lavatories, buffets, galleys, entrances at cargo and passenger doors, and wheel wells and landing gear.

b. Moisture and Other Fluid Intrusion Sources. Moisture, fluid intrusion, and fluid movement within the aircraft are caused by many factors, including:

(1) The flexibility of aircraft structure, which prevents complete and effective airframe sealing at skin joints and around fasteners;

(2) Numerous openings, such as equipment bay doors, access panels, ducts, and static pressure sensors, which can allow moisture intrusion;

(3) Moisture from many sources, such as rain and aircraft wash, and fluids from leaking hydraulic, fuel, oil, and coolant lines; and

(4) Moisture and fluid migration within the aircraft along air condition ducts, fuel and hydraulic lines, and cable and wire bundles. As a result of these conditions, moisture and other fluids can enter, migrate, and be trapped in areas of the aircraft where avionics equipment may be installed, which are normally considered protected.

FIGURE 3-2. SURFACE CORROSION ON AN AVIONICS MOUNTING RACK

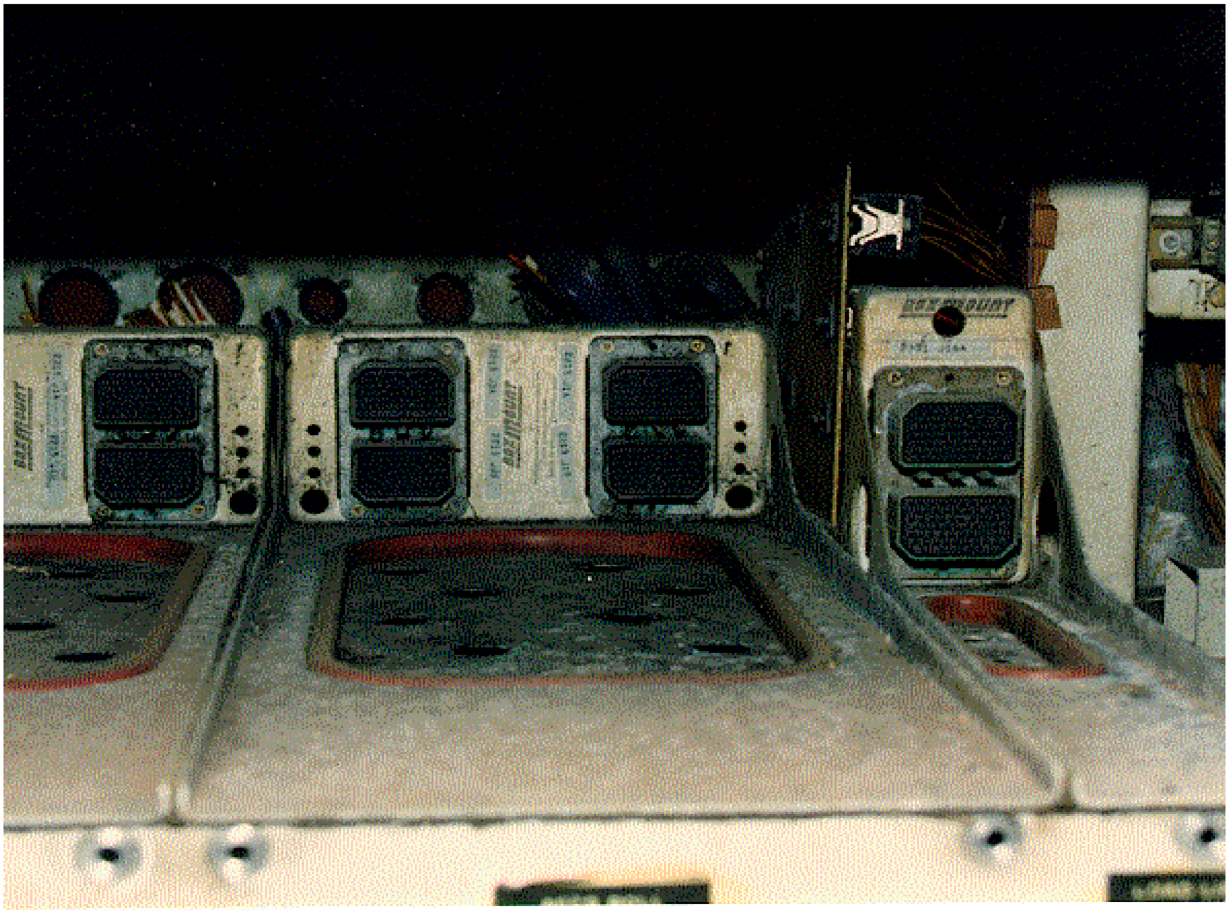


FIGURE 3-3. CORROSION AND LINT ACCUMULATION ON CARGO DOOR MICRO-SWITCH

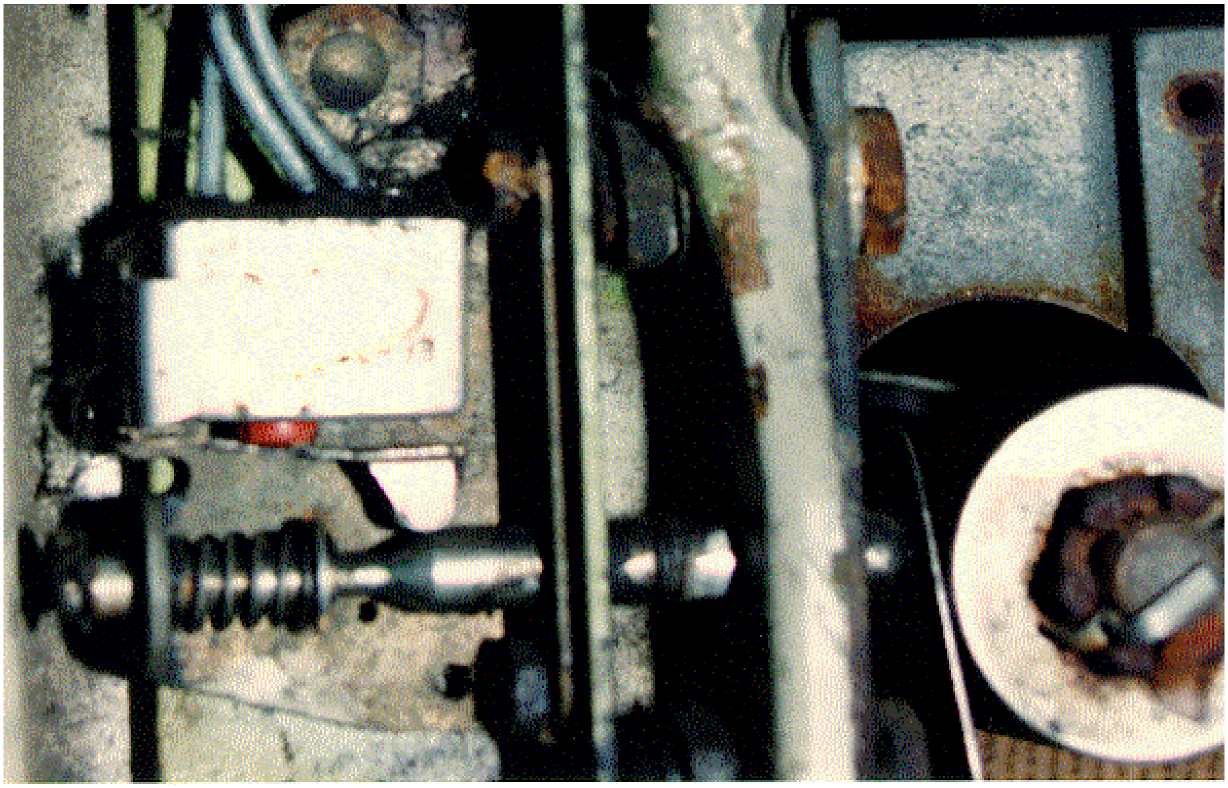


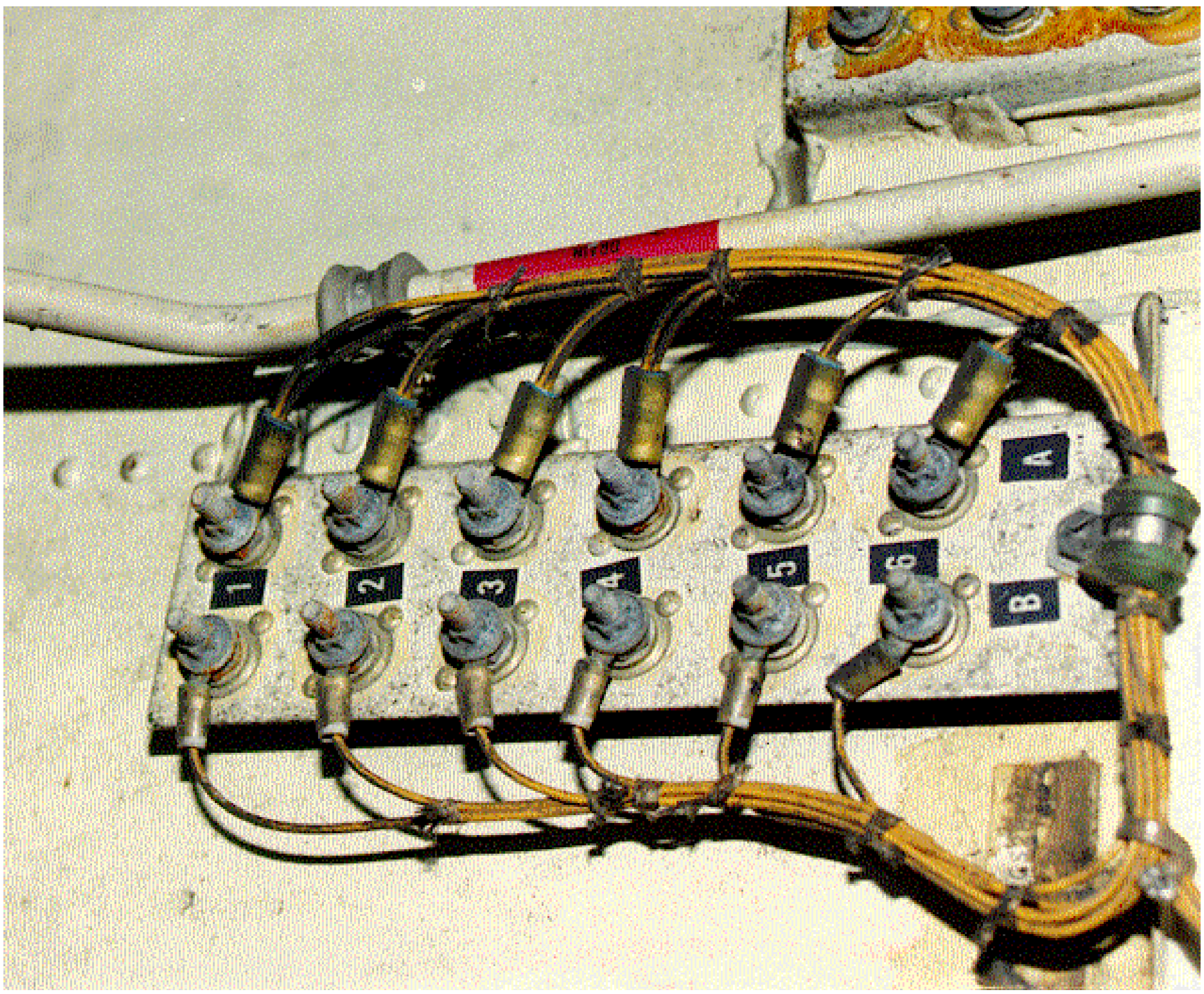
TABLE 3-1. EFFECTS OF CORROSION ON AVIONICS EQUIPMENT

Component	Failure Mode
Antenna systems	Short circuits or changes in circuit constants and structural deterioration.
Chassis, housings, covers, and mount frames	Contamination, pitting, loss of finish, and structural deterioration.
Shock mounts and supports	Deterioration and loss of shock damping effectiveness.
Control box mechanical and electrical tuning linkage, and motor contacts	Intermittent operation and faulty frequency selection.
Water traps	Structural deterioration.
Relays and switching systems	Mechanical failure, short circuits, intermittent operation, and signal loss.
Plugs, connectors, jacks, and receptacles	Short circuits, increasing resistance, intermittent operation, and reduced system reliability.
Multipin cable connectors	Short circuits, increasing resistance, intermittent operation, and water seal deterioration.
Power cables	Disintegration of insulation and wire/connector deterioration.
Display lamps and wing lights	Intermittent operation, mechanical and electrical failures.
Wave guides	Loss of integrity against moisture, pitting, reduction of efficiency, and structural deterioration.
Fluid cooling system lines	Failure of gaskets, pitting, and power loss.
Printed circuits and microminiature circuits	Short circuits, increased resistance, and component and system failures.
Batteries	High resistance at terminals, failure of electrical contact points, and structural deterioration of mounting. Erroneous cockpit signals.
Busbars	Structural and electrical failures.
Coaxial lines	Impedance fluctuations, loss of signal, and structural deterioration of connectors.

c. Structural. Structural parts include housing covers, supports, brackets, cabinets, and chassis, which require structural support and equipment protection. Corrosion on these parts should be cleaned and treated, and the protective finish restored to eliminate long-term deterioration. Severe corrosive damage usually results from damage to the protective finish and subsequent attack to the exposed metal. The protective finish is usually damaged from an environmental attack, handling damage, or microbial growth. Figure 3-2 shows surface corrosion on an avionics mounting rack. Severe corrosion damage requiring major repairs should be accomplished by an authorized repair station. Minor corrosion damage and damaged protective coatings are normally repaired by an authorized certificated person.

d. Electromechanical. Motion is an integral function of electromechanical switches, relays, potentiometers, motors, generators, and synchronous components. Storage or non-operation in certain environments tends to promote corrosion of these devices. The principal causes of malfunction are dust, condensation products, resultant corrosion products (oxides), and organic contaminate films. Failure of these devices does not normally occur during operation. The friction generated during operation usually keeps the critical surfaces clean enough to permit operation. On the other hand, during non-operations, insulating films form, which prevent startup operation of the equipment.

FIGURE 3-4. CORRODED HARDWARE ON TERMINAL BOARD



e. Electronics. Moisture and contaminates penetrate electronic equipment, causing many detrimental effects, such as corrosion. In most modern electronic systems, circuit areas have been minimized for faster signal processing and higher density. In addition, integrated circuits use low voltage for operation. This means that most circuit paths are thin, or small in a cross-sectional area, and that individual circuit paths are close together. In these systems, trace amounts of moisture and contaminates may cause systems failures. Table 3-1 lists the typical effects of corrosion on avionics equipment.

f. Special Considerations. The control of corrosion in avionics equipment is like that in the airframe. Procedures used on the airframe are applicable to avionics with appropriate modifications. Figures 3-4, 3-5, and 3-6 show examples of corrosion moisture traps. The general differences in construction and procedures for corrosion control on airframe and avionics are as follow:

(1) Avionics rely on less durable protection systems.

(2) Very small amounts of corrosion can make avionics equipment inoperative, as compared to airframes.

(3) Dissimilar metals are often in electrical contact.

(4) Stray electrical currents can cause corrosion.

(5) Active metals and dissimilar metals in contact are often unprotected.

(6) Vented avionics boxes can be subject to condensation due to normal temperature changes during flight.

(7) Avionics systems have many areas that trap moisture.

(8) Corrosion on internal components is difficult to detect in many avionics systems.

(9) Many materials used in avionics systems are subject to attack by bacteria and fungi.

(10) Organic materials are often used which, when overheated or improperly or incompletely cured, can produce vapors. These vapors are corrosive to electronic components and damaging to coatings and insulators.

FIGURE 3-5. CORRODED SHOCK MOUNT AND MOISTURE TRAP AREA

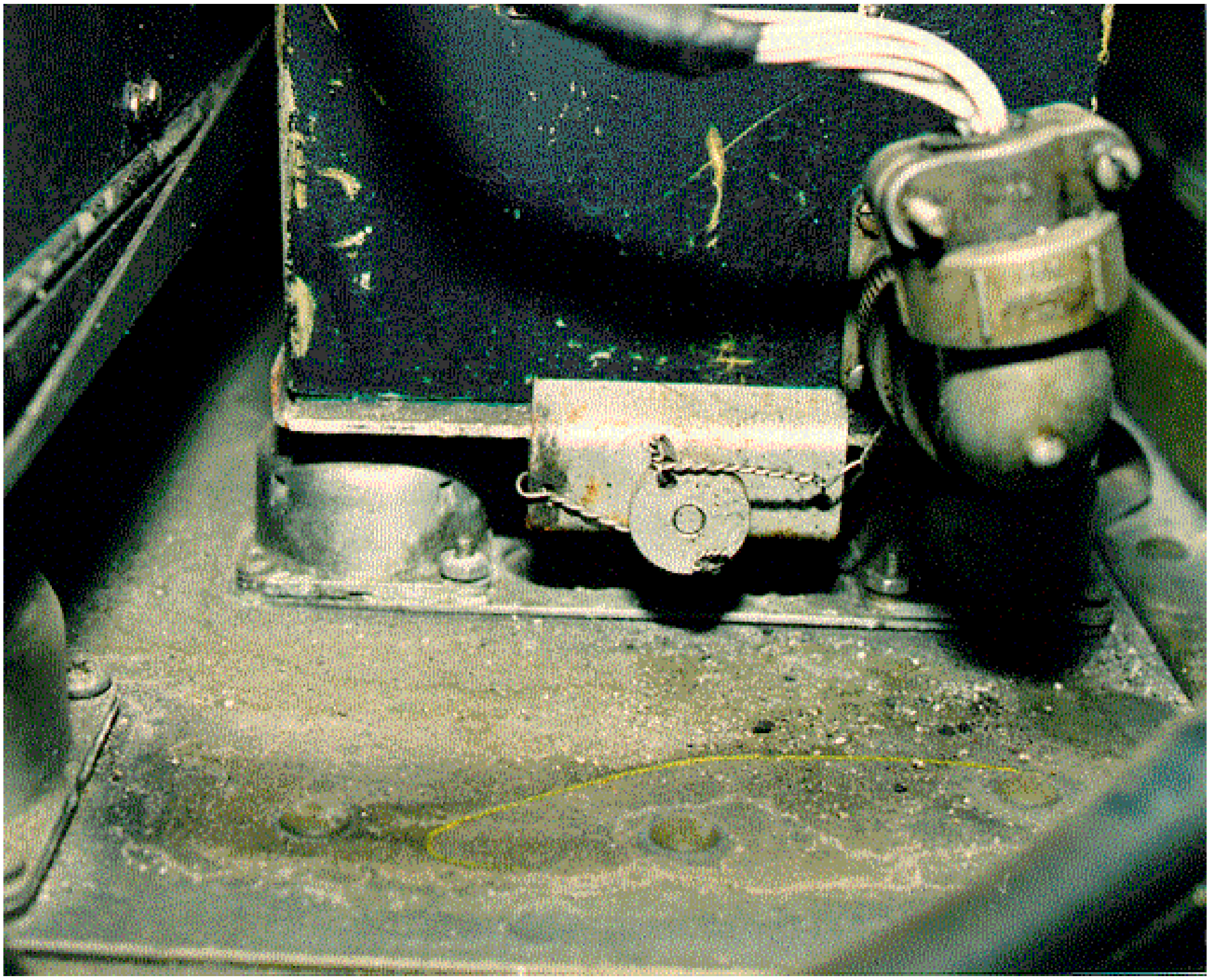


FIGURE 3-6. LINT ACCUMULATION ON AVIONICS RACK COOLING AIR MANIFOLD

304. INSPECTION PROCESS.

a. General. Frequent corrosion inspections are essential to the overall success of a corrosion control program. Through detection, identification, and treatment, the costs resulting from corrosion are minimized. Without regular systematic inspections, corrosion will seriously damage avionics equipment. The following paragraphs describe some of the basic aspects of visual inspection for corrosion and the telltale signs associated with various types of corrosion damage.

b. Inspection Factors. A calendar-based check maintenance inspections should be in accordance with the manufacturer's or operator's instructions. However, extreme environmental and operating conditions should be considered when determining the frequency of corrosion inspections. The following are factors to consider when developing or using a local inspection interval:

(1) Operational environment;

(2) Known corrosion-prone areas, such as battery components and compartments, and electrical bonds;

(3) Length of storage time, with respect to the storage environment and the avionics equipment or component;

(4) The amount of time the equipment is nonoperational, especially for low usage aircraft or equipment;

(5) Non-pressurized avionics components and equipment bays;

(6) Antennas and externally mounted avionics packages; and

(7) Avionics equipment mounted in susceptible water entrapment and intrusion entry areas.

FIGURE 3-7. CROWN AREA INSPECTION

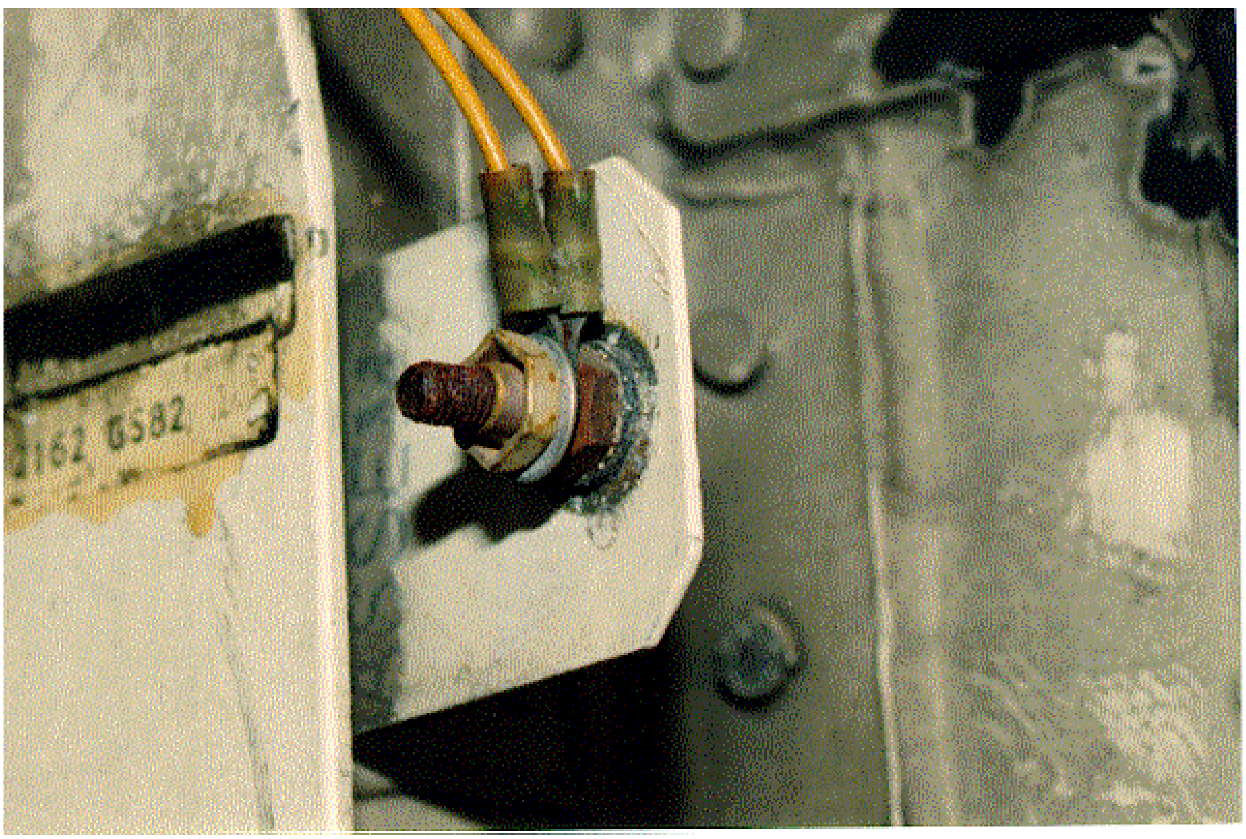
c. General Inspection Procedures. The following general procedures are recommended for an avionics corrosion inspection:

(1) Clean area or component to be inspected.

(2) Visually examine the overall condition of the equipment or component using an appropriate light source. Suspected areas or corrosion-prone areas should be examined using a 10x magnifying glass and an appropriate light source to determine the extent of corrosion or if other damage exists. Miniature or microminiature circuit boards or avionics components should be examined using the appropriate microscope and light source, as necessary.

(3) Refer to the applicable service manual for damage limits.

FIGURE 3-8. CORRODED HARDWARE FOR BONDING STRAP



d. Water Intrusion Inspection. Maintenance personnel who routinely inspect the aircraft and equipment should inspect the interior of equipment bays for evidence of water intrusion and entrapment. Any evidence of water stains or entrapped water will require a thorough inspection of mounted equipment and the surrounding structures for corrosion. Additionally, the source of water intrusion will need to be determined and eliminated. The following are suggested areas and procedures for a water intrusion inspection:

(1) Verify installation of required fasteners in avionics equipment, airframe, and surrounding structure.

(2) Inspect condition of gaskets, form-in-place seals, and pre-formed seals.

(3) Verify drain holes are open and clear in avionics equipment and airframe structure.

(4) Inspect condition of doors, electronic rack drip shields, and covers and panels for material condition, especially warping.

(5) Prepare the compartment for a water intrusion test by installing witness material, such as blotter paper, paper towels, etc. The witness material should be placed in all suspected areas of water intrusion in a manner that will indicate the leakage path.

(6) Close or secure compartment doors, panels, or covers.

CAUTION: Do not direct the stream of water at components with bearings and shaft seals.

(7) Apply fresh water with a hose in a stream to the exterior surface of the airframe for approximately five minutes.

(8) Allow approximately three to five minutes for the water to penetrate and drain.

(9) Open or remove compartment doors, panels, or covers.

(10) Visually examine witness material for signs of water and source of water intrusion.

(11) Accomplish repairs in accordance with applicable repair service manual.

(12) Close or secure compartment doors, panels, or covers.

(13) Repeat water intrusion test (subparagraph d(5) and subsequent), along with the appropriate repairs until water intrusion leaks are no longer observed.

305. RECOGNIZING AVIONICS CORROSION.

a. General. Recognizing the appearance of corrosion or corrosion products for specific metals is an important part of an avionics corrosion prevention and control program. Metals are susceptible to corrosion because all metals have a tendency to return to their natural forms. For example, iron tends to return to iron oxide (rust). Avionics systems make use of many metals not normally considered for airframe structures. Some of the rarer metals are found in avionics components, in transistors, miniature and microminiature circuits, and integrated circuits. Table 3-2 lists the metals most often used in electronics and avionics components. In addition to recognizing the appearance of corrosion or corrosion products for specific metals, maintenance personnel must be able to recognize a corrosive attack from solder flux, microbes, insects, and animal attack. Table 3-3 describes the appearance of corrosion for specific metals and different corrosive attacks.

b. Corrosion Effects on Metals. Deterioration (corrosion) of a metal is caused by a chemical reaction with its environment. The corrosive effect can be accelerated by many of the factors that were discussed in Chapter 2. No metal can have a perfect environmental integrity, and therefore will corrode. Corrosion of a specific metal will take on many different forms as the corrosive attack progresses. The following paragraphs provide a description of corrosion with respect to the most commonly used metals in avionics systems.

(1) Iron and Steel. Iron and steel are used in avionics components as leads, magnetic shields, transformer cores, brackets, racks, and general hardware. Some of these components are plated with nickel, tin, or cadmium. Corrosion of steel is easily recognized because the corrosion product is red or black iron oxide (rust). When iron-based alloys corrode, dark corrosion products usually form first. This material will promote further attack by absorbing moisture from any water source, including ambient air. The most practicable means of controlling corrosion on non-plated steel or iron is complete removal of the corrosion product (rust) by the least harsh method. Iron and steel surfaces are normally protected by applying a plating system, paint system, or application of a preservative compound.

(2) Corrosion Resistant Steel. Stainless steel is used for mountings, racks, brackets, and hardware in avionics systems. Stainless steel is not readily susceptible to corrosion because of a tough chromium oxide film on the surface. However, exposure to a saltwater environment will cause pitting. Stainless steel is corrosion resistant, but is susceptible to crevice corrosion. The corrosion product of stainless steel is a roughened surface with a red, brown, or black stain. Corrosion treatment for stainless steel to remove the red, brown, or black stain should be limited to cleaning with stainless steel wool or a stainless steel brush.

(3) Aluminum Alloys. Aluminum and aluminum alloys are widely used in avionics systems for electrical connectors and back shells, cabinets, housings, chassis, structures, and mounting fixtures. Corrosion of aluminum and aluminum alloys is indicated by a white or gray powder (aluminum oxide). In most environments, especially moist salt-laden air, aluminum alloys are subject to many types of corrosive attack and therefore require protection. Aluminum surfaces are protected by an entire paint coating system composed of a chemical conversion coat, primer, and topcoat. Painted aluminum surfaces, even with the recommended protection system, tend to mask any corrosion attack to the aluminum. Corrosion damage to the aluminum surface will show up in the paint coating as filiform corrosion showing signs of blistering, flaking, chipping, lumping, or other irregularities.

TABLE 3-2. METALS MOST COMMONLY USED IN AVIONICS SYSTEMS

Aluminum	*Gold	*Platinum
Antimony	Indium	*Rhodium
Arsenic	*Iridium	Selenium
Beryllium	Iron	*Silver
Bismuth	Lead	*Stainless Steel (CRES)
*Brass	Lead-Tin Alloy	Steel
*Bronze	Magnesium	*Tantalum
Cadmium	Mercury	*Tin
Cobalt	*Monel	Tungsten
*Copper	*Nickel	
Germanium	*Palladium	

*Usually considered corrosion-resistant

(4) Magnesium. Magnesium alloys are used throughout avionics systems because of their light weight. Magnesium alloys can be found in antennas, component structures, chassis, supports, and frames. Magnesium is highly susceptible to corrosion when exposed to any environment without a protective coating. Magnesium forms a strong (anoxic) galvanic cell with every other metal and is always the metal that will suffer the corrosive attack. Magnesium is subject to almost all types of corrosion mentioned in Chapter 2, and once started, the corrosive attack will spread rapidly. Corrosion on magnesium alloys is recognized by white, powdery, snow-like mounds. When corrosion is found on magnesium, prompt corrective action is required. Magnesium surfaces are protected from corrosive attack by a paint coating system composed of a chemical conversion coat, primer, and topcoat.

(5) Copper. Copper and copper-based alloys are used extensively in avionics systems. Copper and copper-based alloys are used for wiring, contacts, springs, connectors, and printed circuit boards. Copper and copper-based alloys (brass and bronze) are quite resistant to corrosion. Copper is cathodic to most of the other metals used in avionics equipment. The corrosive attack to copper and copper-based alloys is a uniform surface tarnish of a green-gray color that remains relatively smooth. This uniform surface tarnish is the result of the formation of a fine-grained, airtight copper oxide. The copper oxide offers good protection from further corrosion attack to the underlying metal in ordinary situations. However, exposure to moist salt-laden air or salt spray causes the formation of blue-green salts which indicate an active corrosive surface. Copper and copper-based alloys are generally not protected by a paint coating system.

TABLE 3-3. NATURE AND APPEARANCE OF CORROSION PRODUCTS ON METALS

Alloy	Type of attack to which alloy is susceptible	Appearance of corrosion product
Aluminum alloy	Surface, pitting, and intergranular corrosion	White or gray powder
Titanium	Highly corrosion resistant; extended or repeated contact with chlorinated solvents may result in embrittlement; cadmium-plated tools can cause embrittlement of titanium	No visible corrosion products
Magnesium alloy	Highly susceptible to pitting corrosion	White powder, snow-like mounds, and white spots on surface
Carbon and low alloy steel (1000-8000 series)	Surface oxidation and pitting	Reddish-brown oxide (rust)
Stainless steel (300-400 series)	Intergranular corrosion; some tendency towards pitting in a marine environment (300 series more corrosion-resistant than 400 series)	Rough surface; may show red, brown, or black stain
Nickel base alloy (Inconel)	Generally has good corrosion-resistance qualities; sometimes susceptible to pitting	Green powdery deposit
Copper base alloy (Monel)	Surface and intergranular corrosion	Blue or blue-green powder deposit
Cadmium (used as a protective plating for steels)	Uniform surface corrosion	White to brown to black mottling of the surface
Chromium (used as a wear-resistant plating for steels)	Subject to pitting in chloride environments	Chromium, being cathodic to steel, promotes rusting of steel where pits occur in the coating
Silver	Will tarnish in presence of sulfur	Brown to black film
Gold	Highly corrosion-resistant	Deposits cause darkening of reflective surfaces
Tin	Subject to whisker growth	Whisker-like deposits
Electroless nickel (used as a plating on aluminum connectors)	Pitting and flaking of surface plating	Nickel, being cathodic to Aluminum, does not corrode itself, but promotes corrosion of the aluminum base metal where pits occur in the plating.

(6) Cadmium. Cadmium is used primarily in avionics equipment as a plating on hardware (e.g., nuts, bolts, etc.) and electrical connectors. It is also used to provide a compatible surface for parts in contact with other material. Cadmium, when plated over steel, is anoxic to the steel and protects the steel as a sacrificial coating. Corrosion on cadmium is evidenced by white to brown to black mottling of the surface. Cadmium plating on steel hardware is still protecting the steel until signs of rust on the steel appear. Care should be taken not to remove any of the cadmium plating adjacent to a rusted area on the base material.

(7) Silver. Silver is normally used as plating material over copper in wave guides, miniature and microminiature circuits, wiring, and contacts. It is also used on radio frequency (RF) shielding. Silver does not corrode in a normal sense, but it will tarnish in the presence of sulfur. The tarnish (silver sulfide) appears as a brown to black film. Corrosion treatment should be limited to cleaning.

(8) Red Plague. When silver plating over copper is damaged, there can be an accelerated corrosive attack of the underlying copper. Red plague is readily identifiable by the presence of a brown-red powder deposit on the exposed copper. In the case of wiring, the problem is compounded by the wire insulating material. The insulating material can prohibit detection of the damaged silver plating until the damage to the copper is extensive.

(9) Gold. Gold is the best plating material for electrical connections because of its corrosion resistance and the ease with which it can be soldered. Gold is used on printed circuits, semiconductor leads and contacts, and is usually plated over nickel, silver, or copper. Gold is a noble metal and does not normally corrode; however, a slight tarnish will appear as a darkening of its normally reflective surface. When gold is plated over silver or copper, accelerated corrosion can occur at pin holes or pores in the gold plating. This tarnishing of the gold over silver is readily identified by a brown to black film. The tarnishing of the gold over copper is identified as a blue-green film. The methods employed in tarnish removal are critical on gold-plated components because the plating is very thin (typically 0.00015 inch thickness).

(10) Purple Plague. Purple plague is a brittle gold-aluminum corrosion product formed when a gold-plated component and an aluminum component are mechanically attached or bonded together. Microelectronic circuit failures can occur at the interconnecting mechanical bond as this gold-aluminum corrosion product grows.

(11) Tin. The use of tin in solder is a well-known application. Tin is also used as a plating on RF shields, filters, crystal covers, and automatic switching devices. Tin is the best solder and corrosion-resistant coating of the available metallic coatings. The problem with tin is its tendency to grow whiskers on tin-plated wire and other tin-plated devices. Tin whiskers can grow to an extent that they will cause shorting across microelectronic circuits.

(12) Black Plague. Black plague is a black substance that forms in the liquid cooling systems of high power radars. This substance adheres to the walls of tubing and components in the cooling system and affects the heat transfer characteristics of the system. Corrosion removal for these components is the same as for the base metal.

(13) Nickel. Nickel is primarily used as an electroless nickel coating and is subject to pitting corrosion. Flaking of the nickel coating can also occur when the underlying metal corrodes.

306. CORROSION EFFECTS ON NONMETALS. Deterioration of nonmetallic subassemblies and other hardware costs commercial and private operators millions of dollars per year in replacement material costs and loss of equipment availability. In most cases, the deterioration of the nonmetallic material permits the intrusion of moisture into the equipment. This deterioration creates physical swelling, distortion, mechanical failure through cracking, altering of electrical characteristics, etc. The most common nonmetals used in avionics systems and the nature and appearance of their deterioration are listed in Tables 3-4 and 3-5 respectively.

TABLE 3-4. NONMETALS MOST COMMONLY USED IN AVIONICS SYSTEMS

Acrylics	Encapsulates	Paper
Adhesives	Felt	Plastics
Asbestos	Glass	Polymers
Ceramics	Graphite	Potting Compounds
Cloth	Laminates	Primers
Conformal Coatings	Leather	RTV
Cork	Lubricants	Sealants
Elastomers	Paint	Tapes

TABLE 3-5. NATURE AND APPEARANCE OF DETERIORATION ON NONMETALS

Material	Type of attack to which material is susceptible	Appearance of deterioration
Acrylics	UV light, moisture, solvents	Discoloration, cracking
Adhesives	Dirt, UV light, solvent, moisture	Cracking, peeling
Ceramic	Extreme heat	Discoloration, cracking
Cloth	Dry rot, mildew	Discoloration, tears, dust
Conformal coating	Moisture, scratches	Peeling, flaking, bubbling
Cork	Moisture, mildew, dry rot	Discoloration, dust, peeling
Elastomers	Heat, UV light, excessive cycling	Cracks, crazing, discoloration
Encapsulant	UV light, moisture	Cracking, peeling, disbonding
Felt	Moisture, mildew	Discoloration, looseness
Glass	Heat	Cracks, discoloration
Laminates	UV light, moisture, solvents	Discoloration, disbonding, delamination
Paint	Moisture, heat, humidity	Bubbling, peeling, cracking
Plastic	UV light, heat, humidity	Discoloration, cracks, deformation
Polymers	Extreme heat, solvents	Discoloration, deformation
Potting Compound	UV light, moisture, heat	Discoloration, cracks, deformation
RTV (noncorrosive)	Moisture, UV light, heat	Peeling, disbonding, discoloration
Sealants	Moisture, UV light, heat	Peeling, disbonding, discoloration

307. CORROSION EFFECTS OF SOLDER FLUX. Solder flux residues may be conductive and corrosive. They are often tacky, collecting dust which can absorb moisture and create current leakage paths. Solder flux resin appears as an amber-colored globule, drip, or tail at or near the solder joint. Under ultraviolet (UV) light, traces of flux appear as a fluorescent yellow to light brown residue. When soldering, use the lowest acid content flux possible (even neutral fluxes have some acid in order to remove metal oxides) and provide a reducing atmosphere to prevent oxide formation during soldering. After soldering, all flux residue must be completely removed by cleaning. Complete removal can be verified by the use of the UV light.

308. EFFECTS OF MICROBIAL ATTACK. Bacteria and fungi not only feed on organic material, but also release acids which are corrosive. Bacteria and fungi may be found on encapsulates, conformal coated circuit boards, rubber gaskets, thermoplastics, optical lenses, etc. The presence of bacteria and fungi can be readily identified by damp, slimy, and bad-smelling growths. These growths vary in color from black, blue-green, and green to yellow.

309. EFFECTS OF INSECT AND ANIMAL ATTACK. Small insects and animals may enter packaged equipment and feed on various organic materials such as polyethylene and wire insulation. This attack can result in system or equipment failure. The presence of nests, holes in packaging, and excrement indicate animal or insect attack. This problem is generally more severe in equipment that is in storage or has been out of service for a long period of time. Figures 3-9, 3-10, and 3-11 show the effects of animals. Frequent inspection of the equipment or shipping containers is the best method of controlling this problem.

FIGURE 3-9. ANIMAL DROPPINGS ON ELECTRICAL COMPONENTS

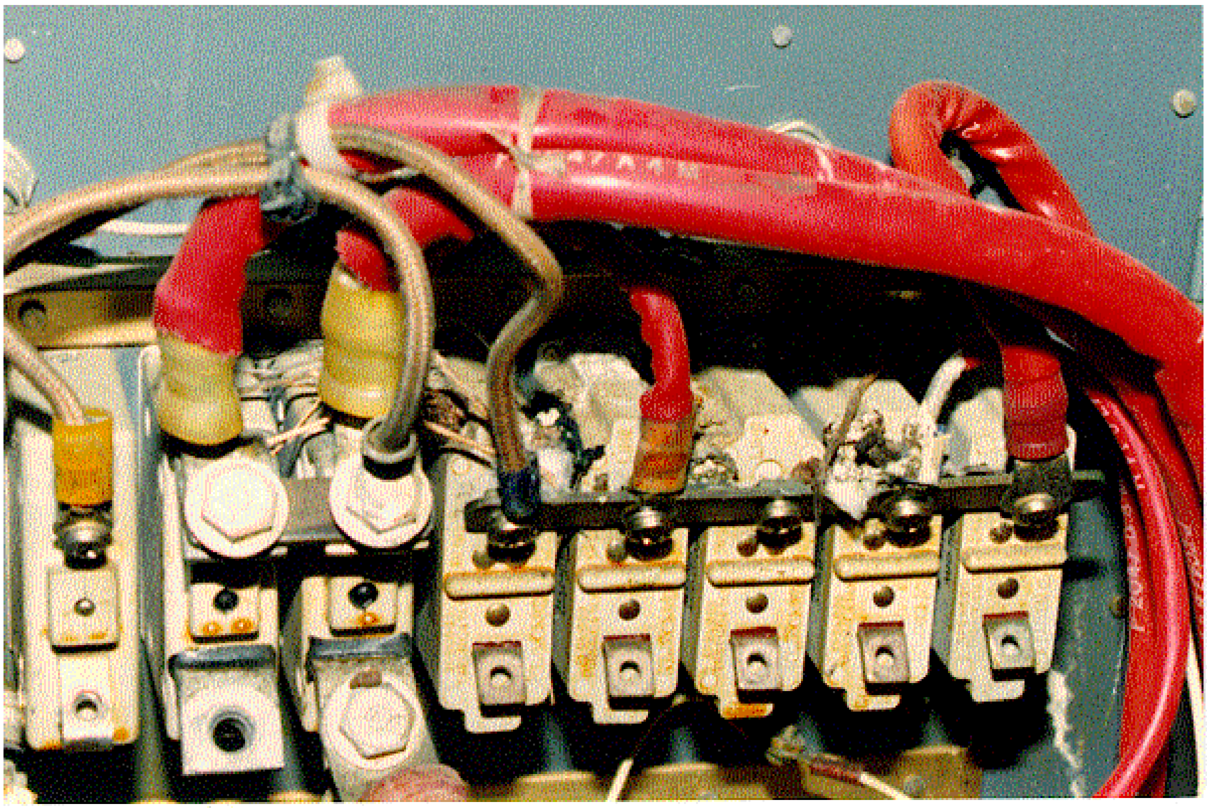


FIGURE 3-10. RODENT DROPPINGS IN BILGE AREA

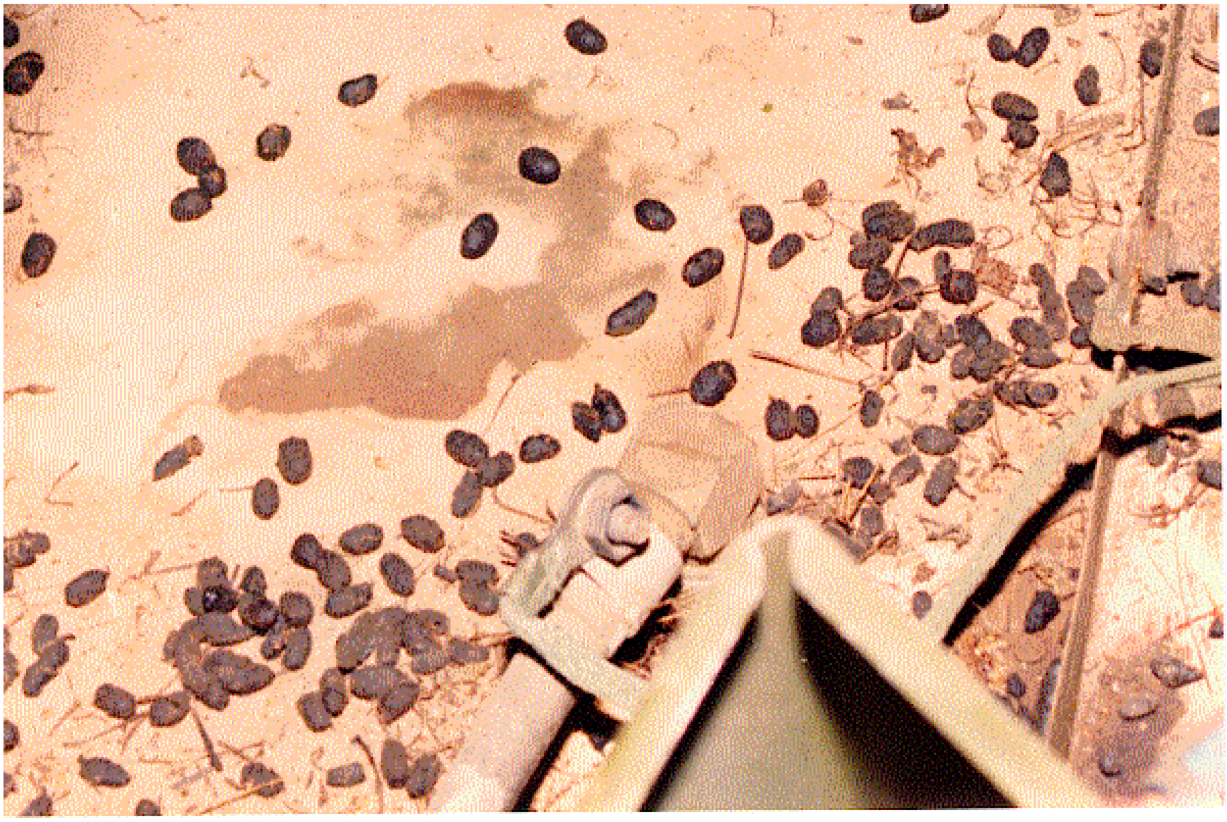


FIGURE 3-11. BIRD NEST IN ENGINE PYLON

FIGURE 3-12. LINT ACCUMULATION IN CROWN AREA

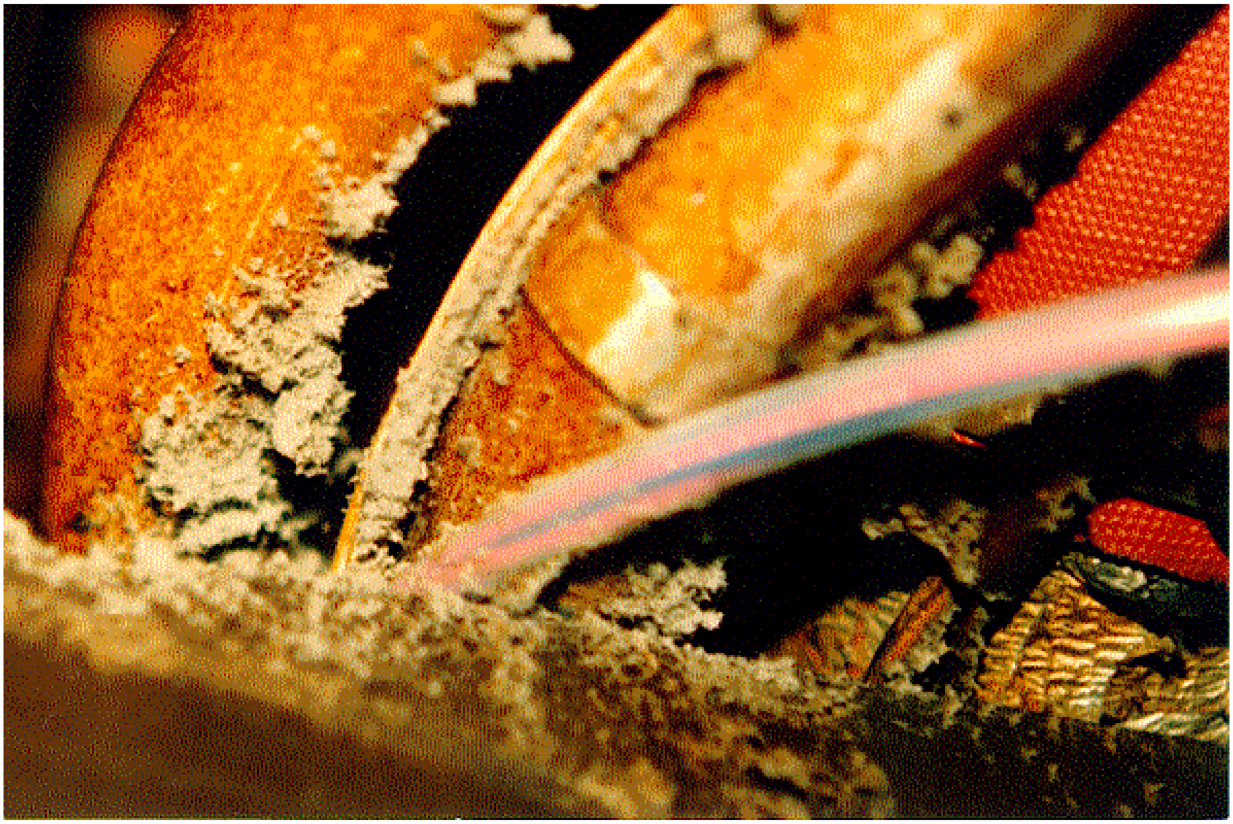


FIGURE 3-13. LINT ACCUMULATION ON ELECTRICAL CONNECTOR

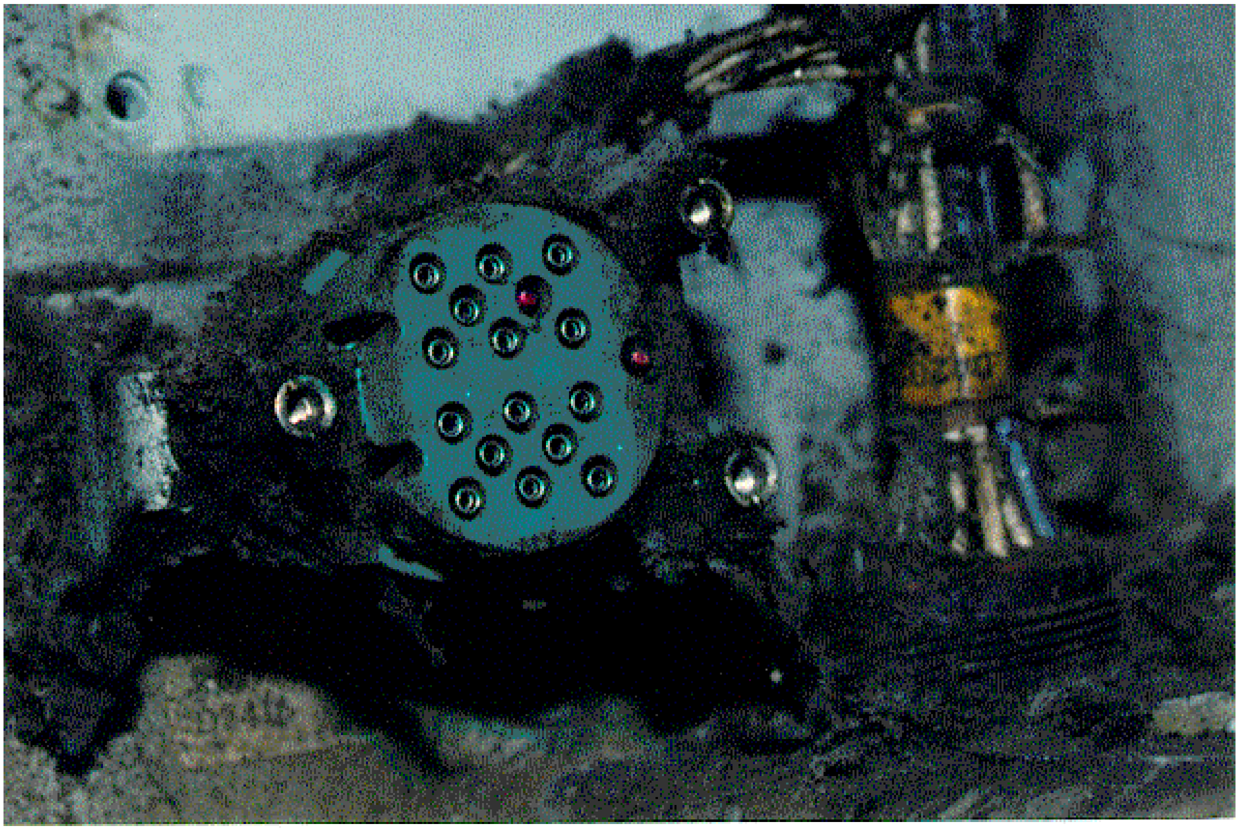


FIGURE 3-14. LINT ACCUMULATION ON WIRING BUNDLE

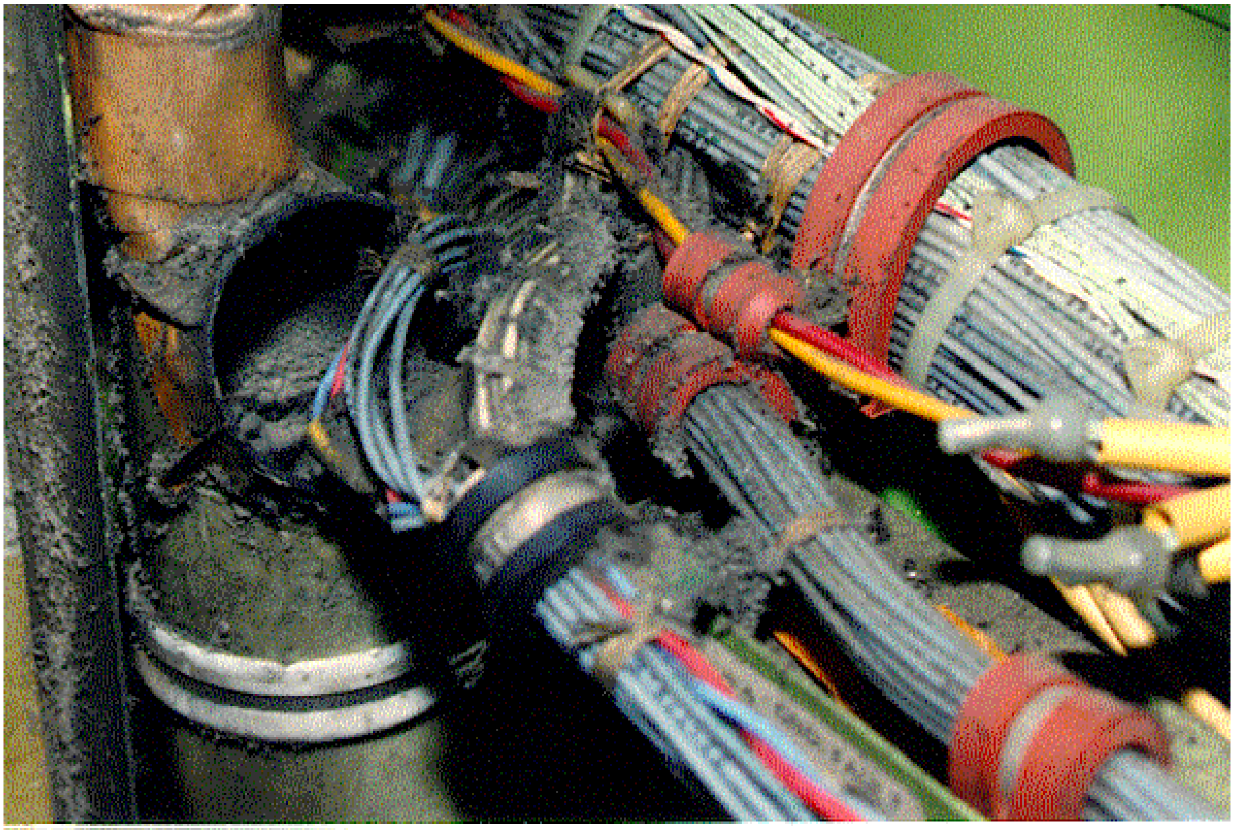
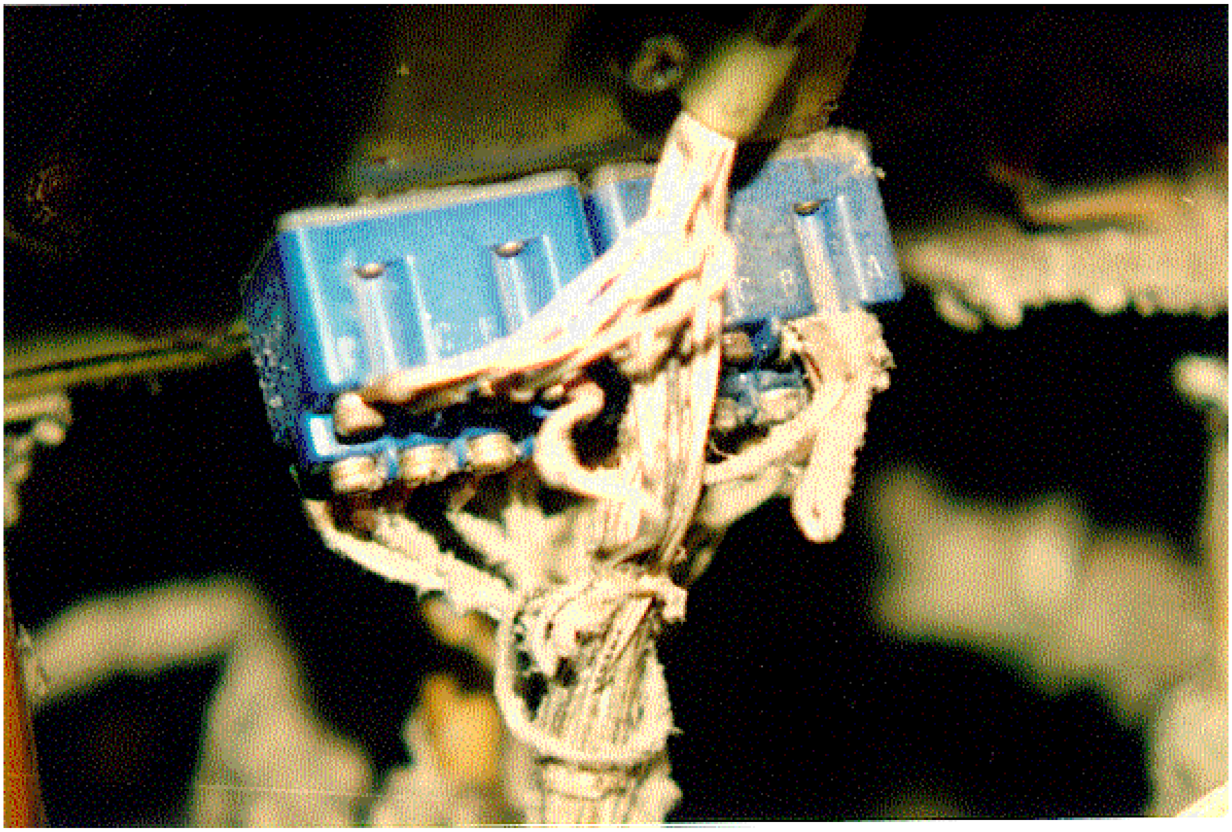


FIGURE 3-15. LINT ACCUMULATION ON ELECTRICAL SWITCH



310. EFFECTS OF DUST/LINT ACCUMULATION. Avionics equipment is subject to dust and lint accumulation. This condition is generally evident when the equipment has been installed for long periods of time and can become more severe with forced cooling air. In addition to the dust and lint accumulation from the movement of air, dust and lint can be attracted by magnetic fields from electric currents surrounding wiring and equipment. Dust can also accumulate on the surfaces of components and on the interior surfaces of components if that equipment has ventilating holes and louvers. The problem with accumulation of dust and lint is it will trap and hold moisture which can provide the electrolyte for corrosion and fungus growth (see Chapter 2, Paragraph 205, Corrosive Conditions). Additionally, dust and lint can degrade avionics equipment by being a conductor or an insulator. When dust and lint act as a conductor in the presence of moisture, they can provide a path for a current flow to either ground as a short or an unwanted circuit path between components. When dust and lint act as an insulator the avionics equipment can overheat causing premature failure. Severe accumulations of dust can appear as long stringy clumps, similar to Spanish moss hanging from trees, but on a smaller scale. Figures 3-12 through 3-15 show examples of dust and lint accumulation. Frequent inspections and general cleaning of equipment will control the accumulation of dust and lint.

311 through 400. RESERVED.

CHAPTER 4. CLEANING AND PRESERVATION

401. GENERAL. The materials, equipment, and techniques described in this chapter are intended to assist the avionics technician at an avionics repair facility. This chapter discusses avionics cleaning and repair facility requirements, specialized support equipment to support cleaning, corrosion removal, drying of avionics equipment, and the different processes of cleaning, drying, preserving, packaging, handling, and shipping avionics equipment.

402. AVIONICS CORROSION CLEANING FACILITY. An avionics cleaning and repair facility should include as a minimum the following resources for the cleaning, drying, preserving, packaging, handling, and shipping of avionics equipment:

a. Adequate lighting and a temperature/humidity-controlled ventilation system.

b. Adequate space for safe operation of avionics cleaning and corrosion control equipment.

c. Operating instructions for each piece of equipment.

d. All hazardous materials (HAZMAT) and material safety data sheets (MSDS) for materials used.

e. Safety equipment and protective personal equipment as required by local, state, and Federal ordinances.

f. Personnel trained in the recognition of corrosion on avionics equipment as specified in this AC.

g. Personnel trained in the safe and proper operation of support equipment.

h. Quality assurance inspectors trained in the operational characteristics and restrictions of each piece of support equipment.

i. Avionics technicians who can recognize the various electrical and electronic equipment and components.

403. MATERIALS AND SUPPORT EQUIPMENT REQUIREMENTS.

a. General. Avionics technicians must understand the functions, capabilities, and restrictions associated with each piece of specialized support equipment, and the hazards of the cleaning and corrosion removal products and preservation materials. This knowledge will prevent injury to personnel and damage to avionics equipment and support equipment.

b. Materials. Consumable cleaning and corrosion removal products and preservation materials listed in Appendix 1 and Appendix 2 may be used as specified on avionics equipment if none were identified by the Original Equipment Manufacturer (OEM) or equipment operator.

c. Materials Used For Cleaning. Table 4-1 contains a list of the various cleaning compounds and solutions, their characteristics, application, mixing instructions, and restrictions. The cleaning of avionics equipment can be accomplished using the following processes:

CAUTION: Some of the materials identified in Table 4-1 can create hazardous conditions or damage equipment unless used strictly in the applications and manner described.

CAUTION: Some of the materials identified in Table 4-1 are chlorofluorocarbons (CFCs), an ozone depleting substance (ODS). These materials may be banned from use by environmental restrictions.

(1) Solvents are effective in dissolving greases and oils. Solvents can be applied by wiping, brushing, soaking, or spraying.

(2) Detergent and water in varying concentrations are used to remove dust, dirt, salt deposits, greases, and oils. Detergent and water cleaning mixtures can be applied by wiping, brushing, soaking, and spraying.

(3) Distilled or fresh water is used to dilute Isopropyl Alcohol or detergents for use in cleaning and as a final rinse. Water may also be used to remove dust, dirt, salt deposits, and cleaning solutions. Application is by wiping, brushing, soaking, and spraying.

TABLE 4-1. AVIONICS CLEANING MATERIALS

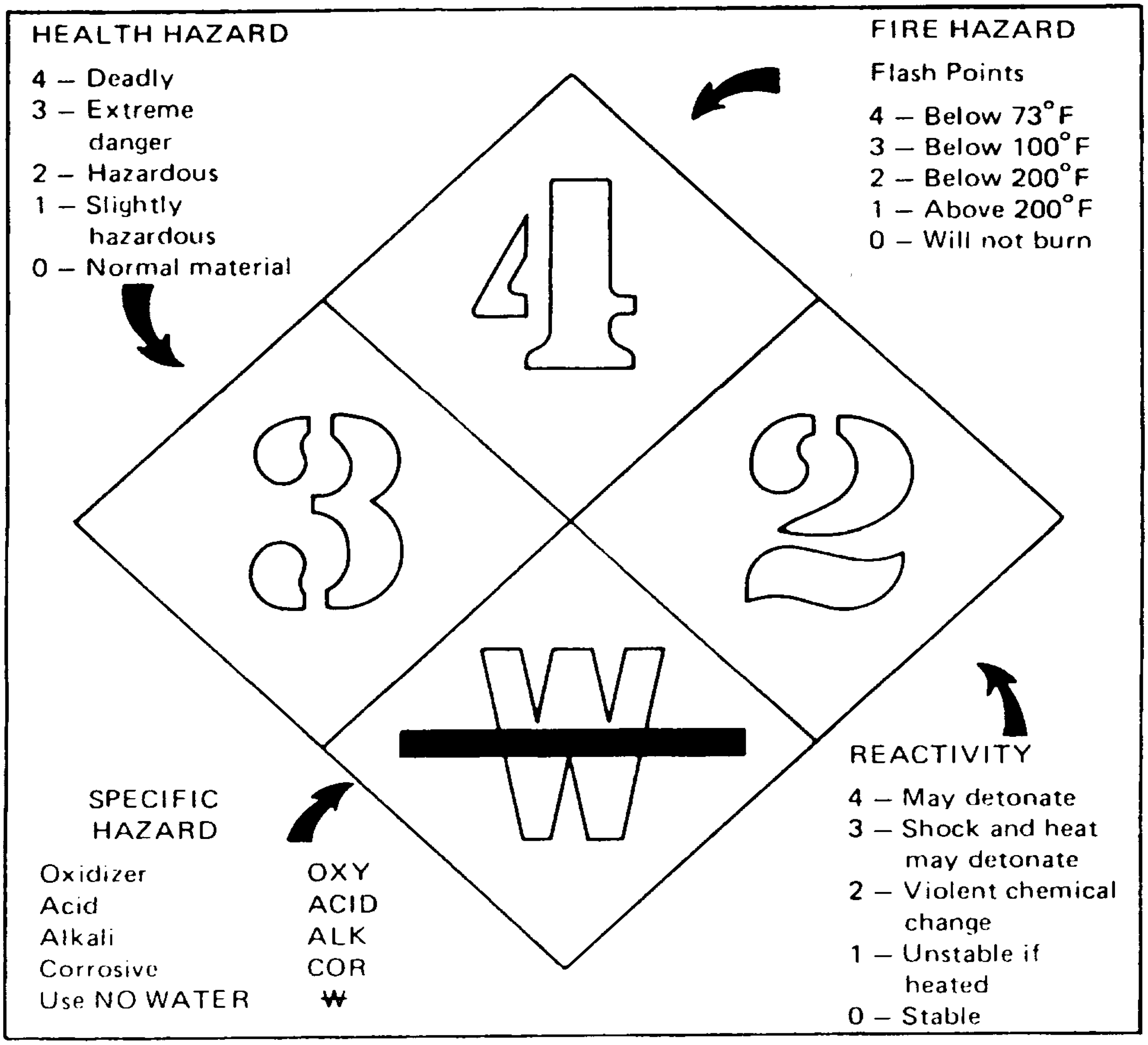
Description	Characteristics	Application	Restrictions
Cleaning Compound, Aircraft Surface, MIL-PRF-85570, Type II	General cleaning agent for light soil and dirt in equipment bays, on external cases, covers, and antenna assemblies.	Mix per manufacturer's instructions or 1 part cleaner in 10 parts distilled water. Apply with cleaning cloth. Rinse with fresh water and wipe dry.	Do not use around oxygen fittings or oxygen regulators as fire or explosion may result.
	Heavy concentrations of surface grime, oil, exhaust smudges, and fire extinguishing chemicals in equipment bays and on external cases and covers.	Mix per manufacturer's instructions or 1 part cleaner in 6 parts distilled water. Apply with cleaning cloth. Rinse with fresh water and wipe dry.	Never use full strength. Do not allow to dry on surface.
Detergent, Liquid, Nonionic MIL-D-16791, Type 1	Cleans transparencies, acrylic plastics, and glass. Also used in the water-based Solvent Spray Cleaning Booth and Aqueous Ultrasonic Cleaner for removing contaminants.	For hand cleaning, apply with flannel cloth. Let dry; then remove with dry flannel cloth.	Mix per manufacturer's instructions or 1 fluid oz. per gallon of water.
Cleaning and Lubricating Compound, Electrical Contact, MIL-PRF-29608, Type 1	A cleaner-lubricant compatible with potting compounds, rubbers, and insulation. Contains 3 to 5% silicon. May be used for cleaning and lubricating electrical contacts.	Apply by spraying an even film to the surface. Wipe clean with disposable applicator or pipe cleaner.	Do not use as a substitute for MIL-C-81302, Type I or Type II. Avoid application to areas requiring soldering or coating.
Cleaning Compound, Solvent, Trichlorotrifluoroethane, MIL-C-81302, Type II	General cleaner for light to medium to heavy dirt, dust, contaminants, and fire extinguishing chemicals.	Used in the Solvent Ultrasonic Cleaner.	Do not use on acrylic plastics and acrylic conformal coatings. Do not use on unsealed aluminum electrolytic capacitors. Damage may result to end caps and cause leakage.
Dry Cleaning, Solvent, MIL-PRF-680, Type II	General purpose cleaner for heavy dirt, dust, contaminants, and fire extinguishing chemicals in equipment bays and on external cases, covers, structural hardware, mounts, racks, etc.	Apply by wiping or scrubbing affected area with cleaning cloth, cheesecloth, or brush. Wipe clean with cleaning cloth.	Do not use around oxygen, oxygen fittings, or oxygen regulator as fire or explosion may result.

Description	Characteristics	Application	Restrictions
	Cleaner for smoke damage removal on internal chassis components.	Apply by scrubbing affected area with cleaning cloth, toothbrush, or typewriter brush. Wipe clean with cleaning cloth.	When used for smoke damage removal, always follow up with a solution of 1 part deionized water and 1 part Isopropyl Alcohol, TT-I-735.
	Cleaner for smoke damage removal on circuit components and laminated circuit boards.	Apply by wiping or scrubbing affected area with cleaning cloth or toothbrush. Wipe clean with cleaning cloth.	May cause swelling of silicone rubber seals in equipment exposed for long periods.
	Cleaner for removal of Water-Displacing Compound, MIL-PRF-81309, Type II or Type III, MIL-DTL-85054; and Corrosion Preventive Compound, MIL-PRF-16173, Grade 2, 3, and 4.	Apply by brush or toothbrush. Wipe clean with cleaning cloth.	May soften some plastics, wire harness tubing, and plastics coating on wiring. Test affected area for adverse reaction prior to general application.
Isopropyl Alcohol, TT-I-735	General purpose cleaner and solvent for removal of salt residue and contaminants common to internal avionics equipment. General cleaner for internal chassis components.	Apply a solution of 1 part deionized or distilled water and 1 part Isopropyl Alcohol, TT-I-735, to affected area with cleaning cloth or toothbrush.	Isopropyl Alcohol, TT-I-735, is highly flammable. All applications of Isopropyl Alcohol, TT-I-735, and water may be air dried or dried by portable air blower or oven.
	Solvent cleaner for solder flux residue in all electronics, electrical equipment, and microminiature circuit applications.	Apply a solution of 1 part deionized or distilled water and 3 parts Isopropyl Alcohol, TT-I-735, and scrub the solder joint and adjacent area with an acid brush or toothbrush. Wipe clean with cleaning cloth.	

	Cleaner for bacteria and fungi attack on all metals and nonmetals.	Apply a solution of 1 part solvent Trichlorotrifluoroethane, MIL-C-81302, Type II, and 1 part Isopropyl Alcohol, TT-I-735, to affected area with cleaning cloth. Wipe clean and air dry.	
	Cleaner for saltwater immersion and fire extinguishing agents on all internal circuit components and laminated circuit boards.	Apply a solution of 1 part Isopropyl Alcohol, TT-I-735, and 9 parts solvent Trichlorotrifluoroethane, MIL-C-81302, Type II, to affected area with cleaning cloth, acid brush, or toothbrush.	
	Cleaner for electrical contact surfaces.	Apply a solution of 1 part deionized or distilled water and 1 part Isopropyl Alcohol, TT-I-735, to affected area with acid brush or pipe cleaner. Wipe clean and air dry.	
Water, distilled	Cleaner for solder flux residue in all electronics, electrical equipment, and microminiature circuit applications.	Apply a solution of 1 part deionized or distilled water to 3 parts Isopropyl Alcohol, TT-I-735, and scrub joint and adjacent area with acid brush or toothbrush. Wipe clean with cleaning cloth.	Deionized water is an acceptable substitute.

d. Hazardous Chemicals and Waste Generation. Many of the materials identified in this AC are hazardous and toxic to personnel not using appropriate personal protective equipment. These materials can also be potentially damaging to avionics equipment and aircraft if used in improper concentrations or misapplied. Prior to using any chemicals such as paint strippers, detergents, solvents, conversion coatings, primers, or paints, personnel should review the appropriate MSDS for warnings and cautions or the HAZMAT identification labels on the containers. Figure 4-1 provides a simple system of readily recognizable and easily understood markings which will give, at a glance, the general idea of the inherent hazards of any HAZMAT. Additionally, the use of materials identified in this AC can, if improperly used or disposed of, create a hazard and contaminate the environment. Avionics technicians should use only the proper amount when mixing materials, close containers when not in use, use only the required amount to complete the intended procedure, and properly dispose of all materials in accordance with all Federal, state, and local regulations.

FIGURE 4-1. NFPA 704 WARNING SYSTEM LABEL



404. AVIONICS CLEANING EQUIPMENT.

a. The following paragraphs identify the different types of avionics cleaning equipment and list their uses and specific restrictions for those pieces of equipment. Table 4-2 lists the recommended cleaning process versus the type of avionics equipment.

NOTE: Avionics technicians should refer to the appropriate equipment service manual for specific operating instructions. Ultrasonic cleaning of printed circuit boards (PCB) is generally not authorized due to the difficulty in determining which component on the board will be susceptible to damage.

CAUTION: Miniature and microminiature PCBs may be susceptible to damage from the ultrasonic frequency, power level, or both.

b. Cleaning Booth, Water-Based Solvent Spray. The water-based solvent spray booth is used for the removal of dirt, dust, salt spray deposits, and loose corrosion deposits. The cleaning action is accomplished by a detergent and spray system.

TABLE 4-2. RECOMMENDED CLEANING PROCESS VERSUS TYPE OF AVIONICS EQUIPMENT

Type of Equipment	Aqueous Ultrasonic	Solvent Ultrasonic	Water-based Spray Booth	Abrasive Tool	Mini-Abrasive	Hand Clean
Housings/covers	X	X	X	X	X	X
Chassis	X	X	X	X	X	X
Racks/mounts	X	X	X	X	X	X
Control boxes	X	X(1)	X		X	X
Instruments					X(1)	X
Light assemblies	X	X	X	X(1)	X	X
Wave guides	X	X	X	X	X	X
Servos/synchros					X(1)	X
Antenna, blade	X	X	X		X	X
Antenna, dome	X(1)	X(1)	X	X(1)	X	X
Antennas, radar			X	X(1)	X	X
Motors	X	X(1)	X	X(1)	X	X
Generators	X	X(1)	X	X(1)	X	X
Batteries						X
Circuit breaker panels	X	X	X		X	X
Gyroscopes			X(1)		X(1)	X
Plugs, connectors			X		X	X
High-density connectors					X	X
Edge connectors			X		X	X
Coaxial connectors			X		X	X
Printed circuit boards			X			X

Note: (1) External use only

(1) The spray equipment provides an air pressure powered spray of a detergent/water solution through a handheld spray gun. The water used can be either filtered or tap water. The equipment can also deliver rinse water or a drying jet of air through the gun.

(2) The spray booth may provide for a turntable which allows 360-degree rotation of the avionics equipment being cleaned or rinsed.

(3) The spray booth operation may be used as a precleaner prior to placing the component in another cleaning process.

(4) The spray booth operation may be used to rinse components after other cleaning processes.

NOTE: Increasing the proportion of detergent in the cleaning solution does not necessarily increase the cleaning power of the detergent. This action can, in some cases, reduce cleaning effectiveness and cause corrosion.

(5) The preferred detergent for the water-based solvent spray booth should conform to MIL-SPEC MIL-D-16791, listed in Appendix 1. The detergent solution should be mixed in accordance with the manufacturer's instructions or one ounce per gallon of water.

(6) Sealed bearings, synchro and servo bearings, instrument bearings, and similar devices with permanently lubricated (sealed) bearings can experience cleaning solution intrusion and the removal of the lubricant. These components could be rendered useless unless the processing procedures protect those components from degeneration or the lubricant is replaced.

(7) Sealed components (other than hermetically sealed) can trap the detergent and water solution. This may cause drying problems. In each case, the sealed component should be opened and inspected for trapped detergent and water solution.

c. Aqueous Ultrasonic Cleaner. The aqueous ultrasonic cleaner is used for the removal of dirt, dust, salt spray deposits, and loose corrosion deposits. The cleaning action is accomplished by the ultrasonic scrubbing action of the detergent and water solution.

(1) The maximum operating temperature should not exceed 130 °F (54 °C). The maximum operating frequency used should be 20 kilohertz (kHz).

(2) Presoaking avionics equipment and components prior to the ultrasonic function is an additional function of this equipment.

(3) The preferred detergent for the aqueous ultrasonic cleaner conforms to MIL-SPEC MIL-D-16791.

(4) Paper capacitors and paper bound components disintegrate in the detergent and water solution.

(5) Sealed bearings, synchro and servo bearings, instrument bearings, and similar devices should be treated per subparagraph 404b(6).

(6) Sealed components (other than hermetically sealed) should be treated per subparagraph 404b(7).

(7) Thin metal foil types of gummed labels can loosen and separate.

d. Solvent Ultrasonic Cleaner. The solvent ultrasonic cleaner is used to remove light to heavy oil, grease, and hydraulic fluid contamination by ultrasonic scrubbing in a solvent solution.

(1) Use only an approved solvent in the solvent ultrasonic cleaner. The maximum operating temperature should be the solvent's boiling point. The maximum operating frequency used should be 40 kHz.

(2) Solvent degreasing, solvent vapor rinsing, and solvent vapor drying are additional functions of the solvent ultrasonic cleaner. Solvent degreasing is performed by solvent ultrasonic action in the degreaser tank. Solvent vapor rinsing (part of the degreasing function) is performed by a solvent vapor cloud. The solvent vapor cloud is created by a cooling coil placed near the top of the degreaser tank. Solvent vapor drying is also performed by the solvent vapor cloud.

(3) The solvent ultrasonic cleaner normally has a solvent degreaser tank. The solvent vapor rinse and solvent vapor drying function do not use the ultrasonic frequency function. Therefore, they may be used to rinse and dry PCBs.

(4) Some acrylics may be susceptible to damage from the solvents used in solvent ultrasonic cleaners. Coaxial connector gaskets and other neoprene rubber components are susceptible to damage by some solvents. Refer to the manufacturer's instructions or use another non-solvent cleaning process. See Table 4-3 for other restrictions.

(5) Sealed bearings, synchro and servo bearings, instrument bearings, and similar devices with permanently lubricated bearings should be treated as described in subparagraph 404b(6).

(6) Sealed components (other than hermetically sealed) should be treated as described in subparagraph 404b(7). The sealed component should be opened and inspected for trapped solvent.

e. Abrasive Cleaning Tools. Abrasive cleaning tools such as portable mini-abrasive units and blast cleaning cabinets are used to remove corrosion and corrosive products.

(1) The abrasive blast medium used in abrasive cleaning tools can easily be trapped in miniature and micro miniature female edge connectors. When working on components where these connectors are installed, the connectors should be sealed with pressure-sensitive tape. Upon completion of the cleaning process, ensure the tape is removed.

(2) Delicate metal surfaces, such as metal plating, are susceptible to damage from indiscriminate, unauthorized use of abrasive cleaning tools. Only properly trained personnel are authorized to use abrasive cleaning tools on avionics equipment.

(3) Some miniature/micro miniature PCBs contain electrostatic discharge (ESD)-sensitive devices (Chapter 9). These ESD sensitive devices may be destroyed by the static charge created in the rapid movement of air and abrasive agents in the abrasive cleaning tools. Therefore, abrasive cleaning tools are not authorized on components where ESD-sensitive devices are installed.

405. AVIONICS CLEANING PROCEDURES.

a. General. Corrosion products and contamination by other sources previously described in Chapter 2 and this chapter are responsible for numerous problems and failures in avionics equipment. Proper cleaning can prevent many of these problems and is the next logical step after the initial inspection. Cleanliness is very important in maintaining the functional integrity and reliability of the avionics system and components. Corrosion products and contaminants can be either conductive or insulating. As a conductor they may provide undesirable electrical paths, and as an insulator they may interfere with the avionics equipment or systems operation. The following paragraphs contain information and suggested procedures for the cleaning of avionics equipment.

b. Cleaning Method Selection Criteria. The best technique for selecting a cleaning method is to select the mildest cleaning method that will accomplish the task. The selection of the cleaning method is a decision that may be outlined in an OEM's maintenance manual or made by authorized personnel at the avionics equipment repair station. The decision on the mildest cleaning method should consider the following:

(1) Certain circuit components can be damaged by support equipment and cleaning solutions and solvents;

(2) Type and extent of the corrosion damage or contamination;

(3) Accessibility to the corrosion damage or contamination; and

(4) Type of avionics equipment.

c. Hazards of Cleaning. As previously mentioned, it is a good maintenance practice to use the mildest cleaning method that will ensure the removal of the corrosion or the contamination. It is also important that the correct cleaning solutions and cleaning materials be used to avoid further damaging the avionics equipment. The following items are offered to emphasize some of the hazards that can occur during cleaning of avionics equipment:

(1) Cleaning solvents or other cleaning materials can become trapped in crevices or seams of components or chassis. These trapped cleaning materials could then interfere with the application of protective coatings and result in the initiation of corrosion.

(2) Vigorous or prolonged scrubbing of laminated circuit boards can cause damage to the boards.

(3) Certain cleaning solvents can soften conformal coatings, wire insulation, acrylic panels, and PCBs.

d. When to Clean. The immediate removal of corrosion or contaminants on avionics equipment and the surrounding structure is always a high priority in a good Corrosion Prevention and Control Program (CPCP). Therefore, immediate cleaning should be accomplished on avionics equipment and components if they have been exposed to adverse weather, saltwater immersion or spray, fire extinguishing agents, spilled battery electrolytes, other acids, high pH alkaline cleaners, mercury, and corrosion products during component repair.

e. Precleaning Criteria and Cautions.

(1) Disconnect electrical and other power sources (mechanical/hydraulic).

(2) Ensure the work area and equipment are safe for maintenance.

(3) Ensure drain holes are open.

(4) Remove covers and panels for accessibility.

(5) Disassemble where practicable.

(6) Use only authorized materials.

(7) Ensure compatibility of materials prior to use.

(8) Mask and protect accessories or components to prevent intrusion of water, solvents, and cleaning solutions.

f. Cleaning and Drying Restrictions. Certain circuit components create potential problems during cleaning and drying. These problems can generally be overcome prior to cleaning the equipment by carefully masking those components likely to trap and hold cleaning liquids due to their construction. Table 4-3 lists different components and describes techniques to avoid problems. Mechanical, shock, and heat damage are other types of damage that can occur during cleaning and drying. The following suggestions are provided to avoid trapping water and solvent during cleaning:

(1) Seal small components with pressure-sensitive tape. Ensure tape and any tape residue are removed using an approved solvent prior to drying the component.

(2) Seal large components in static-free plastic bags or other water and vapor-proof barrier material. Place the plastic bag or barrier material around the component and seal with pressure-sensitive tape. Ensure tape and any tape residue are removed using an approved solvent prior to drying the component.

(3) When possible and if authorized, remove subassembly components and clean separately.

TABLE 4-3. CLEANING AND DRYING RESTRICTIONS

Component	Problem	Solution
APC connections (microwave)	Shock damage to center conductor	Seal and hand clean only
Crystal detectors	Heat damage from ovens	Dry at 130 °F (54 °C) maximum
Delay lines	Trapped solution in housing	Seal or remove
Fan motors	Trapped solution in housing	Seal or remove
Gyroscopes	Trapped solution in housing	Seal
Klystron cavity	Trapped solution in sockets	Remove tube and seal
Meters and instrument gauges	Trapped solution through open housing	Seal
Paper capacitors	Disintegrate	Seal
Potentiometers	Trapped solution in open housing	Seal
Printed circuit	Trapped solution (when installed)	Remove (clean separately)
Rotary switches	Trapped solution in open housing	Seal
Sliding attenuators (radio frequency (RF))	Trapped solution in slide housing	Seal or remove
Sliding cam switches	Shock damage to cam only	Remove or hand clean
Synchros and servos	Lubricant removed from bearing	Seal or remove
Transformers	Trapped solution in housing	Seal
Tunable cavities	Trapped solution in cavity area	Seal or remove
Vacuum tubes	Shock damage	Remove
Variable attenuators (microwave)	Trapped solution in housing	Seal or remove
Wave guide (microwave)	Trapped solution in housing (when installed)	Seal or remove
Wire wrap connections	Shock damage	Hand clean only

g. Hand Cleaning Methods. Hand methods should be used for cleaning small, delicate, confined surfaces where parts cannot tolerate other cleaning methods. Also, hand cleaning methods should be used when accessories/facilities for other methods are not available. The following list contains some of the equipment that may be utilized for hand cleaning:

(1) Lint-free cloth;

(2) Cheesecloth;

(3) Cotton-tipped applicator;

(4) Acid brush;

(5) Toothbrush;

(6) Other soft bristle brushes; and

(7) Plastic manual spray bottle.

h. Fingerprint Removal. The salts and oils from human fingerprints are highly corrosive. The following paragraphs list the material and procedures for their removal:

(1) Apply a mixture of 1 part Isopropyl Alcohol, TT-I-735, or other approved solvent and 1 part distilled water to the affected area with a clean cloth, cheesecloth, acid brush, or toothbrush as appropriate;

WARNING: Do not use a synthetic fiber wiping cloth with Isopropyl Alcohol, TT-I-735, due to its low flash point. A dry fiber wiping cloth will cause a static charge to build up and can result in a fire.

(2) Wipe or scrub affected area until contaminants have been removed;

(3) Remove residue by wiping or blotting with clean cheesecloth or cotton-tipped applicator as required. Inspect area for signs of residue or contaminants;

(4) Discard contaminated cheesecloth or cotton-tipped applicators and solvents in an approved container after cleaning operations to avoid contamination of other components; and

(5) Repeat process as required until all evidence of contamination is removed.

i. Cleaning and Removal of Solder Flux Residue. Solder flux residue is present in all soldering operations. This residue will cause corrosion if an electrolyte is present. Use of an approved cleaning solvent or diluted Isopropyl Alcohol, TT-I-735, is required. These solvents should not damage associated wiring circuit components or laminated circuit board coatings. The presence of soldering flux can be detected by using ultraviolet (UV) light. Under the presence of UV light, traces of solder flux appear as a fluorescent yellow to brownish residue. Clean solder flux residue as follows:

WARNING: Lead contained in solder can rub off onto a person's fingers from a soldered joint. Lead and lead oxide are toxic and cannot be eliminated from the body. This toxic poison will accumulate in the body. Touching solder followed by smoking or eating is a potential means of ingesting trace amounts of lead. Wash hands thoroughly following any soldering or desoldering operation.

(1) Solder flux residues should be removed from circuit boards and circuit components using the general procedures described in subparagraph 405h. Use a solution of 1 part distilled water to 3 parts Isopropyl Alcohol, TT-I-735, to clean the affected area. After a soldering operation, clean the affected area and one inch around the solder point to ensure complete decontamination.

CAUTION: Prior to using the UV light for inspection to ensure complete removal of soldering flux residue, examine the piece of equipment for erasable programmable read-only memory (EPROM) components. EPROM have windows that are usually covered with an aluminum foil mask or black tape. Visually examine to ensure the tape or foil has not lifted from the window.

NOTE: UV light from an UV light inspection light source is very intense and can degrade EPROM devices.

(2) Visually inspect circuit boards and circuit components for evidence of soldering flux residue using an UV light source. Repeat cleaning process as required until all evidence of solder flux is removed.

j. Cleaning and Removal of Silicone Lubricant. Remove silicone residue from surfaces coated with silicone lubricant as follows:

(1) Wipe or scrub contaminated surface with a cleaning cloth, cheesecloth, acid brush, or cotton-tipped applicator dampened with an approved solvent or Naphtha, TT-N-95B, Type II, until surface is clean;

(2) While surface is still wet, wipe area dry with clean cheesecloth or cotton-tipped applicator as appropriate; and

(3) Discard contaminated cheesecloth, cotton-tipped applicators, or other cleaning devices, and solvents in an approved container after cleaning operations to avoid contamination of other components.

k. Cleaning and Removal of Bacteria and Fungi. Dust, dirt, and other airborne contaminants are leading contributors to bacterial and fungal (microbial) attack. The best defense against this form of attack is to maintain cleanliness and, where possible, low humidity. Remove fungi and bacteria as follows:

(1) Mask air capacitors, relay contacts, open switches, tunable coils, and other components affected by solvents with pressure-sensitive tape; and

(2) Treat affected areas with materials and instructions described in subparagraph 405h.

l. Cleaning and Removal of Dust. Dust, dirt, grease, and oil should be removed from components as follows: (Figures 4-2 and 4-3 show dirt accumulation in an engine compartment.)

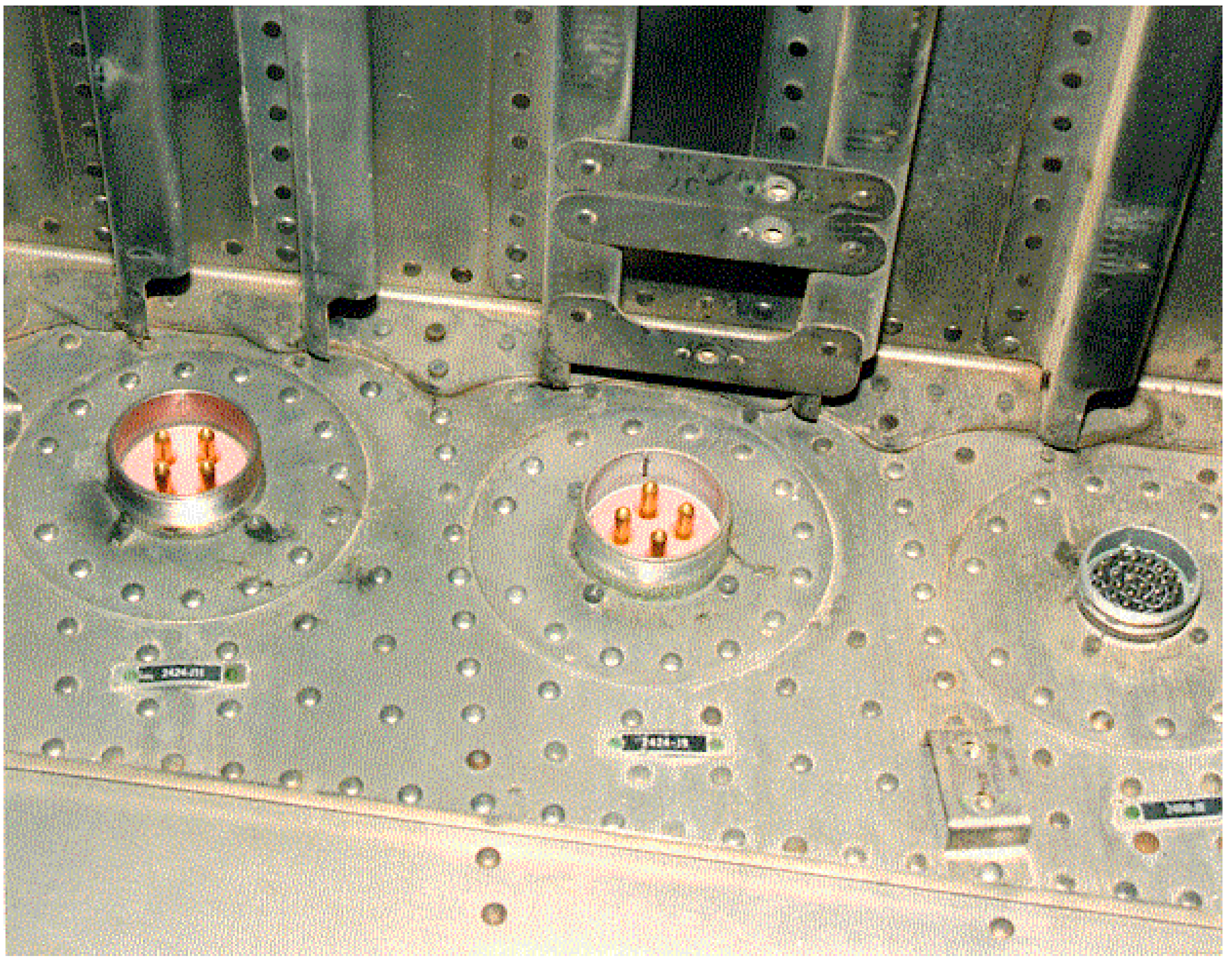
(1) For dust and dirt, apply a solution of 1 part Aircraft Cleaning Compound, MIL-PRF-85570, Type II, to 9 parts of distilled water;

(2) For grease and oil, apply a solution of 1 part Aircraft Cleaning Compound, MIL-PRF-85570, Type II, to 4 parts of distilled water;

(3) Wipe or scrub affected areas or components with cleaning cloth, cheesecloth, acid brush, toothbrush, or cotton-tipped applicator until surface is clean; and

(4) Rinse affected area or component with fresh water and dry with a clean cloth or cheesecloth.

FIGURE 4-2. ENGINE COMPARTMENT ELECTRICAL CONNECTORS



m. Surface Preparation. The true cleanliness of bare metal surfaces after a cleaning process is very critical to adhesion of any subsequent coating material. Examples of subsequent coatings include: chemical conversion coating (prepaint), paint system, sealant, dry film lubrication, etc. The method generally used to identify a surface that is clean enough for adhesion of any of the subsequent coatings is called the Water Break Test. Figure 4-4 illustrates a water-break surface. Perform a Water Break Test as follows:

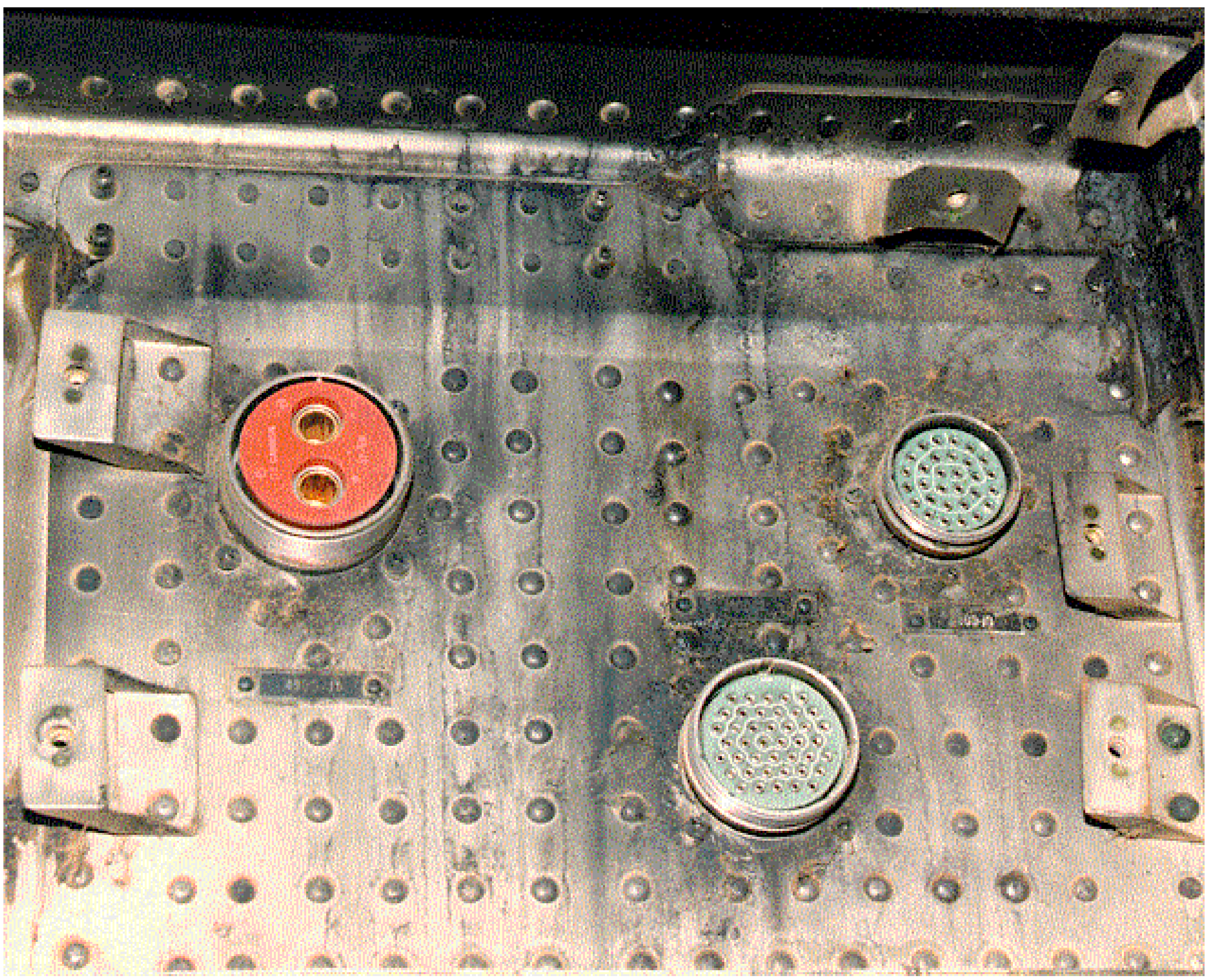
(1) Feather edges of any existing paint finish (if applicable) to ensure a smooth overlapping transition between the old and new paint coating. Feathering can be accomplished using 240-grit or 320-grit aluminum oxide abrasive cloth or a fine or medium grade abrasive mat.

(2) Clean (lightly scrub) the area with very fine or fine abrasive mat saturated with water. Rinse surface with fresh water. Particular attention should be given to fasteners and other areas where residues may become entrapped.

(3) Visually inspect the part after the last rinse; the surface should be water-break free (see Figure 4-4). A surface showing water breaks (water beading or incomplete wetting) is contaminated, usually with grease or oil (fingerprints, etc.). The contaminated surface will not allow proper adhesion with any subsequent protective coating system (conversion coating, primer, topcoat).

(4) If the surface is not water-break free, clean area with a solution of 1 part Aircraft Cleaning Compound, MIL-PRF-85570, Type II, to 9 parts distilled water. Lightly scrub the area with very fine or fine abrasive mat saturated with cleaning solution. Rinse surface with distilled water. Visually inspect the part after the last rinse. The surface should be water-break free.

FIGURE 4-3. ENGINE COMPARTMENT ELECTRICAL CONNECTORS



n. Special Considerations. Dust, fingerprints, surface oxides, and other contaminants can undo the protection provided by subsequent protective coatings. Specific avionics equipment and components should be cleaned by procedures addressed for the specific equipment in Chapter 5.

o. Post-Cleaning Procedures.

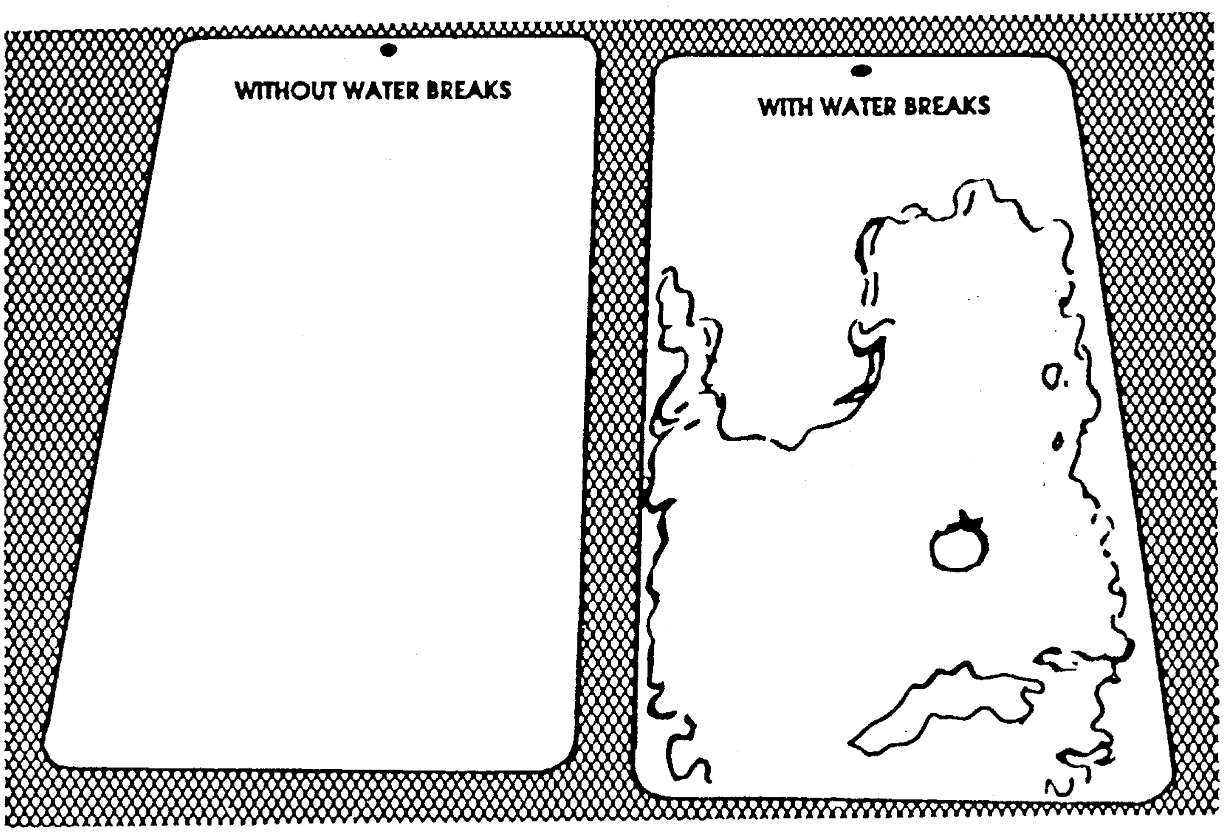
(1) After completion of the cleaning steps, inspect the affected area for signs of residue, surface film, or water.

(2) If inspection reveals the area is not clean, (residue, surface film), repeat the appropriate cleaning procedures. Water displacement, preservation, and lubrication should follow the cleaning and drying steps for completing the preventive maintenance.

406. DRYING EQUIPMENT AND PROCEDURES.

a. General. Drying time depends on the complexity of the equipment/component being dried. The more complex the individual component, the longer the drying time. Another consideration in drying time is the humidity or moisture content of the air where the drying oven is operated. The higher the moisture content of the ambient air, the longer the drying time.

FIGURE 4-4. A WATER-BREAK-FREE SURFACE COMPARED WITH ONE WITH WATER BREAKS



CAUTION: Portable air blowers, hot air blowers, hair dryers, and similar drying devices may cause fires when used in or around aircraft. Use only authorized (spark proof) hot air guns in and around aircraft. The motion of air from an aerosol spray, compressed air, and air from dryers can generate static charges that can degrade or destroy ESD-sensitive devices. Care must be exercised during handling, cleaning, and repair of these items. See Chapter 9 for recommended shop practices.

b. Drying Preparation. Prior to placing a component in a drying oven, remove all covers, lids, etc. Ensure any pressure-sensitive tape and protective plastic bags used during the cleaning cycle have been removed.

c. Air Drying. Air drying is usually adequate for housings, covers, and some hardware. This method is not considered adequate for more complex equipment or components that may contain cavities or moisture traps.

d. Drying with Hot Air Blower. Procedures for the use of hot air blowers are as follows:

(1) Blow off excess water with dry air or dry nitrogen at not more than 10 pounds per square inch (psi) pressure. Deflect air off interior back and sides of enclosure to diffuse air jet.

(2) Dry the equipment with a hot air gun. Surfaces should not be heated with the air gun above 130 °F (54 °C) when drying the equipment.

e. Drying with Circulating Air Oven. The circulating air drying oven is used to dry small electrical and electronic components, such as non-pressurized instruments, control boxes, PCBs, and similar devices. The circulating air drying oven should not be operated above 130 °F (54 °C) when drying avionics equipment or components. Damage may result from overheating of discrete electronic circuits components. Procedures for the operation of the circulating air drying ovens are as follows:

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

CAUTION: Older circulating air drying ovens may have uncalibrated dials or controls for setting the oven temperature. These uncalibrated ovens should have the dials calibrated, prior to use, by placing a red line on the dial so as not to exceed 130 °F (54 °C).

(2) Set the temperature control at a maximum of 130 °F (54 °C);

(3) Place the component(s) in the oven and close the door. If a timer is available, set the time for approximately 3 to 4 hours; and

NOTE: Opening and closing the oven door during the drying cycle will increase the drying time. This is due to the diffusion of hot, dry air in the oven cabinet with cooler, more humid air from the surrounding area.

(4) Upon completion of the drying cycle, remove the component(s).

f. Drying with Forced Air Oven. The forced air drying oven is the most efficient of the drying ovens. This unit can be used to dry all types and sizes of equipment and components. The procedures for the operation of the forced air drying oven are as follows:

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

CAUTION: Check the temperature dial (or control calibration) periodically to ensure the temperature setting is correctly calibrated.

(2) Set the temperature control at a maximum of 130 °F (54 °C);

(3) Place the component(s) in the oven and close the door. If a timer is available, set the time for approximately 1 to 2 hours. Opening and closing the oven door during the drying cycle will increase the drying time slightly but not appreciably. This is considered one of the advantages of the forced air drying oven over the circulating air type oven; and

(4) Upon completion of the drying cycle, remove the component(s).

g. Drying with Vented Oven (Bulb-type). Vented drying oven procedures are as follows:

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

(2) Place the component(s) in the oven and close the door. Dry the component or equipment at a maximum of 130 °F (54 °C). If a timer is available, set the time for approximately 3 to 4 hours; and

(3) Upon completion of the drying cycle, remove the component(s).

h. Drying with Vacuum Oven. Vacuum oven drying procedures are as follows:

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

(2) Place the component(s) in the oven and close the door. Dry the equipment at approximately 130 °F (54 °C) and 26 inches of mercury (Hg). If a timer is available, set the time for approximately 1 to 2 hours; and

(3) Upon completion of the drying cycle, remove the component(s).

i. Solvent Vapor Drying. Solvent vapor drying is an additional feature of the solvent ultrasonic cleaner. This method of drying is considered the fastest and most efficient method of drying avionics components. The drying time is usually 15 seconds to 3 minutes. Follow the equipment manufacturer's operating procedure for cleaning and degreasing. The procedures for solvent vapor drying are as follows:

CAUTION: Environmental regulations may prohibit the use of the ozone depleting CFCs solvents used in solvent ultrasonic cleaners.

(1) Suspend the component being processed in the solvent vapor cloud for a period of 15 seconds to 3 minutes. Drying time depends on the complexity of the component and the amount of water or solvent present;

(2) Rinse by altering the position of the component in the vapor cloud to drain any trapped water or solvent;

(3) After thorough rinsing, slowly raise (withdraw) the component out of the vapor cloud. This will cause rapid drying of the component; and

(4) Inspect the component for visible signs of water or solvent. If required, repeat the solvent vapor drying process.

407. PRESERVATION.

a. General. Surfaces and components not normally conformal coated or painted need preservation. Cleanliness and elimination of moisture are keys to avoiding corrosion. Preservation of equipment is essential, since it is nearly impossible to guarantee a dry, moisture-free environment. In today's avionics systems, miniaturization has resulted in very small electronic circuits. Even a small amount of corrosion can cause the entire system to fail. Preservation has become an essential part of the repair and maintenance of avionics systems.

b. Why Preserve.

(1) To protect nonmoving parts by filling air spaces, displacing water, and providing coatings;

(2) To protect components such as hinges, control cables, gears, linkages, bearings, etc., from wear by providing lubrication; and

(3) To protect nonoperational or idle equipment.

c. When to Preserve.

(1) After cleaning;

(2) On equipment prior to shipment;

(3) On equipment or components that are not operational, including those awaiting parts and repair;

(4) On parts or components that are normally inaccessible for inspection without disassembly;

(5) Where additional protection is required for other coating systems;

(6) After immersion and exposure to fresh and saltwater or fire extinguishing agents; and

(7) When other corrosion protection systems have failed because of in-service use.

d. What to Preserve. Preservatives should be used only where their application and maintenance will not hamper electrical circuits or component operation. Most preservatives form a nonconductive film that acts to insulate mating surfaces from moisture intrusion. The following provides a list of avionics equipment and components that may require preservation and maintenance:

(1) Door latches and hinges;

(2) Electrical connectors (internal and external);

(3) Shock mounts, rigid mounts, and associated attaching hardware and brackets;

(4) Any dissimilar metals not protected by other coating systems;

(5) Antenna mounts, brackets, hardware, and housings;

(6) Fasteners, screws, nuts, and bolts not otherwise covered elsewhere;

(7) Equipment lids on interior or exterior of equipment that is susceptible to moisture;

(8) Solder joints not otherwise protected by other coatings;

(9) Any unprotected surface that will not receive a paint coating system or other coating material (plating or conformal coatings);

(10) External and internal surfaces of coaxial connectors;

(11) External surfaces of cooling system joints; and

(12) Ground straps and wires.

e. What Not to Preserve. The following items should not be preserved or come in contact with preservatives:

(1) Laminated circuit boards that are conformal coated;

(2) Nonmetallic surfaces such as acrylic control box face plates;

(3) Tunable capacitors and inductors;

(4) Internal surfaces of wave guides;

(5) Internal surfaces of tuned tanks;

(6) Relay and circuit breaker contacts; and

(7) Fuses.

f. Preservative Materials. Preservatives are materials that can take the place of more permanent coating materials such as paint, but require removal and repeated application on a scheduled basis. Some preservatives may also act as water-displacing compounds. Table 4-4 contains a list of preservatives and water-displacing compounds for use on avionics components. Preservatives must be applied over water-displacing, corrosion preventive compound, MIL-PRF-81309, Type II, to accomplish a complete water-displacing and preservative system on all areas exposed to elements and moisture.

g. How to Preserve. The application of preservatives for specific avionics components is covered in Chapter 5. The following are general application procedures that apply in most cases:

(1) Ensure surface to be preserved is free of dirt, grime, other contaminants, standing water, and corrosion products. Remove corrosion products as outlined in Chapter 5. Clean and dry the surface as appropriate with a cleaner and dryer as outlined earlier in this chapter;

(2) When necessary, apply pressure-sensitive tape to protect areas and components not to be preserved. Subparagraph 407e refers to areas and components not to be preserved;

(3) Water-displacing preservative compounds that conform to MIL-PRF-81309, Type III, (Avionics), MIL-PRF-81309, Type II, and MIL-DTL-85054 (AMLGUARD) should be applied with an even, thin film to the surface. Ensure complete coverage of dissimilar metal contact areas, crevices, and water entrapments areas. Avoid excessive application. When MIL-DTL-85054 is used, apply a second coat after 30 minutes;

(4) Non-water-displacing preservative compound that conforms to MIL-PRF-16173, Grade 4 should receive a film of water-displacing preservative compound as described in subparagraph 407g(3) to the part or component prior to the application of MIL-PRF-16173, Grade 4, to remove any moisture. MIL-PRF-16173, Grade 4, should be applied with a brush or sprayed in a thin, even film to nonmoving external areas. Fasteners may be dipped in MIL-PRF-16173, Grade 4, prior to installation; and

NOTE: MIL-PRF-16173, Grade 4, may be thinned for spraying as required with an approved solvent or a general purpose oil.

(5) Remove pressure-sensitive tape as required.

TABLE 4-4. PRESERVATIVE COMPOUNDS FOR AVIONICS EQUIPMENT

Description	Characteristics	Application	Restrictions
Corrosion Preventive Compound, Water-Displacing, Ultra-Thin Film, MIL-PRF-81309, Type III, avionics Grade 2.	General preservative for avionics equipment, internal areas of electrical connectors, and solder receptacles and joints. Contains water-displacing properties.	Apply by spraying an even, thin film to the surface. Can be removed with an approved solvent or Dry Cleaning Solvent, MIL-PRF-680, Type II.	Not intended for use on exterior of avionics equipment. Deposits a thin film which must be removed for proper function of contacts points and other electromechanical devices where no slipping or wiping action is involved. Do not use around oxygen, oxygen fittings, or oxygen regulators, since fire or explosion may result.
Corrosion Preventive Compound, Water-Displacing, Ultra-Thin Film, MIL-PRF-81309, Type II.	General preservative for internal and external areas of chassis, equipment covers, hardware, mounting brackets, latches, hinges, terminal boards, busbars, ground straps, and internal/external areas of junction boxes.	Apply by spraying an even, thin film to the surface. Can be removed with an approved solvent or Dry Cleaning Solvent, MIL-PRF-680, Type II.	Do not use on interior surfaces of electrical connectors and receptacles. Do not use on interior surfaces of coaxial connectors. Do not use around oxygen, oxygen fittings, or oxygen regulators, since fire or explosion may result.
Corrosion Preventive Compound, Water-Displacing, Clear, MIL-DTL-85054.	General preservative for external surfaces exposed to elements and moisture, including: chassis, equipment covers, mounting racks, equipment racks, shelving, brackets, radar plumbing, antenna hardware, latches, terminal boards, busbars, ground straps, junction boxes, fasteners, external connectors, coaxial connectors, and receptacles.	Apply by spraying an even thin film or brush onto the surface. Material presents a thin, non-tacky, clear film. Can be removed with an approved solvent or dry cleaning solvent, MIL-PRF-680, Type II, Isopropyl Alcohol, TT-I-735, or by applying Corrosion Preventive Water-Displacing Compound, MIL-DTL-85054, and wiping.	Do not use on interior surfaces of electrical equipment and hardware. Do not use on moving/sliding surfaces. Do not use on interior surfaces of electrical connectors, coaxial connectors, or receptacles. Do not use around oxygen, oxygen fittings, or oxygen regulators, since fire or explosion may result.
Corrosion Preventive Compound, Solvent Cutback, Cold Application, MIL-PRF-16173, Grade 4.	General preservative for external surfaces exposed to elements and moisture, including: mounting racks, shelving, brackets, radar plumbing, shock mounts, rigid mounts, antenna hardware, general hardware, hinges, fasteners, ground straps, and exterior surfaces of electrical connectors, coaxial connectors, and receptacles.	Apply by brush or spraying an even, thin film to the surface. Material presents a semi-transparent film. Can be removed with an approved solvent or Dry Cleaning Solvent, MIL-PRF-680, Type II.	Do not use on interior surfaces of avionics equipment. Do not use on interior of electrical connectors, coaxial connectors, or receptacles. Do not use around oxygen, or oxygen regulators, since fire or explosion may result.

408. LUBRICANTS.

a. General. Lubrication of equipment performs several important functions: it prevents wear between moving parts, provides a barrier to corrosion, and is a short-term preservative. Particular attention should be given to lubrication points around hinges, latches, etc., for prevention of lubrication breakdown. Lubrication breakdown includes caking of the lubricant, an indicator of contamination.

b. Requirements. Maintenance personnel should refer to the applicable maintenance manual for specific lubrication requirements, materials, and frequency.

409. PACKAGING, HANDLING, AND STORAGE.

a. General. An avionics corrosion control program must include procedures for packaging, handling, and storage of avionics equipment and components. These components will be rendered useless if the packaging, handling, and storage procedures are not followed. Materials used for the packaging, handling, and storage must be compatible with the avionics equipment and the anticipated environment. Figures 4-5 and 4-6 show typical storage and shipping containers. These containers are not intended for storage in the elements.

b. Packaging and Storage Materials Guidelines.

(1) Certain packaging materials containing wood, cotton, foam, and paper are susceptible to mold and fungal attack. (See Chapter 3, paragraph 308.) These materials and other items such as shredded newspaper, excelsior, and cardboard may give off sulfurous or acidic vapors that can promote a corrosive attack on electronic components.

(2) Use only metal or preserved wooden shelves for storing avionics equipment and components. Inadequately preserved wood can produce corrosive vapors.

(3) Provide closed-cell polyethylene foam 1/2 inch thick as a cushioning for equipment on shelves, pallets, etc. Do not use an open-cell foam or sponge rubber, horse hair, or similar material that will hold moisture.

(4) Use conductive plastic or metal caps for electrical connector protection.

(5) Use cellular plastic film cushioning material (bubble wrap) for short-term protection during transportation of equipment and to protect against handling and shock damage.

(6) Never place bubble wrap in direct contact with ESD-sensitive devices. The electronic device or component should first be placed in a conductive bag. For equipment requiring ESD protection, see Chapter 9.

(7) Use plastic bags for short-term protection of noninstalled small components and microminiature PCBs against moisture and contamination.

(8) Use unicellular polypropylene packing foam and water vapor proof packaging material for long-term protection of miniature and microminiature circuit components, laminated circuit boards, and critical avionics components against moisture and contamination. Figures 4-5 and 4-6 show typical shipping containers for avionics equipment.

c. Handling. Damage can occur to avionics equipment because of incorrect packaging methods and rough handling between the manufacturer, aircraft, and avionics repair facilities. The best method of avoiding handling damage when transporting equipment is to use the specially designed cushioned shipping container from the OEM. A method that can be used if the original shipping container is not available is to use cellular plastic film cushioning material (bubble wrap). Bubble wrap is primarily used to absorb shock and is not intended as a water vapor proof packaging material. Bubble wrap should be placed around the component to be protected in two layers, with the second layer rotated 90 degrees from the original layer. The corners should be left open to allow the component and packing material to breath and avoid condensation and water entrapment. Secure the alternating layers of bubble wrap using masking tape or other pressure-sensitive tape.

d. Package and Storage. Packaging of avionics equipment is normally a function of a supply or receiving and shipping department. In many cases, the packaging of avionics equipment is accomplished by aircraft or avionics maintenance personnel. Packaging methods employed by these personnel are an important consideration for the equipment due to the length of time in storage awaiting repair or transit between aircraft and repair stations.

(1) Proper packaging should include provisions for the length of time the equipment will be in storage. Equipment should be packaged for long-term storage if the length of storage time is not known.

(2) Proper packaging materials, when specifically designed shipping containers are not available, should include: 6 mm thick (minimum) anti-static zip lock plastic-type bags. These bags are adequate for short-term storage and protection from moisture and contamination. They should be used during maintenance or repair operations on laminated circuit boards and small electrical/electronic components. They should also be used as part of a longer storage packaging and sealing system. For long-term storage, water vapor proof, heat-sealed barrier material provides excellent protection against moisture and contamination. Cushioning material such as unicellular polypropylene packaging foam should be used in conjunction with the plastic bags and water vapor proof, heat-sealed barrier material when protection from shock and handling is required.

(3) For equipment requiring ESD protection, see Chapter 9.

e. Electrical Connector and Wave Guide Caps. Metal caps and blank off plates, preferably moisture and vapor proof, are the preferred methods of protecting electrical connectors and wave guides from contamination and damage. Conductive plastic caps are another acceptable method of protection. Use only plastic caps which cover by surrounding the connectors or wave guide. Do not use push-in type caps or covers. These type caps or covers can easily be overlooked during assembly or become foreign object debris (FOD). When metal or conductive plastic caps and blank off plates are not available, electrical connectors and wave guides may be capped off with pressure-sensitive tape conforming to MIL-T-22085, Type II. Other type tapes should not be used to seal or cap-off electrical connectors or wave guides.

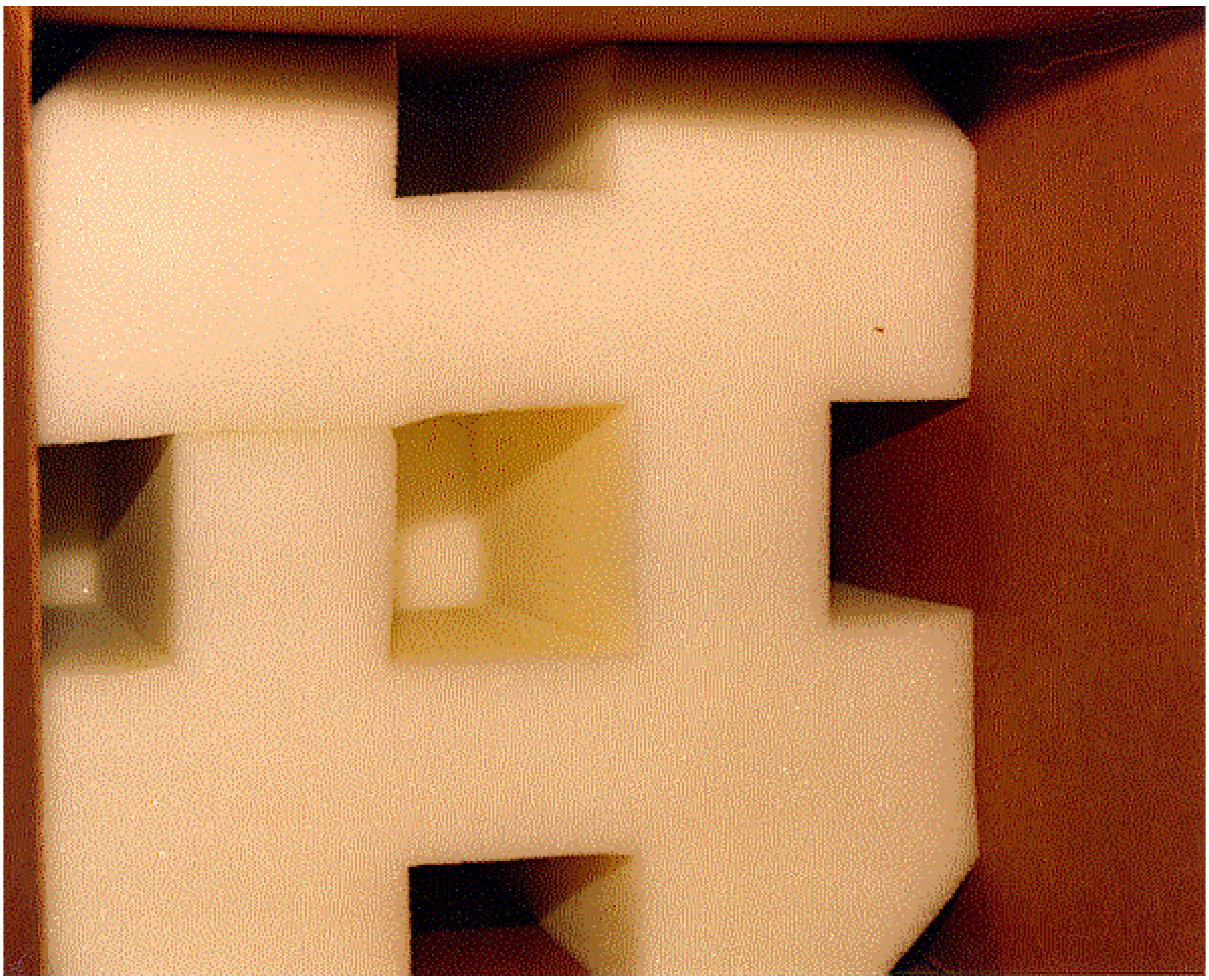
f. Desiccants. Desiccants are normally packaged with equipment packaged for storage or shipment. The purpose of the desiccant is to absorb moisture and lower the relative humidity. The following describes some of the problems and considerations for using desiccants.

(1) Desiccants may be ineffective for the following reasons:

(a) Moisture may condense as water when the desiccant becomes saturated.

(b) Desiccant is not placed in the proper location.

FIGURE 4-5. TYPICAL SHIPPING CONTAINER FOR AVIONICS EQUIPMENT



(c) Rapid changes in ambient temperature may produce precipitation before the desiccants can react.

(d) Not enough desiccant was used for the area to be protected.

(2) The following considerations apply to desiccants:

CAUTION: Do not use loose desiccants in packing of avionics equipment. Loose desiccant may contaminate and cause damage to the packaged equipment.

(a) Desiccant material should be contained in rupture-resistant sturdy bags.

(b) Desiccant bags should be secured to prevent movement.

(c) Desiccant bags should not be placed on or permitted to come in contact with unprotected surfaces.

(d) Desiccants should be reactivated prior to reuse.

(e) Desiccant bags should not be removed from their sealed container until ready for use.

FIGURE 4-6. TYPICAL SHIPPING CONTAINER FOR AVIONICS EQUIPMENT

(3) If a desiccant bag should break open during transit, clean the avionics equipment immediately upon discovery. Do not turn moving parts any more than absolutely necessary until all desiccant particles have been removed. Work out the desiccant particles with a clean acid brush and not more than 10 psi dry air pressure. An alternate method is to use a clean acid brush and a vacuum cleaner. For equipment with ESD protection, see Chapter 9.

g. Humidity Indicators. Humidity indicators should be placed in containers when desiccants are used. A humidity indicator is used to determine if a desiccant is sufficiently active to maintain an acceptable relative humidity within the container.

CAUTION: Do not place humidity indicator in direct contact with metal. Chemicals used in the indicator may cause corrosion.

410 through 500. RESERVED.

CHAPTER 5. CORROSION REMOVAL, SURFACE TREATMENT, PAINTING, AND SEALING

501. GENERAL. This chapter outlines the materials, equipment, and techniques involved in corrosion control. Maintenance personnel should analyze each corrosion problem and select the correct corrosion removal and preservation materials. Where possible, follow-up actions should be conducted to ensure that all corrosion has been removed and proper protection has been applied. An avionics corrosion control program is an important function in maintaining any aircraft and aircraft component. The program requires knowledge of the science and technology of avionics corrosion control. Preventive maintenance must occur as part of all maintenance functions performed on avionics systems. Whenever equipment is removed from the aircraft for bench check or repair, covers and housings should be inspected and treated for corrosion. Avionics technicians must ensure that corrosion, repair, treatment, and preventive maintenance becomes a normal part of their maintenance and repair procedure.

502. CORROSION REMOVAL MATERIALS AND EQUIPMENT.

a. General. Avionics technicians and repair stations should review Appendix 1 of this AC to convert military specification corrosion repair materials and equipment mentioned in these chapters to the commercial equivalent.

b. Corrosion Removal. When corrosion is detected, corrective action is required. When the corrosion is within repairable limits specified in the applicable Original Equipment Manufacturer's (OEM) manual or other directive, corrective action should be initiated. This should consist of paint removal (as required), cleaning, corrosion removal, treatment, and the application of protective coatings and preservation. The mildest method of corrosion removal should always be used. The following paragraphs list approved methods for use on avionics equipment.

WARNING: Prolonged breathing of vapors from organic solvents or materials containing organic solvents is dangerous. Refer to the appropriate material safety data sheet (MSDS) for warnings and required protective gear. Chemical paint removers are toxic to the skin, eyes, and respiratory tract. Avoid breathing the vapors. Use only with adequate ventilation. Avoid skin and eye contact. Wear gloves and goggles while handling. If eye contact is made, wash immediately with large amounts of water. If skin contact is made, wash immediately with soap and water.

CAUTION: Epoxy paint removers are harmful to rubber and plastic products, including wiring insulation. Exercise care to avoid contact with such surfaces. Mask those adjacent areas which are not to be stripped with pressure-sensitive tape.

(1) Chemical Paint Removers. Epoxy paint removers conforming to QPL-81294 may be used to chemically remove paint from metal surfaces. This paint remover should be applied by brush. Care must be observed to ensure that the paint remover does not contact any part of the body. Observe all cautions and warnings. Whenever a chemical paint remover has been used, ensure that the surface is washed with a detergent and water mixture and thoroughly rinsed prior to the application of other coatings. Properly dispose of hazardous wastes generated during the stripping process.

(2) Cleaning. Chapter 4, paragraph 405 outlines the materials and procedures for cleaning avionics equipment.

(3) Corrosion Removal Equipment and Methods.

(a) Hand Rubbing/Abrasion. The nature of some surfaces, such as chrome-, nickel-, gold- and silver-plated contacts, restricts the use of highly abrasive methods. Tarnish and light corrosion can be removed from such surfaces by hand rubbing with a pencil eraser, brushes, and nonabrasive pads. Surfaces such as covers, connectors, receptacles, antenna mounts, equipment racks, chassis, etc., may have light to moderate corrosion removed by an abrasive mat or cloth.

(b) Portable Mini-Abrasive Unit. The portable mini-abrasive unit is a handheld miniature abrasive tool used to remove light corrosion products from small avionics components, such as printed circuit boards (PCB), edge connector pins, small avionics structural components, etc. Care should be taken not to remove the thin plating from these surfaces. Monobasic sodium phosphate conforming to AWWA B504-18 is generally the specified abrasive material used in portable mini-abrasive units. Refer to the manufacturer's manual for other possible material choices. The portable mini-abrasive unit should only be operated in a blast cleaning booth or other similar structure. Contamination of other equipment or components by monobasic sodium phosphate can occur if it is allowed to blow freely into the surrounding shop area.

(c) Handheld Abrasive Tools. The handheld abrasive tool is used to remove corrosion products from larger components such as avionics equipment structures and housings. Glass beads conforming to MIL-G-9954 are generally the specified abrasive material used in handheld abrasive tools. Refer to the manufacturer's manual for other possible approved abrasive material choices. This unit should also be operated only in a blast cleaning booth or other similar structure. Contamination of other equipment or components by glass beads can occur if they are allowed to blow freely into the surrounding shop area.

503. SURFACE TREATMENT.

a. Chemical Conversion Material Procedures. Chemical conversion is an extremely important part of the corrosion control process. Properly applied, chemical treatments impart considerable corrosion resistance to the basic metal and greatly improve the adhesion of subsequently applied paints.

WARNING: Chemical film materials are strong oxidizers and a fire hazard when in contact with organic materials such as paint thinners. Do not store or mix surface treatment materials in containers previously containing flammable products. Rags contaminated with chemical film materials should be treated as hazardous materials and disposed of accordingly.

(1) Treatment Application Particulars. The material for the treatment of aluminum alloys conforms to MIL-DTL-81706. Class 1A chemical conversion material provides superior corrosion protection. Class 3 chemical conversion material provides less corrosion protection and is used where low electrical resistance is required, such as mounting areas for antennas. The material for the treatment of magnesium alloys conforms to SAE-AMS-M-3171, Type VI. These chemical conversion materials may be in the form of dry crystals or pre-mixed. When dry crystals are provided, they must be mixed with an appropriate amount of distilled water. When the chemical conversion material is pre-mixed, no additional distilled water need be added.

(2) Distinguishing Between Magnesium and Aluminum. The methods to distinguish between magnesium and aluminum are as follows:

(a) Magnesium may be distinguished from aluminum by spot testing with a silver nitrate solution. When silver nitrate crystals are provided, dissolve a few crystals (approximately 1/4 teaspoon) of silver nitrate conforming to A-A-59282 in approximately one ounce of distilled water. When a pre-mix is provided, that solution is ready for use.

WARNING: Silver nitrate, A-A-59282, is corrosive and toxic to the eyes, skin, and respiratory tract. Skin and eye protection is required. Use only in a well-ventilated area.

(b) Select or make a clean, bare spot on the metal. Place one drop of solution on the spot. If that area turns black, the material is magnesium. Aluminum and its alloys will not show any reaction to silver nitrate solution.

b. Aluminum Surface Treatment. When an aluminum alloy needs to be surface treated, clean the surface to obtain a water break-free surface as described in Chapter 4, subparagraph 405m. Apply chemical conversion coating on the aluminum surface as follows:

NOTE: Metal portions of brushes should be wrapped with masking tape prior to use when applying conversion coating material in order to protect against contamination from the metal wrapping of the brush.

NOTE: Chemical conversion material conforming to MIL-DTL-81706 is the only chemical conversion treatment for aluminum used on avionics equipment.

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: Chemical conversion solutions can become contaminated if brought in contact with glass containers, ferrous metals (other than 300-series stainless steels), or copper alloys. Stainless steel, polyethylene, and polypropylene containers should be used. Discard all contaminated solutions.

(1) Wet the surface with water.

(2) While the surface is still wet, apply the chemical conversion material using an artist's brush. Continue to apply the chemical conversion material until an iridescent golden color is obtained. This usually takes 2 to 4 minutes.

(3) Once the iridescent golden color is obtained, immediately rinse the chemical from the surface with fresh water. Rinsing thoroughly is important to stop the chemical action and minimize solution entrapment. Failure to adequately rinse may accelerate corrosion and reduce paint adhesion.

(4) Remove all excessive chemical conversion material that may be trapped in pools within the aircraft or component.

(5) After thorough rinsing, allow the coated surface to air dry for a minimum of 30 minutes undisturbed. Do not wipe the area with a cloth or brush until dry, since premature wiping would remove the soft coating. The coating is soft until dry.

NOTE: As a chemical conversion solution approaches its shelf life, or at temperatures below 50 °F, more time may be required to form good films. This is indicated by the proper golden color.

(6) Any difficulties in properly obtaining the iridescent golden color can usually be attributed to insufficiently cleaned metal surfaces, or to depleted or contaminated solution. Chemical conversion materials generally have a shelf life of one year. Contaminated or overaged chemical conversion material may not form good films. Suspected overage chemical conversion material may still be used if the iridescent golden color can be obtained on the aluminum in under 4 minutes.

c. Magnesium Surface Treatment. When a magnesium alloy needs to be surface treated, clean the surface to obtain a water break-free surface as described in Chapter 4, subparagraph 405m. Apply chemical conversion coating on the magnesium alloy surface as follows:

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: Chemical conversion solutions can become contaminated if in contact with glass containers, ferrous metals (other than 300-series stainless steels), or copper alloys. Stainless steel, polyethylene, and polypropylene containers should be used. Discard all contaminated solutions.

NOTE: Chemical conversion material conforming to SAE-AMS-M-3171 is the only chemical conversion treatment for magnesium used in avionics.

(1) Wet the surface with water.

(2) While the surface is still wet, apply the chemical conversion material using an artist's brush. Continue to apply the chemical conversion material until a greenish-brown or brass-yellow color is obtained. This usually takes 1 to 5 minutes.

(3) Once the greenish-brown or brass-yellow color is obtained, immediately rinse the chemical from the surface with fresh water. Rinsing thoroughly is important to stop the chemical action and minimize solution entrapment. Failure to adequately rinse may accelerate corrosion and reduce paint adhesion.

(4) Remove all excessive chemical conversion material that may be trapped in pools within the aircraft or component.

(5) After thorough rinsing, allow the coated surface to air dry for a minimum of 30 minutes undisturbed. Do not wipe the area with a cloth or brush until dry, since premature wiping would remove the soft coating. The coating is soft until dry.

NOTE: As a chemical conversion solution approaches its shelf life, or at temperatures below 50 °F, more time may be required to form good films. This is indicated by the proper greenish-brown or brass yellow.

(6) Any difficulties in properly applying chemical conversion materials can usually be attributed to insufficiently cleaned metal surfaces, or to depleted or contaminated solution. Contaminated or overaged chemical conversion material may not form good films. Suspected overage chemical conversion material may still be used if the greenish-brown or brass-yellow color can be obtained on the magnesium in under 30 minutes.

d. Treatment of Other Metals. The treatment of other metals is limited to corrosion removal and cleaning.

e. Post-Treatment of Conversion Coated Surfaces. Before painting or applying sealant, allow chemical conversion coating to dry (usually 1 hour). The coating is soft until dry. Do not wipe the area with a cloth or brush until dry, since wiping will remove the soft coating.

504. PROTECTIVE COATINGS.

a. General. Protective coatings (generally paint) are susceptible to damage by handling, accidental scratching, and corrosion. The function of boxes, chassis, housings, and frames are to enclose, protect, and secure the vital internal components of the avionics unit. Therefore, with proper maintenance of the protective coating, the structural integrity and protection of the avionics unit can be maintained.

(1) Painted Surfaces. Painted surfaces on avionics equipment will withstand a normal amount of abrasion from handling and hand tools. When the painted surface becomes chipped, scratched, or scuffed, the loss of the protective coating allows the base metal to become more susceptible to corrosion. Maintenance personnel should pay particular attention to the use of tools around, and handling of, avionics equipment. When protective coatings are properly applied, they will prolong the useful life of the base material by protecting it from corrosion and harmful agents. The application of a paint system involves three basic steps:

(a) Surface preparation;

(b) Application of primer or undercoat; and

(c) Application of one or more finish coats.

(2) Minor Paint Damage. Minor paint film damage generally occurs when maintenance personnel use hand and power tools on and around avionics equipment. Damage can also occur from equipment handling. The result of this damage is a protective finish that is chipped, scratched, or abraded. Short-term protection includes the application of a water-displacing corrosion preventive compound. Chapter 4 describes several water-displacing, corrosion preventive compounds that provide short and moderate term preservation. Long-term repair of a damaged protective coating is accomplished by touching up the paint system.

(3) Extensive Paint Damage. Extensive paint damage requires stripping of the old paint, evaluation for corrosion, cleaning, conversion coating for aluminum and magnesium, priming, and the application of one or two finish coats.

b. Cleaning and Surface Preparation. When the surface to be painted is contaminated, the paint system will not properly adhere. Almost all paint system adhesion failures such as peeling, flaking, etc., are the result of an improperly prepared (contaminated) surface. Contaminants include oil, grease, dirt, moisture, or defective paint systems (loose or cracked paint). Proper cleaning and surface preparation includes removal of corrosion products and other contaminants. Chapter 4, paragraphs 403, 404, and 405, and Chapter 5, subparagraph 502b, describe the equipment and procedures for cleaning and corrosion removal. Surface preparation (conversion coating) for aluminum and magnesium surfaces are described in paragraph 503. Surfaces that are not to be painted should be masked with pressure-sensitive tape.

c. Painting Equipment and Materials. Painting equipment and accessory materials available for the application of protective paint coatings are listed in the following paragraphs.

(1) Painting Equipment.

(a) Spot Touch-up Spray Gun;

(b) Artist's Air Brush;

(c) Paint Brush;

(d) Artist's Paint Brush;

(e) Air Regulator and Metering Valve; and

(f) Paint Spray Booth.

(2) Painting Materials.

(a) Water-Reducible Epoxy Primer, Chemical and Solvent Resistant, conforming to MIL-P-85582. A low volatile organic compound (VOC) of not more than 340 g/1), environmentally compliant primer used to improve topcoat adhesion and provide a corrosion-inhibiting undercoating. This two-part primer kit should be mixed per the paint manufacturer's instructions and applied over a properly prepared surface as described in Chapter 4, paragraphs 403, 404, and 405, and Chapter 5, subparagraphs 502b and 503a.

NOTE: Local air pollution regulations may restrict the use of many primers, paint coatings, and thinners. Comply with all local air pollution regulations. Most aircraft primers and topcoats are issued as two-part kits. Mix only the materials from the same two-part kit. The brand and batch numbers should be the same. Follow all mixing instructions provided by the paint manufacturer.

(b) Primer coating, Epoxy-polyamide, Chemical and Solvent Resistant, conforming to MIL-P-23377. A solvent-based primer used to improve topcoat adhesion and provide a corrosion-inhibiting undercoating. This two-part primer kit should be mixed per the paint manufacturer's instructions and applied over a properly prepared surface described in Chapter 4, paragraphs 403, 404, and 405, and Chapter 5, subparagraphs 502b and 503a.

(c) Epoxy-polyamide, conforming to MIL-C-22750, and aliphatic polyurethane, conforming to MIL-C-83286B. Several topcoats are available for the final or finish coat. The epoxy-polyamide and aliphatic polyurethane are solvent-based topcoats used to provide long-term protection to avionics equipment. An available environmentally compliant topcoat is Coating, Polyurethane, High Solids (VOC of 420 g/l), conforming to MIL-PRF-85285, Type 1. This topcoat is a water-reduced paint that provides long-term protection to avionics equipment. These topcoats are supplied as two-part kits and should be mixed per the paint manufacturer's instructions. Selection of a topcoat color is normally based on the equipment's location. Unless otherwise directed, refer to the OEM specification. The topcoat should be applied over a primed surface within 24 hours of the primer application. Applicable markings should be applied, using a stencil, with Lacquer, Acrylic Nitrocellulose, Lusterless, conforming to MIL-L-19538C in an appropriate color.

WARNING: Topcoats, Epoxy-Polyamide, MIL-C-22750; Polyurethane, Aliphatic, MIL-C-83286B; and Coating, Polyurethane High Solids, MIL-PRF-85285, Type 1, are toxic to the eyes, skin, and respiratory tract. Skin and eye protection required. Avoid repeated or prolonged contact. Use only in well-ventilated areas. Keep away from open flames or other sources of ignition.

WARNING: Prolonged breathing of vapors from organic solvents or materials containing organic solvents is dangerous. Refer to the MSDS for warnings and required protective gear. Polyurethane, Aliphatic Thinner, MIL-T-81772 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.

(d) Thinners are volatile solutions used to thin or reduce the paint topcoat to a desired consistency. The type of thinner that may be used, and the recommended quantity, are determined by the paint manufacturer and displayed on the paint container.

(3) Paint Problems. Certain discrepancies may appear on finish coatings due to faulty application methods or contamination of the surface to which the coating was applied. Table 5-1 lists the most common defects, probable causes, and prevention methods.

d. Application of Coatings. The methods used to paint, touch-up, or apply preservatives depends on the extent of the job, material, tools, facilities, and time available. Spraying is faster than other methods and results in a smoother surface finish. However, the time and labor required to set up spray equipment may not be justified by the amount of work to be done, or if extensive masking is required. Brushes are used where the use of spray guns is impractical, unsuitable, or not allowed.

(1) Paint Spray Booth. The paint spray booth should be used to conduct paint spray operations. The paint spray booth should, at a minimum, be equipped with an exhaust fan and filtration system capable of evacuating paint fumes and entrapping spray particles.

(2) The paint spray booth should comply with all applicable air pollution control requirements.

e. Application of Primer. Primers identified in subparagraph 504c are to be applied on avionics equipment as follows:

(1) The surface to be primed should be thoroughly cleaned and pre-treated per instructions in Chapter 4, paragraphs 403, 404, and 405, and Chapter 5, subparagraph 502b, which describe the equipment and procedures for cleaning and corrosion removal. Surface preparation (conversion coating) for aluminum and magnesium surfaces is described in paragraph 503.

(2) Mask all openings and areas not to be painted with pressure-sensitive tape and Kraft paper or other suitable barrier materials.

(3) Mix primer per manufacturer's instructions. Thin (reduce) with applicable thinner as required.

TABLE 5-1. CAUSE AND PREVENTION OF PAINT DEFECTS

Paint Application Defects	Cause	Prevention
Webbing	• Insufficient thinning • Wrong thinning mixture	• Ensure sufficient mixing and thinning
Dry Spots or Dulling - flattening out of the gloss in selective areas	• First coat applied too thin, especially in hot weather • Poorly cleaned surface • Wrong thinning mixture	• Ensure proper application • Ensure proper preparation of the surface • Ensure sufficient mixing and thinning
Orange Peel - orange skin appearance	• Spraying at high viscosities • Air pressure too high • Poor spray technique, such as spraying too far from surface	• Ensure proper thinning • Reduce air pressure • Move closer to surface
Blistering - looks like a bubble or swelled area in the paint film	• Trapped solvents • Corrosion under the paint film • Moisture in air supply line • Prolonged exposure to high humidity	• Ensure sufficient drying time between coats • Ensure proper surface preparation • Ensure air supply line is free of water • Avoid use of overly fast drying thinners when temperature is high
Blushing - appears like milky gray cloud on paint film	• Occurs on humid days during or shortly after application • Caused by condensation of moisture on the freshly painted surface when it is cooled to a temperature below the dew point. The cooling can be caused by: a. Evaporation of fast drying solvents b. Air from the spray gun c. Movement of item to area where the ambient temperature is below the dew point	• Apply paint only when paint area is warm enough to prevent cooling to dew point • Do not subject item to ambient temperatures that are below the dew point until a minimum of 2 hours has elapsed after painting
Fish-Eyed - appears like small crater-like openings just after spraying	• Oil or silicone materials in the air lines • Dirty surfaces	• Ensure all equipment and surfaces to be painted are free of oil or silicones • To remove fish-eyed paint, clean area with an approved solvent. Blot dry using clean absorbent cloth. Repeat as necessary and repaint.

Paint Application Defects	Cause	Prevention
Grit	• Settling of particulate debris onto freshly painted surfaces, usually within two hours of application	• Clean surface prior to application • Filter paint before mixing • Keep freshly painted surfaces protected from blowing or falling dust and debris
Alligatoring - characterized by irregular separations and wide cracks in the paint film	• Softened undercoat • Uncured layer	• Remove affected paint and refinish • Allow adequate drying time between coats
Bleeding - discoloration of the paint film	• Pigment absorption from underlying coat • Insufficient topcoat thickness	• Apply additional topcoat. If problem remains, remove paint coatings and refinish area with specified paint system
Chalking - dull, powdery film	• Loss of gloss to oxidation of the topcoat	• Polishing or light sanding of area. If problem persists, refinish affected area
Checked - thin lines criss-crossing each other	• Softened undercoat • Uncured layer • Condition increases with aging	• Ensure sufficient mixing and thinning • Allow adequate drying time between coats
Cracking - irregular lines in the paint film	• Inadequate curing of paint • Inadequate mixing • Change in temperature during application	• Allow adequate drying time between coats • Ensure sufficient mixing and thinning
Crowfooting - lines branching in all directions and crossing each other	• Application before undercoat has dried • Too rapid evaporation of thinner • Coating too thick	• Allow adequate drying time between coats • Ensure sufficient mixing and thinning • Ensure proper application of paint
Peeling - separation and lifting of paint	• Separation of topcoat from primer or primer from metal surface due to: a. Lack of or improper chemical conversion coating b. Contaminated (dirty) surface c. Wet surface	• Ensure proper surface preparation • Ensure surface is properly cleaned and dried
Runs and Sags	• Application of too much paint • Paint contains too much solvent	• Properly apply paint • Ensure sufficient mixing and thinning
Scratches and Chips	• Gouging with sharp tool • Sharp blows by tools or stones	• Handle tools properly

(4) Primer coat should be applied per specifications of the OEM by spraying or brushing in an even, uniform thickness. When specifications are not provided, use the following dry primer thickness limits: 1 coat, 0.0004 to 0.0010 inch thickness, for avionics equipment exposed to harsh environments apply 2 coats, 0.0008 to 0.0014 inch thickness.

(5) Ensure as much as possible that the primed item or material is kept in a dry, dust-free location until the primer coating is dry (cured) and hardened. Primer coats are normally tack-free in approximately 30 minutes and can be handled, if required, in approximately 1 hour. The primer will be sufficiently dry (cured) to enable topcoat application in approximately 2 hours. The topcoat should be applied within 24 hours of primer application. Primer coats cured beyond the 24 hour time will require cleaning and a light coating of primer prior to topcoat application.

f. Application of Topcoat. The topcoat is the final or finish coat applied over the primer. The type of topcoat paint and the selection of the color will depend upon the equipment's intended location and the OEM specification. Epoxy-polyamide conforming to MIL-C-22750, aliphatic polyurethane conforming to MIL-C-46168D, Type 2, and aliphatic urethane conforming to MIL-C-83286B are topcoats that may be used. The topcoat should be applied on avionics equipment as follows:

(1) In preparation for application of a topcoat the surface should already be cleaned, pre-treated, masked, and primed per Chapter 4, paragraphs 403, 404, and 405. Surface preparation (conversion coating) for aluminum and magnesium surfaces, masking, and priming are described in paragraph 503 and subparagraph 504e.

(2) The topcoat should be applied by brush or spray to the component within 24 hours of primer application. Application method depends on the type of finish required, materials used, and the surface to be finished. Care should be taken to keep the area free of dust and other foreign matter when applying the topcoat.

(3) When a single coat does not adequately cover the primer and when protection against extreme exposure is necessary, two or more coats may be required.

(4) Remove all masking material as soon as possible.

505. ENCAPSULATES.

a. General. Encapsulates are materials used to cover a component or assembly in a continuous organic resin. Encapsulates provide electrical insulation resistance to corrosion, moisture, and fungus, and mechanically support the components. In avionics equipment, encapsulates are classified as follows:

(1) Potting Compounds. Potting compounds are used to seal electrical connectors, plugs, and receptacles.

(2) Fungus Proof Coatings. Fungus proof coatings, usually varnishes, are used to encapsulate certain avionics circuit components in a thin protective film that is impervious to fungal attack. Varnishes were used in older microelectronics and electrical components.

(3) Conformal Coatings. Conformal coatings are used to encapsulate PCBs and modules.

b. Potting Compounds. Potting compounds are used for their moisture-proof and reinforcement properties. They are used on electrical connectors to protect against fatigue failures caused by vibration and lateral pressure at the point of wire contact with the pin. Potting compounds also protect electrical connectors from corrosion contamination and arcing by excluding moisture, stray particles, and aircraft liquids (hydraulic fluid, fuel, oil, etc.).

(1) Materials. The following materials should be used for sealing (potting) electrical connectors, plugs, and receptacles.

WARNING: Potting compounds are 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.

(a) Sealing Compound, Synthetic Rubber, Accelerated Cure, conforming to MIL-PRF-8516 is a two-part polysulfide synthetic rubber compound kit. The kit consists of a base and an accelerator (curing agent). This sealing compound is used for sealing low-voltage electrical connectors, wiring, and other electrical apparatus where the temperature does not exceed 200 °F (93 °C). This sealing compound should not be used in engine bays, aircraft keel areas, or adjacent to bleed (hot) air ducts.

NOTE: A sealing compound that has reverted changes (reverts) from the cured compound back into a liquid compound.

(b) Sealing Compound, Silicone Rubber, room temperature vulcanizing (RTV), conforming to MIL-S-23586, Type II, Class 2, Grade B-1 is a reversion-resistant silicone rubber compound consisting of a base and an accelerator (curing agent) in a kit. This sealing compound is used for sealing electrical connectors and components where the sustained equipment operating temperature exceeds 200 °F (93 °C). This sealant has a maximum temperature of 450 °F (232 °C). This sealant may be used in a closed space.

(c) Sealing Compound, Silicone Rubber, RTV, conforming to MIL-S-23586, Type II, Class 2, Grade A is a reversion-resistant silicone rubber compound consisting of a base and an accelerator (curing agent) in a kit. This sealant is used for sealing small electrical connectors that are not in a closed space and where the sustained equipment operating temperature exceeds 200 °F (93 °C). This sealant has a maximum temperature of 450 °F (232 °C). If electrical connectors are potted with this compound and allowed to cure in a closed space, or if they normally exist in a closed space after curing, this sealing compound will be susceptible to reversion.

(d) Sealing Compound, Silicone Rubber, (RTV), conforming to MIL-A-46146, Type II is used for sealing electrical connectors. This compound is a less viscous (flows easily), single-component (one-part) compound. The different types of this compound are defined in Subparagraph 505d, Sealants.

(e) Sealing Compound, Fuel Resistant, conforming to SAE-AMS-S-8802 is used to prevent entry of corrosive elements, and where fuel and oil may be present. This polysulfide sealing compound consists of a base and an accelerator (curing agent) in a kit. This sealing compound has a maximum temperature of 275 °F (135 °C). The different types of this compound are defined in Subparagraph 505d, Sealants.

(f) Sealing Compound, Corrosion-Inhibiting, conforming to MIL-PRF-81733 is used to prevent entry of corrosive elements, and where fuel and oils may be present. This polysulfide sealing compound contains corrosion inhibitors, and consists of a base and an accelerator (curing agent) in a kit. This sealant has a maximum temperature of 250 °F (121 °C). The different types of this compound are defined in Subparagraph 505d, Sealants.

(g) Sealing Compound conforming to MIL-M-24041 is used for sealing and reinforcing electrical connectors, wiring, and components in a seawater environment. This sealing compound is a two-component polyether polyurethane system consisting of a prepolymer and a curing agent. This sealing compound has good cold-flow properties and will adhere to metal, rubber, and polyvinyl chloride (PVC). The temperature range of this material is -80 °F to +300 °F.

(2) Reverting Potting Compounds. Some potting compounds have a past history of reverting to a liquid after a year or two. This reversion is highly dependent on the environment of the potting compound. Compounds that revert exhibit a sticky, viscous, oozing consistency that flows out of the connector back shell. In some cases, the reverted potting compounds flow around and through pins and receptacles, insulating the connection where continuity is required.

(3) Precautions. When using potting compounds, the following precautions should be followed:

(a) Thoroughly clean the area to be potted using an approved solvent.

(b) Follow manufacturer's instructions when mixing the base compound and accelerator. Substitutions, partial mixing, or incorrect proportions of the base compound and accelerator may produce a sealant with inferior properties.

(c) Do not mix base compounds and accelerator components of different batch numbers because substantial electrical properties may result.

(d) Potting compounds may contain small quantities of flammable solvents, and/or may release by-products on curing. Observe all warnings and cautions, and use personal protective gear identified in the MSDS and by the potting compound manufacturer.

(e) Potting compounds that have exceeded their listed shelf life should not be used unless tested and certified by an approved laboratory.

(f) Avoid contamination of the potting compound. Do not use masking tape and fiberboard molds around the connector during the potting compound cure. If potting molds are not furnished with the connector or are not available, a plastic sleeve should be constructed. The plastic sleeve will aid in forming the potting compound around the connector during the cure.

(g) Allow potting compounds to cure until firm prior to installing connector or components in equipment.

(h) Frozen pre-mixed potting compounds should be used as soon as possible after their removal from the freezer or a significant (up to 50 percent) reduction in working life can be experienced.

(i) Remove reverting or reverted potting as soon as possible.

c. Fungus-Proof Coatings. Fungus-proof coatings should not be applied indiscriminately to all electrical components. Treat only those components that have a specific need or are designated in the applicable manufacturer's service directives. Fungus-proof coatings can, in some instances, be detrimental to the function and maintenance of equipment. For example, fungus-proof coatings deteriorate wire insulation, and their removal for maintenance action is labor-intensive. A repair activity should re-coat an entire area only when a touch-up of the previously coated component will not provide the required protection. Many hours of repair time will be required if the fungus-proof coating is not maintained.

(1) Fungus-Proof Varnish. The authorized fungus-proof coating is a varnish conforming to MIL-V-173C. These varnishes should be thinned, if necessary, with an approved solvent per the manufacturer's instructions or with a thinner conforming to A-A-3007.

(2) Items That Should Not Receive Fungus-Proof Varnish. Varnish should not be applied to any surface where its application will interfere with the operation or performance of the equipment. Those surfaces should be protected during application of fungus-proof varnish with pressure-sensitive tape. The following items should be protected from varnish application:

(a) Components and Materials.

1. Cable, wire, braids, and jackets that are flexed during operation of the equipment.

2. Cables where treatment would reduce the insulation resistance below, or increase the loss factor above, the acceptable service limits provided by the OEM.

3. Variable capacitors (air, ceramic, or mica dielectric).

4. High wattage and wire wound resistors.

5. Ceramic insulators that are subject to an operating voltage over 600 volts and in danger of flashover.

6. Painted, lacquered, or varnished surfaces, unless otherwise specified by the OEM.

7. Rotating parts such as dynamotors, generators, motors, etc. Electrical components that are associated with the rotating component may be treated in accordance with the procedures outlined in this AC.

8. Wave guides (mating surfaces).

9. Electron tubes.

10. Tube clamps.

11. Miniature tube shields.

12. Plug-in relays.

13. Pressure-contact grounds.

14. Coaxial test points or receptacles.

15. Windows, lenses, etc.

16. Transparent plastic parts.

17. Plastic materials such as polyethylene, polystyrene, polyamide, acrylic, silicone, epoxy (other than printed wiring boards), melamine, fiberglass, fluorocarbon, vinyl, and alkyds.

18. Materials used for their specific arc-resistance properties and classified as such.

(b) Electrical contacts, contact portions, or mating surfaces of binding posts. Also connectors, fuses, jacks, keys, plugs, and relay sockets (including tube sockets, switches, and test points).

(c) Mechanical Parts.

1. Bearing surfaces (including bearing surfaces of gaskets and sliding surfaces).

2. Gear teeth and gear trains or assemblies.

3. Pivots and pivot portions of hinges, locks, etc.

4. Screw threads and screw adjustments (those moved in the process of operation or adjustment).

5. Springs, except at base of pile-up.

(d) Surfaces which rub together for electrical or magnetic contact, such as bearings, contact fingers, potentiometers, shafts, shields, and variable auto-transformers.

(e) Surfaces whose operational temperatures exceed 266 °F (130 °C), or whose operating temperature will cause carbonization or smoking.

(f) The exterior or visible outside portion of indicating instruments (do not open or treat inside), control boxes, or other equipment mounted in the cockpits of aircraft.

(3) Methods of Application. The varnish coating may be applied by spraying, brushing, dipping, or any combination of these processes. The dried film should have a clear, smooth finish (free from bubbles, wrinkles, filaments, or spray dust). Runs, puddles, or gathering of the film into drops should be avoided. The dry film thickness should be at least 0.002 inch unless otherwise directed in the manufacturer's service directives.

NOTE: All surfaces to be coated should be free of dirt, grease, and other foreign matter. Components that cannot be cleaned satisfactorily or that show evidence of corrosion should be cleaned and treated per the instructions in this AC or replaced by acceptable components. Local air pollution regulations may restrict the use of fungus-proof varnish. Comply with all local air pollution regulations.

CAUTION: Avoid varnish adhesion failures. Apply only on clean, dry surfaces with a temperature of less than 100 °F (38 °C).

(a) Spraying. For larger equipment, a pressure-pot spray gun system with the tip regulated to give a wet spray is recommended. For small, compact equipment, a pencil spray tip, regulated to give a narrow, wet spray, is recommended. The varnish should be applied in a continuous wet coat over all parts to prevent the formation of fuzz or filaments. Incomplete wetting of the component surface with varnish will produce a dry spray. The dry spray texture appears as dust on the surface of the component. Dry spray is an unacceptable finish. The equipment or individual assembly should be sprayed from as many angles as necessary to ensure complete coverage with a wet coat. If more than one coat of varnish is necessary or required by the manufacturer's service directives, allow sufficient drying time between coats. Refer to the varnish manufacturer's time/temperature instructions.

(b) Brushing. All parts which cannot be reached by spray may be coated with a brush. A brush may also be used to cover small areas not covered during the spraying process. On components that require extensive masking, brush application may prove more efficient than spray application.

(c) Dipping. Subassemblies or components may be coated by dipping, provided all requirements of subparagraphs 505c(2) and 505c(5) are met.

WARNING: Components that are to be enclosed in airtight cases (hermetically sealed) should be allowed to air-dry for at least an additional 24 hours after the varnish dries. Fumes (outgassing) may accumulate to dangerous levels within the case and may be ignited by an ignition source.

(4) Drying of Coated Equipment. Equipment coated with varnish should be dried by heating to 130 °F (54 °C). Heating should be gradual to prevent shrinking, cracking, warping, or other deterioration of the parts or materials. The drying temperature should be maintained for at least 1/2 hour but no longer than 3 hours. The drying process may be done in a vented oven, vacuum oven, or with a hot air gun.

(5) Special Precautions. When varnish is to be applied on certain types of equipment, special precautions are required. The following paragraphs list equipment and parts requiring special precautions.

(a) Radio Receivers and Transmitters. The application of varnish will cause changes in some of the circuit constants. These changes may be discernible only by electrical tests and measurements. A change in alignment may be noted immediately after application of the varnish. As the varnish dries and ages, further changes in circuit constants may take place. The greatest change ordinarily will occur within 72 hours after treatment. The set should be completely realigned at the end of that period.

(b) Coil Shields. When coil shields are removed and replaced, they can be damaged and alter the tuning adjustments. If there is significant damage, proper alignment may be impossible. Extreme care should be exercised in removing and installing coil shields.

(c) Trimmer Capacitors. Avoid spraying or brushing varnish on the plates of trimmer capacitors. To minimize damage, all trimmer capacitors should be masked completely during varnish application. If the variable capacitor fails to operate satisfactorily after treatment, make a thorough inspection for varnish deposits.

(d) Tuning Slugs. If varnish is accidentally applied to a tuning slug, the tuning slug will normally require replacement. Extreme care should be taken in removing and replacing tuning slugs.

(e) Discriminator Circuits. Careful adjustment of discriminator circuits after applying varnish is essential, especially in the case of frequency-modulated receivers. Discriminator circuits are more susceptible to varnish-induced changes in circuit constants than any other component.

(f) Tuned Circuits. Be especially careful during masking to ensure the wires associated with the tuned circuit are not moved. Movement of such wires may change the circuit value.

(g) Relays. Deposits of varnish on the armature, pivot, or similar components will cause the relays to bind. Mask the entire relay carefully prior to general component varnish application. After the masking has been removed, brush-apply varnish as required to coils and leads. Relays with palladium-tipped contacts should be removed before application of varnish.

(h) Meters. Since meters are easily damaged by the varnish spray treatment, all meters should be checked for accuracy before treatment. Some meters may be affected by the heat of the drying process. In other instances, meter magnets may be affected by magnetic fields that exist around drying equipment. Refer to the OEM applicable service instructions for varnish treatment. If guidance is not available, do not apply varnish.

d. Sealants. Sealants are another type of protective film used in avionics equipment. Sealants are usually provided in the uncured form as a liquid or paste which solidifies (cures) after application. Sealants can be applied by hand methods, such as brush or spatula, or by air or mechanically powered filleting/injection guns. Sealants form a flexible seal in gaps and depressions, preventing moisture intrusion at mechanical joints, spot welds, and threaded closures. In addition, they prevent entry of corrosive environments into faying surfaces, fastener areas, exposed landing gear switches, and other metal-encased avionics equipment. They function principally as waterproof barriers. Therefore, when an inspection notes damaged sealant, it should be removed, the area inspected for damage, and new sealant applied. The following describes various types of sealant available.

(1) Sealing Compound, Polysulfide, Conforming to MIL-PRF-81733. A two-part, dichromate cured, polysulfide sealant with added soluble chromates which inhibit corrosion. This sealant is intended for use at faying surfaces subject to galvanic action and temperatures up to 250 °F (121 °C). This sealant has excellent resistance to shrinkage, aircraft fuels, and lubricating oils. It also resists deterioration from saturation with ester-type hydraulic fluids. The mixed sealant may be applied by brush or spatula. The sealant is provided in four types which allow long assembly times.

(2) Sealing Compound, Polysulfide, Low Temperature Curing, Conforming to SAE-AMS-S-83318. A two-part polysulfide sealant characterized by an excellent cure rate at low temperature. This sealant is intended for quick field repairs to other sealants. Apply with brush.

(3) Sealing Compound, Polysulfide, Conforming to SAE-AMS-S-8802, Type A. A brush-applied, room-temperature cured sealing compound that is used for sealing gaps, seams, and faying surfaces. This sealant has excellent adhesion to most aircraft materials; excellent resistance to water, aircraft fuels (aviation gas and jet fuel), and petroleum-based oils; good resistance to deterioration from saturation with diphosphate ester-type hydraulic fluids; and can withstand temperatures up to 250 °F (121 °C). Four different sealants are available with application life and cure times from 1/2 to 4 hours. Type B sealants are spatula-applied compounds with the same characteristics as Type A.

(4) Adhesive Sealant, Silicone, RTV, Noncorrosive, Conforming to MIL-A-46146, Type III. This one-part adhesive sealant is used for encapsulating and sealing electrical and electronic components where the avionics equipment will operate at temperatures between 250 °F (121 °C) and 350 °F (177 °C).

(5) Adhesive Sealant, Silicone, RTV, Conforming to MIL-A-46146, Type I. This general purpose, one-part adhesive sealant is used for encapsulating and sealing electrical and electronic components. This material has good resistance to oxidation, weathering, and water.

CAUTION: A large number of RTV silicone sealants contain an acetic acid curing agent. These sealants, in contact with metal, result in rapid corrosion.

RTV sealants that contain acetic acid are not authorized for use on electronic or electrical circuits. They may be identified in most cases by a vinegar odor from the dispenser tube or while curing.

(6) Sealants Containing Acetic Acid. Table 5-2 lists some of the RTV silicone sealants that are considered corrosive and should not be used in avionics equipment.

(7) Adhesion Promoters. Some sealing compounds may require the application of a special primer or adhesion promoter prior to the sealant application, in order to develop a good adhesive bond with the surface. Use only those primers or adhesion promoters recommended by the manufacturer for their product.

(8) Sealant Application Procedures.

(a) Cleaning. Preclean the surface where sealant is to be applied per Chapter 4, paragraph 405 to remove dirt, grime, etc. Perform a final wipe of the area with an approved solvent, recommended by the sealant manufacturer, using a clean cheesecloth. While the surface is still wet with solvent, wipe dry with a clean, dry piece of cheesecloth.

(b) Masking. To prevent sealant from contacting adjacent areas during application and to aid in post-application smooth out, mask the area to be sealed with pressure-sensitive tape.

(c) Primers or Adhesion Promoters. Apply sealant primer or adhesion promoter when recommended by, and in accordance with, the sealant manufacturer's instructions. Allow the surface to air dry undisturbed for 30 minutes to one hour prior to sealant application.

(d) Sealant Mixing. The proper mixing of the base and accelerator sealant components is essential for proper curing and adhesion of the sealant. Mixing should be accomplished in a clean environment per the manufacturer's instructions. The accelerator and base components should be added together after the proper amounts are determined by weight or volume, then mixed until a uniform color is obtained. Two-part sealants are chemically cured and do not depend on solvent evaporation for curing.

TABLE 5-2. CORROSIVE SILICONE SEALANTS, ADHESIVES, AND COATINGS

RTV 102	RTV 192	RTV 999	RTV 92-055
RTV 103	RTV 198	RTV 1890	RTV 94-002
RTV 106	RTV 236	*RTV 3144	RTV 94-003
RTV 108	RTV 730	*RTV 20-046	*RTV 94-009
RTV 109	*RTV 731	*RTV 20-078	*RTV 94-034
RTV 112	RTV 732	RTV 30-079	*RTV 96-005
RTV 116	*RTV 733	*RTV 30-121	*RTV 96-080
RTV 118	RTV 734	*RTV 4-2817	RTV 96-081
*RTV 140	RTV 736	*RTV 90-092	RTV Q3-6069
*RTV 142	*RTV 780	*RTV 92-005	RTV Q3-6090
RTV 154	*RTV 781	RTV 92-007	RTV Q4-2817
RTV 156	RTV 784	RTV 92-009	RTV 92-010
RTV 157	*RTV 785	*RTV 92-018	SCS 100
RTV 158	RTV 786	*RTV 92-024	
RTV 159	*RTV 891	*RTV 92-048	

***Products discontinued by the manufacturer, but may still be available from approved sources.**

NOTE: RTV 730 is a high temperature (550 °F to 600 °F) corrosive sealant that may be required to seal engine compartment electrical connectors. RTV 730 should be used only when specified by the OEM or authorized engineering authority.

(e) Application Life. Once mixed, two-part sealants have an application life. The application life of a sealant is the length of time that a mixed sealing compound remains usable in standard conditions of 70 °F (24 °C) and 50 percent relative humidity. Generally, the dash number of the sealant manufacturer's part number is the application life.

(9) Sealant Application. Apply sealant within the application life for the sealant being used. Thick sealants may be applied with a nonmetallic spatula or scraper. Avoid entrapment of air. Work sealant into recesses by sliding the edge of the spatula or scraper firmly back over the recesses. Smoothing of the sealant surface will be easier if the spatula or scraper is first dipped in water. Sealant applied with a brush is applied and smoothed by the brush until the desired thickness is reached. Sealant applied with an air or mechanically powered filleting/injection gun, depending on the application, may not require masking and is especially suited to filling seams, fay sealing, and creating form-in-place door seals. When applying a fay seal, ensure there is adequate sealant squeeze-out between the mating parts.

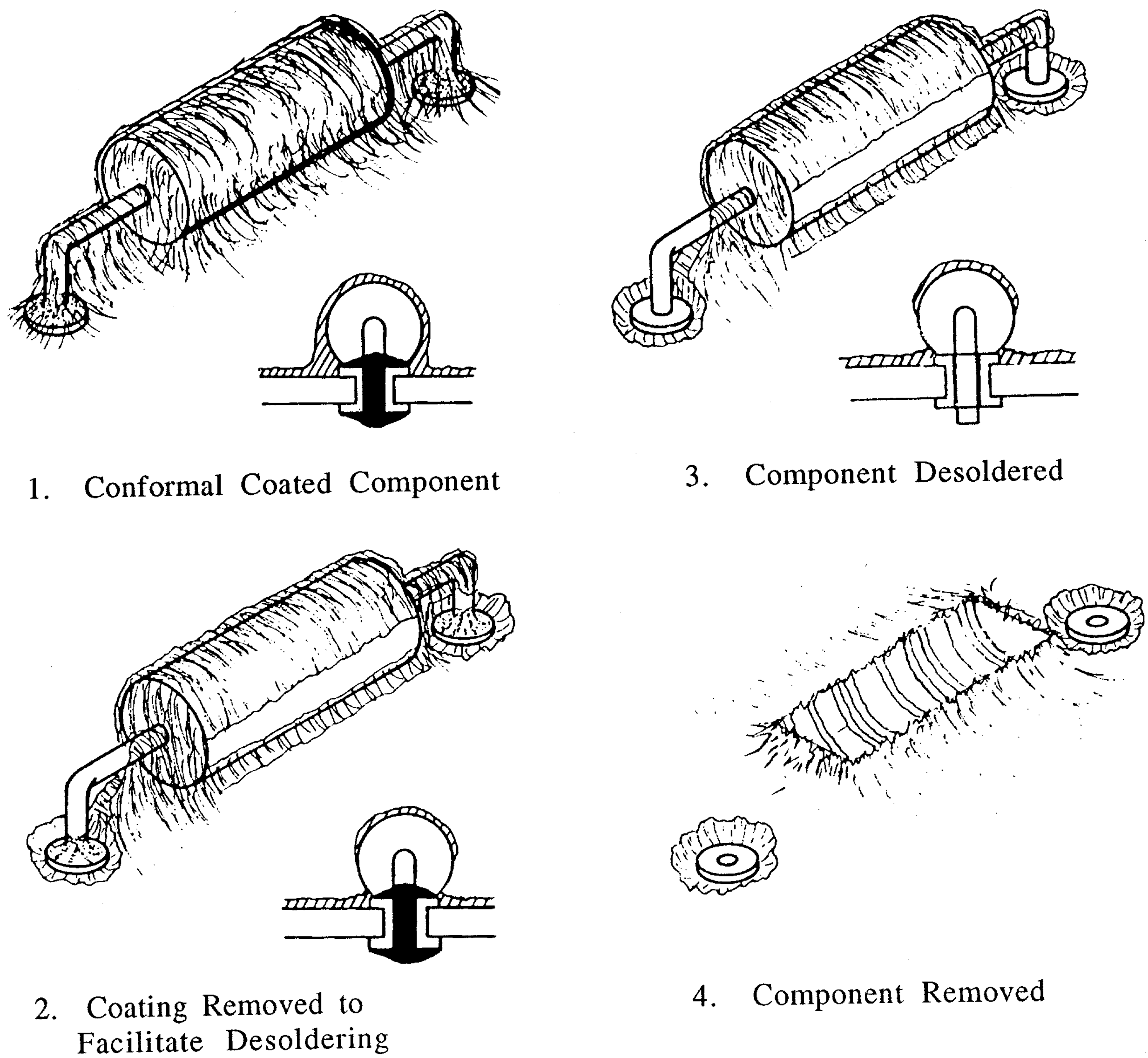
e. Conformal Coatings. Conformal coatings are generally two-part coatings that are applied in a thin coat to and over PCBs and other components. Conformal coatings protect PCBs and components from moisture, fungus, and thermal shock. They also protect the components from fatigue failure by their encapsulating properties. The coatings are flexible, flame resistant, and are suitable for application to PCBs by dipping, brushing, spraying, or vacuum deposition. The following types of conformal coatings are available: acrylic resin (AR), epoxy resin (ER), silicone resin (SR), polyurethane resin (UR), and paraxylylene (XY). Coating thickness is dependent upon the type of coating system. For AR, ER, and UR coatings, the proper thickness is 0.002 plus or minus 0.001 inch; for SR coatings, 0.005 plus or minus 0.003 inch; and for XY coatings, 0.0006 plus or minus 0.0001 inch.

(1) Conformal Coating Removal. Conformal coatings must be removed prior to component removal from the PCB. The following describes the degree of recommended coating removal and various removal methods:

(a) Removal Area. Remove only as much coating as is necessary to facilitate removal of the discrepant component. Remove the coating from all solder connection areas to allow for desoldering. Figure 5-1 shows a typical step-by-step process for the removal of a component from a conformal-coated PCB.

NOTE: Do not attempt to remove all the coating down to the laminate surface. A thin residual layer will not interfere with component removal.

FIGURE 5-1. CONFORMAL COATING REMOVAL



CAUTION: Do not attempt component removal until the component leads are completely free of solder, as damage to the PCB could occur.

1. Prior to desoldering, remove the coating from along all sides of the affected component, below the widest profile of the component.

2. To debond the component, heat the component body to release it from any residual coating or bonding compound.

3. Remove any residual remaining coating that may interfere with the replacement component positioning, soldering, or post-soldering cleaning.

TABLE 5-3. REMOVAL METHOD PREFERENCE ON SPECIFIC COATINGS REMOVAL METHODS

Virgin Coating Type	Chemical	Controlled Heat Thermal Parting	Controlled Heat Hot Air	Abrasive Dental Burrs	Abrasive Disc & Bullets	Abrasive Rotary Brushes	Abrasive Dental Tools
Acrylic (AR)	1*		2		5#	4#	3
Epoxy (ER)		2#	1*	3		5#	4
Urethane (UR)		2#	1*			3	4#
Silicone (SR)	3					2	
Paraxylylene (XY)		2	1		5	4	3

*Denotes method that best identifies generic type of conformal coating.
#For thin coating only.

(b) Removal Methods. There are three basic methods to remove conformal coatings. There is no preferred method or combination of methods. The method(s) employed will depend upon coating thickness, circuit density, and coating transparency. Table 5-3 lists the suggested removal methods for the various type of conformal coatings.

1. Chemical. This method is effective on AR coatings (lacquers and varnishes) which may be dissolved by either an approved solvent recommended by the coating manufacturer; 1, 1, 1 Trichloroethane, MIL-T-81533; or Isopropyl Alcohol, TT-I-735. These solvents are also effective on some SRs. They may dissolve or swell the silicone resins, allowing removal. They should be applied with a solvent-saturated cotton swab or acid brush. Gently rub the affected area and blot the solvent residue with a clean cotton swab. Repeat as required until the coating is removed. The final step is to neutralize the area with distilled or deionized water and blot dry with disposable tissue.

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

WARNING: Solvents are 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.

2. Controlled Heat. Heat is effective on all resin coatings which will soften or revert (over cure) when exposed to a controlled, localized, low temperature (300 °F to 400 °F) heat source. The heat source method may also be effective for the release of components from the conformal coating or adhesive bonding of compounds beneath component bodies. This method is recommended on thicker coatings (0.025 inch or greater) because thin coatings offer little thermal protection to the PCB laminate. The use of either low pressure hot air or thermal parting is recommended. The area that is heated should be held to a minimum. After the coating has softened, gently push the residue aside with a plastic scraper or thermal parting tip. Scraping and peeling in conjunction with applied heat is effective on all resin coatings except silicone RTVs.

CAUTION: Excessive heat can cause damage to components and PCBs. Use only the minimum temperature which will assist in the removal of the component.

3. Abrasion. Abrasive removal is effective on all resin coatings. The type of abrasive removal tool and method (motorized or manual) is dependent upon the thickness, hardness, surface contour, and transparency of the coating. Motorized abrasive cutting with dental burrs is effective on transparent, thick, and hard coatings of PR and UR. Abrasive discs are effective on all transparent, thin, hard coatings with flat surfaces. Dental brushes are effective on soft to semi-hard coatings with irregular surfaces. Manual abrasive dental tools, carvers, knives, and chisels are effective on thin, soft to semi-hard coatings where the removal area is small.

CAUTION: Exercise extreme care when using abrasive methods. Abrasive tools have a high potential for causing damage.

(2) Conformal Coating Replacement. Preparation of the laminate PCB surface is the most important part of the conformal coating application process. Most adhesion failures are the result of improper cleaning and surface preparation.

(a) Cleaning. Prior to the replacement of the conformal coating, all repair actions residues (dirt, grime, soldering flux, etc.) should be removed. Clean the PCB laminate surface or component in accordance with the instructions in Chapter 4, paragraph 405.

(b) Drying. Dry the PCB or component in accordance with the instructions in Chapter 4, paragraph 406. Set temperature to 130 °F (54 °C) and dry the PCB or component for 1 hour.

(c) Stabilization. Allow the PCB or component to stabilize at room temperature, 77 °F (25 °C), for 1 hour. Coatings that are not recommended for accelerated curing above room temperature may be adversely affected by preheated laminates.

(d) Preservation. Cleaned and dried PCBs or components should be stored in a clean, static-free plastic bag if the PCB or component is not conformal coated within 30 minutes after reaching the stabilized room temperature. Seal the bag to prevent moisture from forming on the PCB or component.

(e) Pretreatment. Some conformal coatings require an additional treatment prior to coating application.

1. XY-coated assemblies require a pretreatment adhesion promoter to increase the bond strength of the replacement coating. Follow the coating manufacturer's adhesion promoter and application instructions. Ensure a 0.25 inch (6 cm) overlap of any existing coating.

2. SR-coated assemblies require a pretreatment primer to increase the bond strength of the replacement coating. Follow the coating manufacturer's application instructions. Ensure a 0.25 inch (6 cm) overlap of any existing coating.

(f) Selection of a Replacement Coating. The selection of a replacement coating is based on the compatibility of the replacement coating with that of the original coating on the PCB or component. Refer to the OEM drawings or repair manual.

(g) Conformal Coating Mixing. Mix the replacement conformal coating per the coating manufacturer's instructions. Ensure the components are mixed in a clean container. Any air bubbles generated during the mixing must be removed. To remove the air bubbles, place the mixture in an anaerobic incubator (vacuum oven) at room temperature and 28 in/Hg for 30 minutes.

NOTE: Some two-part conformal coating resins require measurement by weight and not by volume.

CAUTION: Increasing or decreasing the mixture ratios of the conformal coating components will result in degradation of the coating properties.

(h) Application of Conformal Coating. The selection of a conformal coating will depend upon the area to be coated and any existing coating. The coating should be applied to a uniform thickness, with a 0.25 inch (6 cm) overlap of any existing coating, and no air bubbles.

1. Spraying. Spraying is one of the best methods when more than just a spot touch-up is required. Spraying is particularly useful when the surfaces are uneven or irregular, or there is a high density of components on the PCB.

2. Brushing. Brushing is one of the best methods for minor patching of existing conformal coating. It is preferable to flow the coating over the area and then brush it out to attain a uniform thickness.

3. Dipping. Dipping, like spraying, is one of the best methods when more than just a spot touch-up is required. Dipping is generally more suitable to production runs, where more than one PCB or component is involved. Dipping is particularly useful when the surfaces are uneven or irregular, or there is a high density of components on the PCB. Ensure proper coating thickness and avoid puddling of the coating by rotating the PCB or component in all axes during curing of the coating.

(i) Coating Thickness. All conformal coatings, with the exception of silicone RTVs, should have the coating thickness applied to 0.003 inch or less, unless directed otherwise by the OEM directive. Applications greater than 0.003 inch will not allow the solvents in the curing coating to evaporate or outgas, thereby trapping the solvents within the curing coating. These trapped solvents can cause bubbles and pinholes in the coating. Refer to the OEM or maintenance directives for the proper coating thickness. Silicone RTVs may be applied in a thickness up to 0.008 inch. If multiple coats of any of the coatings are required by direction, ensure sufficient time for the solvent to outgas.

(j) Conformal Coating Curing. Although the shortest cure time is desirable to speed the production process, the curing time is generally determined by the chemical characteristics of the coating. The curing temperature is limited by the PCB and its components. There are two main types of curing systems used: moisture reactive and solvent based. Conformal coating curing should always be accomplished in a dust-free environment. Elevated temperature curing should be accomplished in a forced-air drying oven at a temperature of not more than 130 °F (54 °C).

1. Moisture reactive curing systems use the relative humidity to form a gelatin of the compound and subsequent cure. These types of coating systems usually can be cured at room temperature, 77 °F (25 °C), but the curing process requires 24 hours.

2. Solvent based curing systems rely on elevated temperature to accelerate the chemical reaction. The chemical reaction among the ingredients produces a stable one-part solvent that is oxidized by the elevated temperature to cure the coating in as little as 30 minutes.

(k) Coating Inspection and Preservation. The final step in the process of conformal coating replacement is a thorough inspection using an ultraviolet (UV) light and a 10x to 15x magnifying lens. Visually inspect the new and original coating for defects such as charring, discoloration, cracking, delamination, solder flux residue, dry spots, foreign matter, air bubbles, and pinholes. If the inspection is satisfactory, the PCB or component should be placed in a polyethylene bag and taped closed.

506 through 600. RESERVED.

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 43-4, Corrosion Control for Aircraft, Chapter 4, paragraph 4.13.3. 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 A-A-1048, or an abrasive nylon mat, conforming to A-A-58054, 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, subparagraphs 405i and o.

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

(5) Apply primer and topcoat as required in accordance with the OEM's maintenance instructions or Chapter 4, subparagraph 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 (see Figure 6-1).

(1) Repair or replace damaged components as required.

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

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

(b) Clean and treat electrical terminal boards in accordance with subparagraph 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, CAS 1393-92-6 Litmus Powder, 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, A-A-59282, 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.

1. 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.

2. 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 subparagraph (a).

(e) Reapply the indicating solution as in subparagraph (b). If the solution does not change color, rinse the area as in subparagraph (d) and dry the area with a clean cloth or rags. If the solution changes color, repeat subparagraphs (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, prepaint 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 A-A-1048, or abrasive nylon mat, conforming to A-A-58054, Type I. Pay particular attention to dissimilar metal couples.

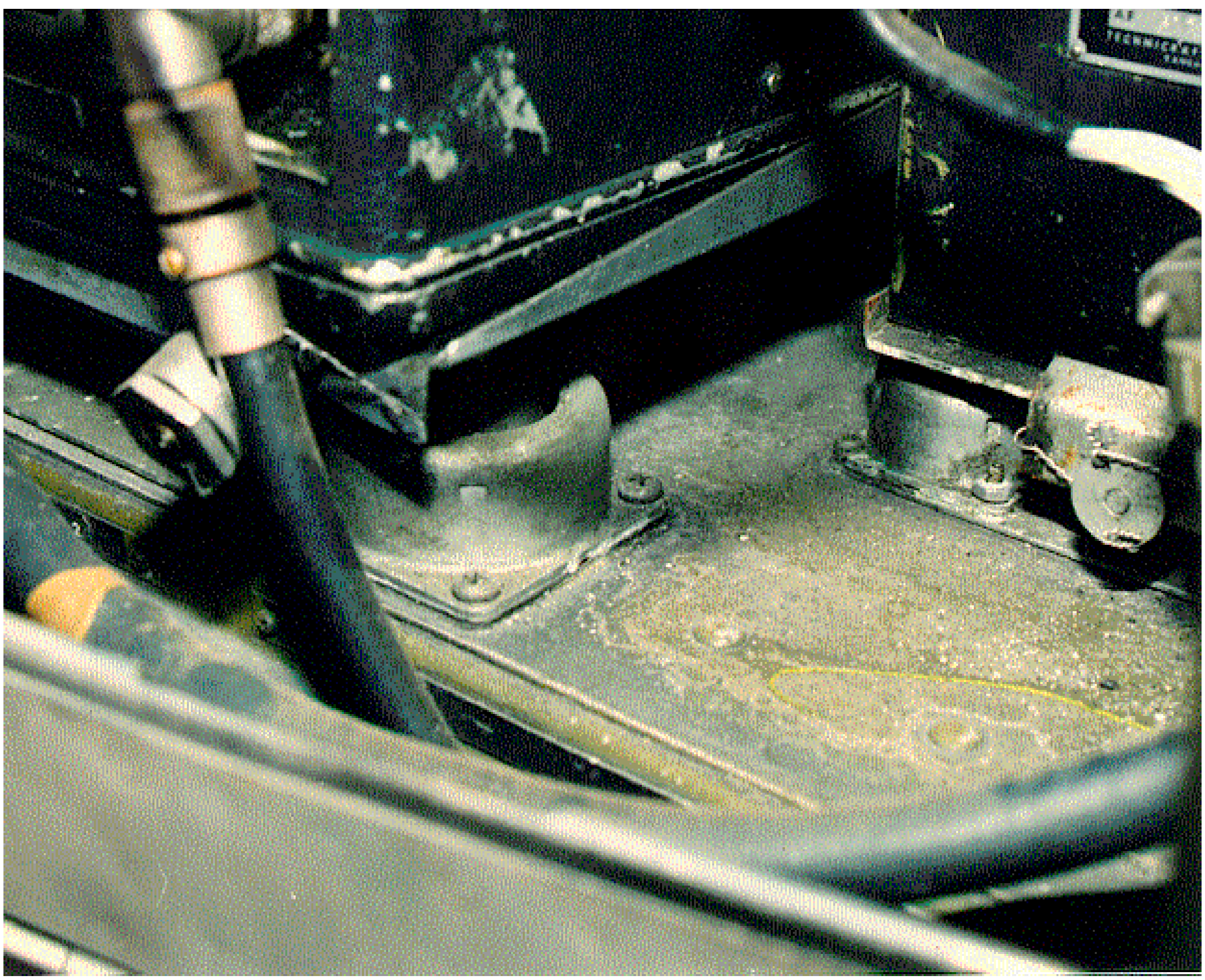
NOTE: The use of dissimilar metals in the selection of screws, washers, and nuts should be minimized wherever possible. See Chapter 7 for information on bonding and grounding hardware.

(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-DTL-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: See 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 subparagraph 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 subparagraph 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-DTL-85054. For internal surfaces, apply a thin film of Water-Displacing Corrosion Preventive Compound, conforming to MIL-PRF-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 A-A-58054, Type I, or an appropriate cleaning and polishing pad.

(4) Clean the affected area with an approved solvent or Dry Cleaning Solvent, MIL-PRF-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, MIL-PRF-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-PRF-81309, Type II, on exterior metal surfaces and wipe off any excess with a clean cloth or cheesecloth. Do not get preservative on the acrylic plastic faceplates of instruments.

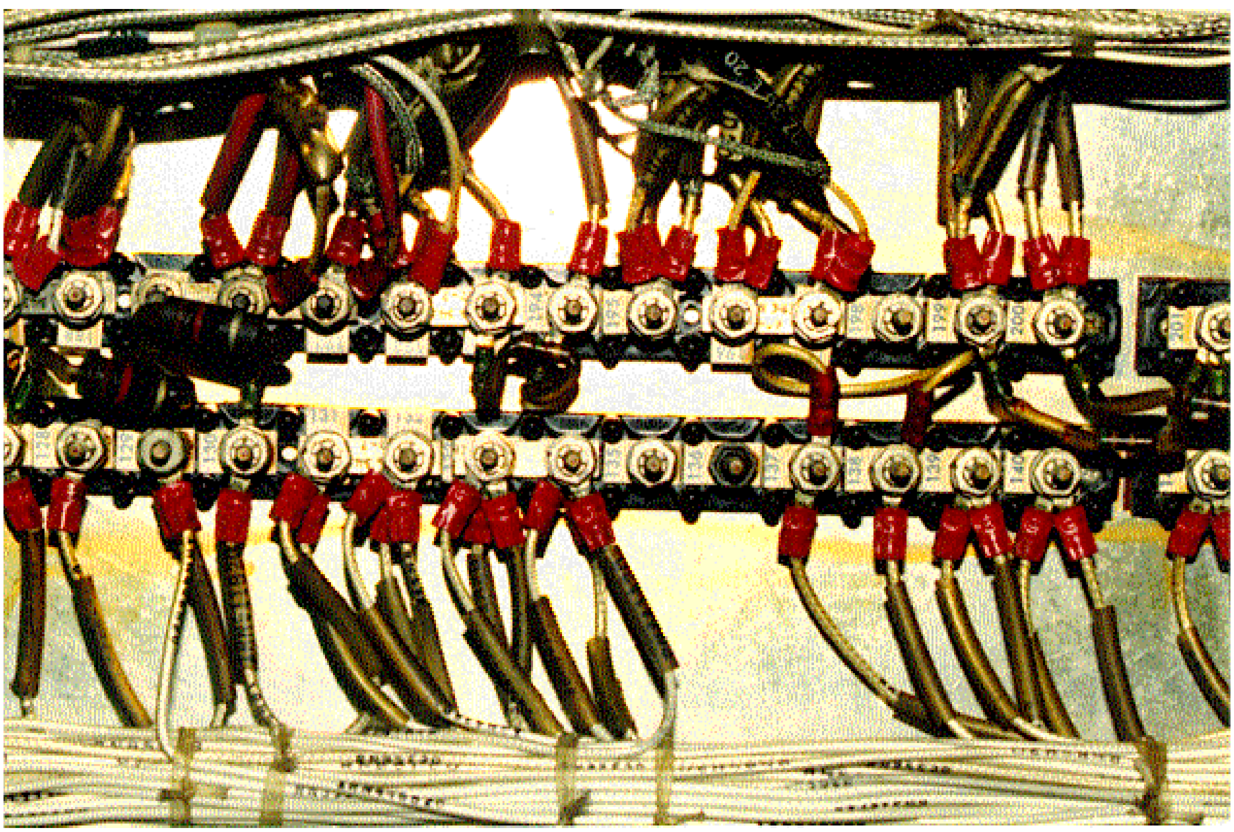
(8) Clean and preserve toggle, rotary, and push-button switches in accordance with subparagraph 603k.

(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 subparagraphs 603k(2) through (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 subparagraph 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-DTL-85054.

(2) Internal Surfaces and Components:

(a) Remove corrosion with an abrasive nylon mat, conforming to A-A-58054, Type I.

(b) Clean the 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 the surface to air dry.

(c) Clean and preserve electrical connectors in accordance with subparagraphs 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-PRF-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 subparagraph 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 subparagraphs 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 A-A-1048, or an abrasive nylon mat, conforming to A-A-58054, 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-PRF-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 subparagraph 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 A-A-1048, or an abrasive nylon mat, conforming to A-A-58054, 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, subparagraph 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-PRF-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-PRF-32033, 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 subparagraph 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 subparagraph 602b.

(1) Moisture traps and cavities may be filled with Sealing Compound, conforming to MIL-PRF-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. Figure 3-8 and Figure 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

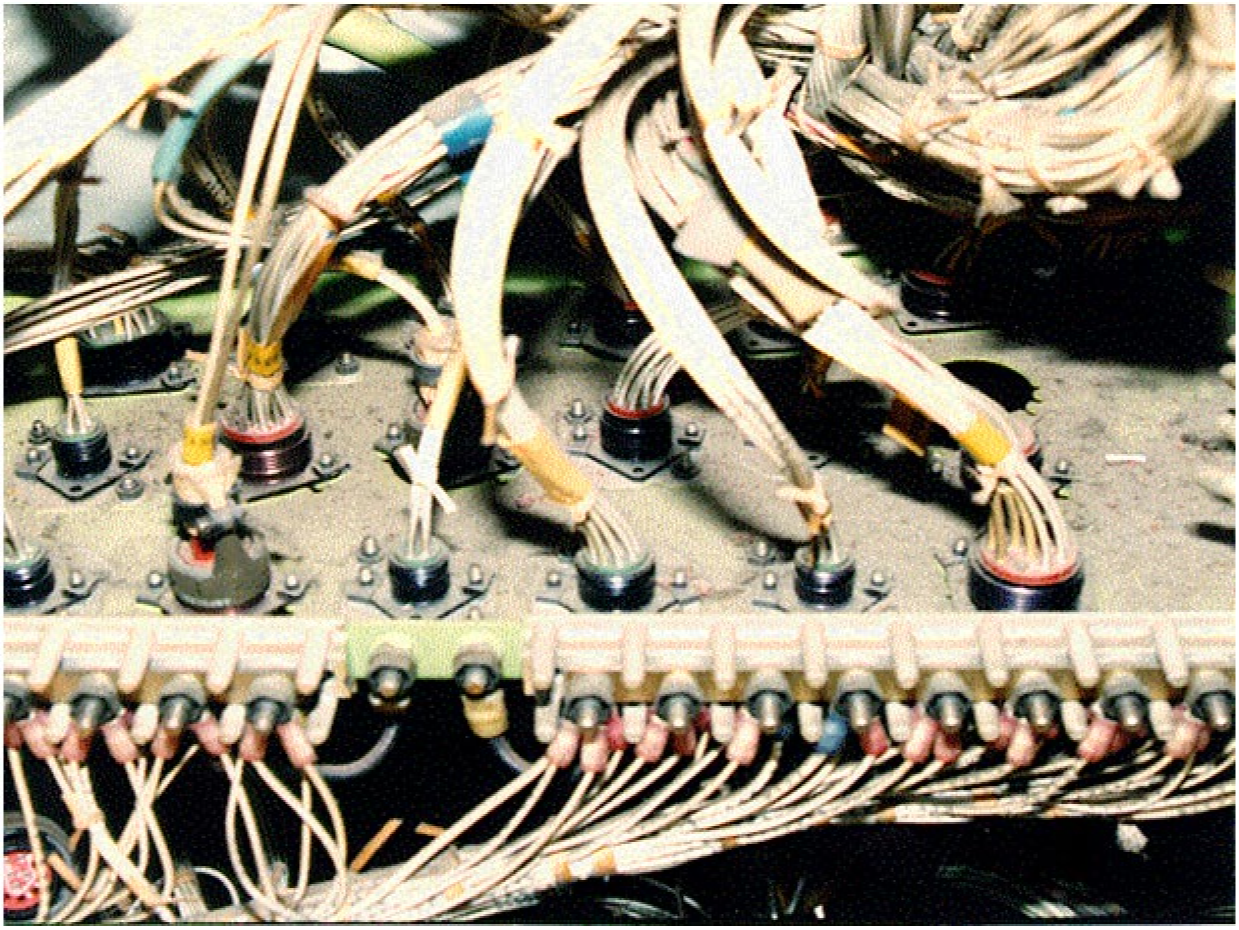


FIGURE 6-6. LINT AND DEBRIS ACCUMULATION ON A SHELF

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 deicing 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 a 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 A-A-1048, or an abrasive nylon mat, conforming to A-A-58054, Type I. Ensure complete corrosion removal from the antenna base and mating aircraft surface.

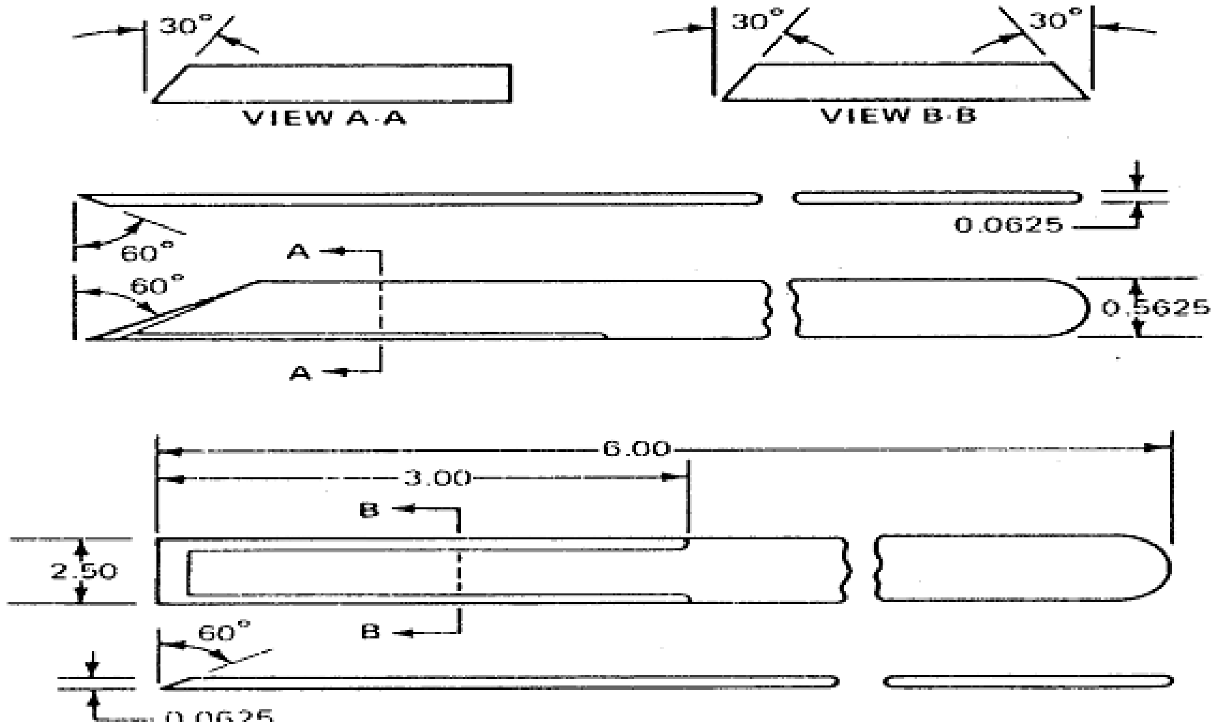
(f) Wipe off corrosion removal products using a cleaning cloth or cheesecloth dampened with Isopropyl Alcohol, TT-I-735. Allow the surface to air dry.

(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-DTL-81706, Class 3, in accordance with Chapter 5, paragraph 503.

FIGURE 6-7. CORRODED BONDING STRAP AND ATTACH HARDWARE

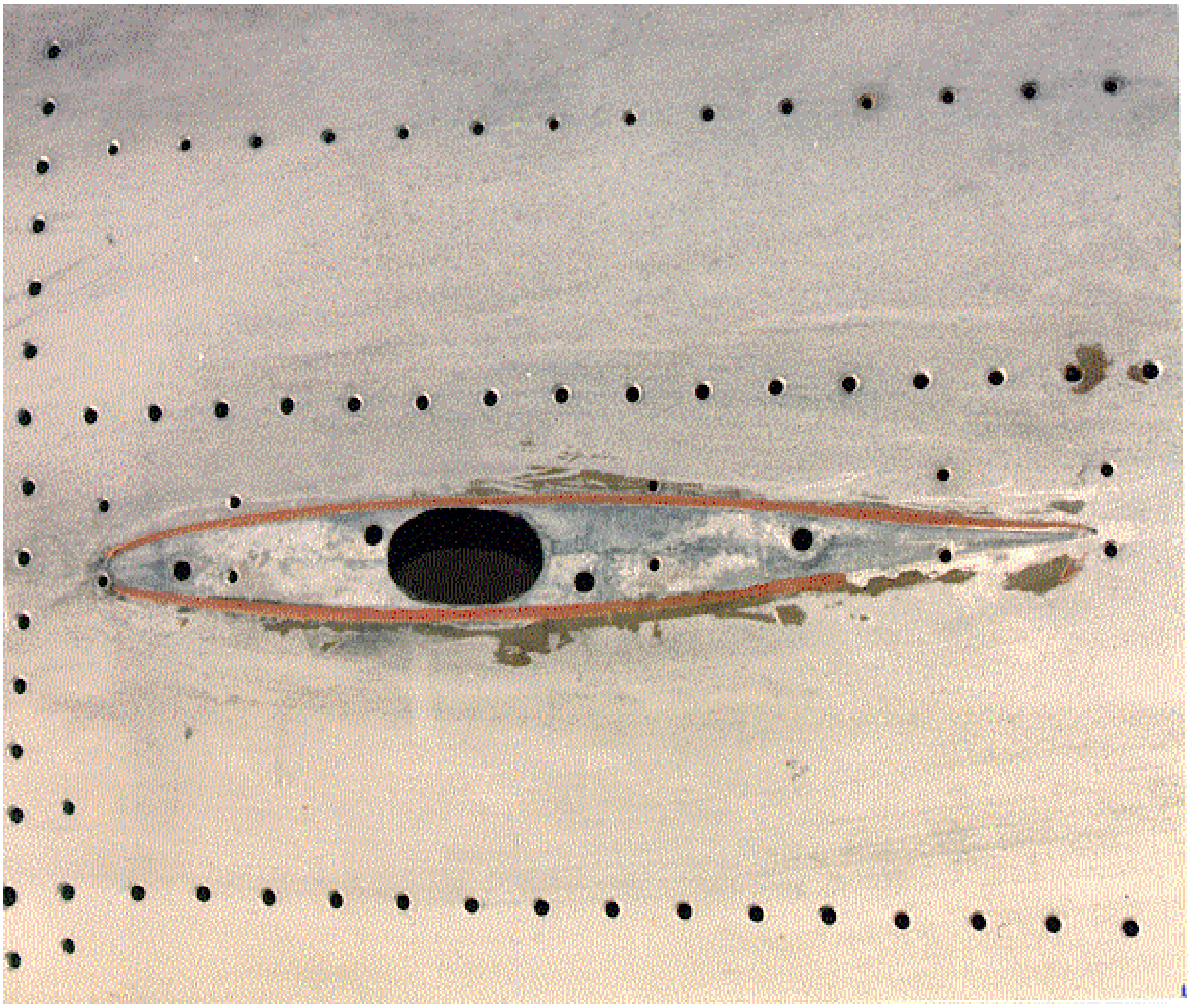
FIGURE 6-8. CORRODED ANTENNA MOUNTING AREA AND ELECTRICAL PLUG

FIGURE 6-9. NONMETALLIC SEALANT REMOVAL TOOLS



NOTE: 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 subparagraph 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 A-A-1048, or an abrasive nylon mat, conforming to A-A-58054, Type I.

(c) Clean the base of the 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-DTL-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:

1. Apply an even coating of Corrosion Preventive Compound, conforming to MIL-PRF-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 subparagraph 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.

2. (Alternate method 1.) Mix and apply an even coating of Polysulfide Sealing Compound, MIL-PRF-81733 or AMS-3276, to the antenna base and mating aircraft structure/skin in accordance with Chapter 5, subparagraph 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.

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

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

5. Conduct an electrical resistance test in accordance with subparagraph 603a(12).

FIGURE 6-11. BLADE ANTENNA INSTALLATION

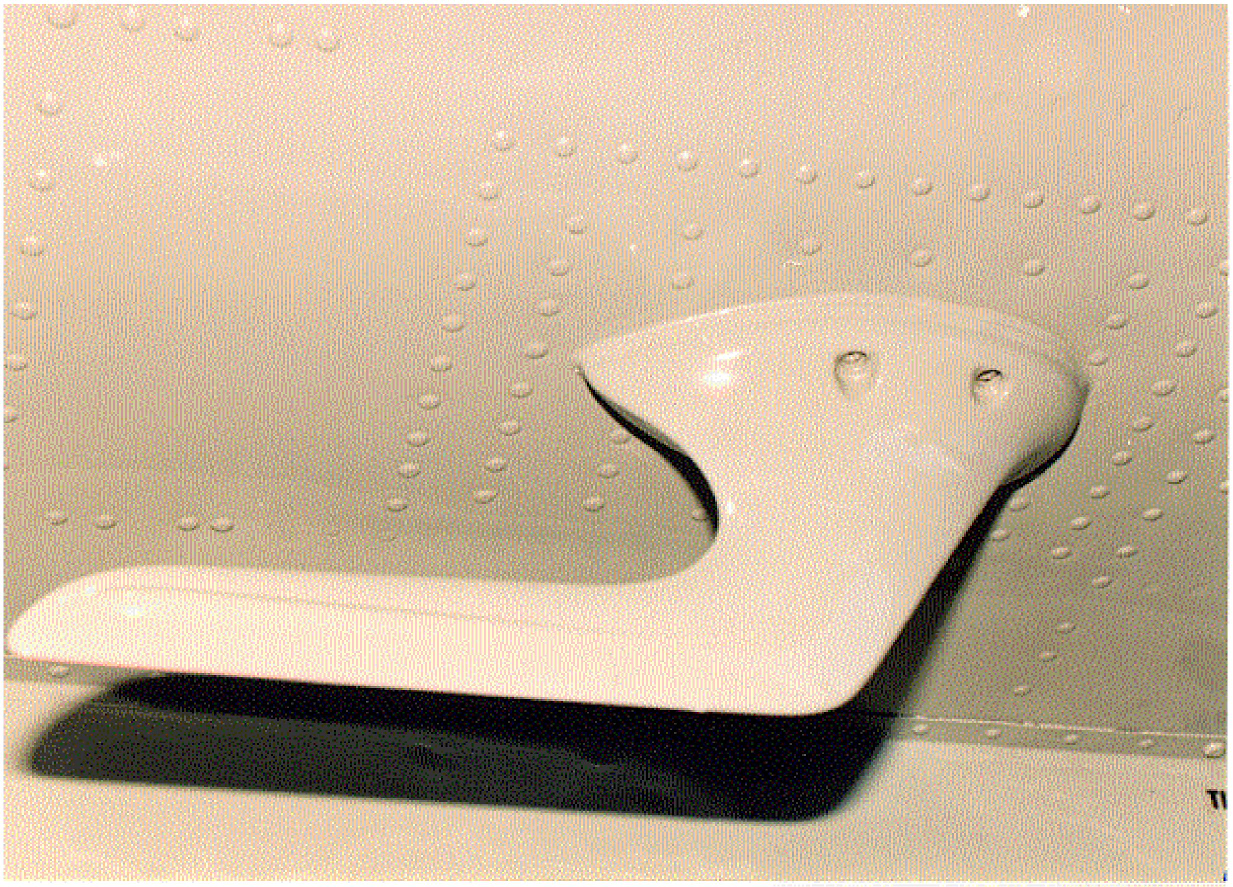
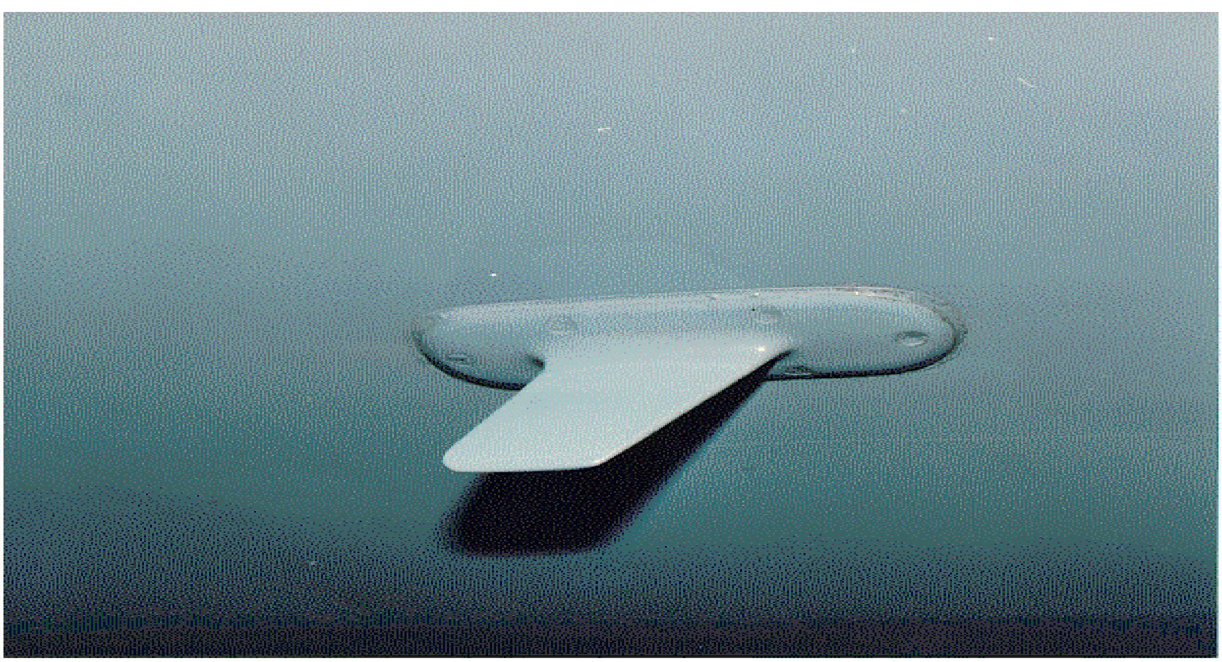


FIGURE 6-12. BLADE ANTENNA INSTALLATION



6. (For all installation methods.) Apply a fillet seal of Polysulfide Sealing Compound, MIL-PRF-81733 or AMS-3276, 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, subparagraph 505d to form a watertight seal.

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

8. 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 subparagraphs 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-PRF-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 the countersink area is clean under the fastener heads. Set and torque the fasteners.

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

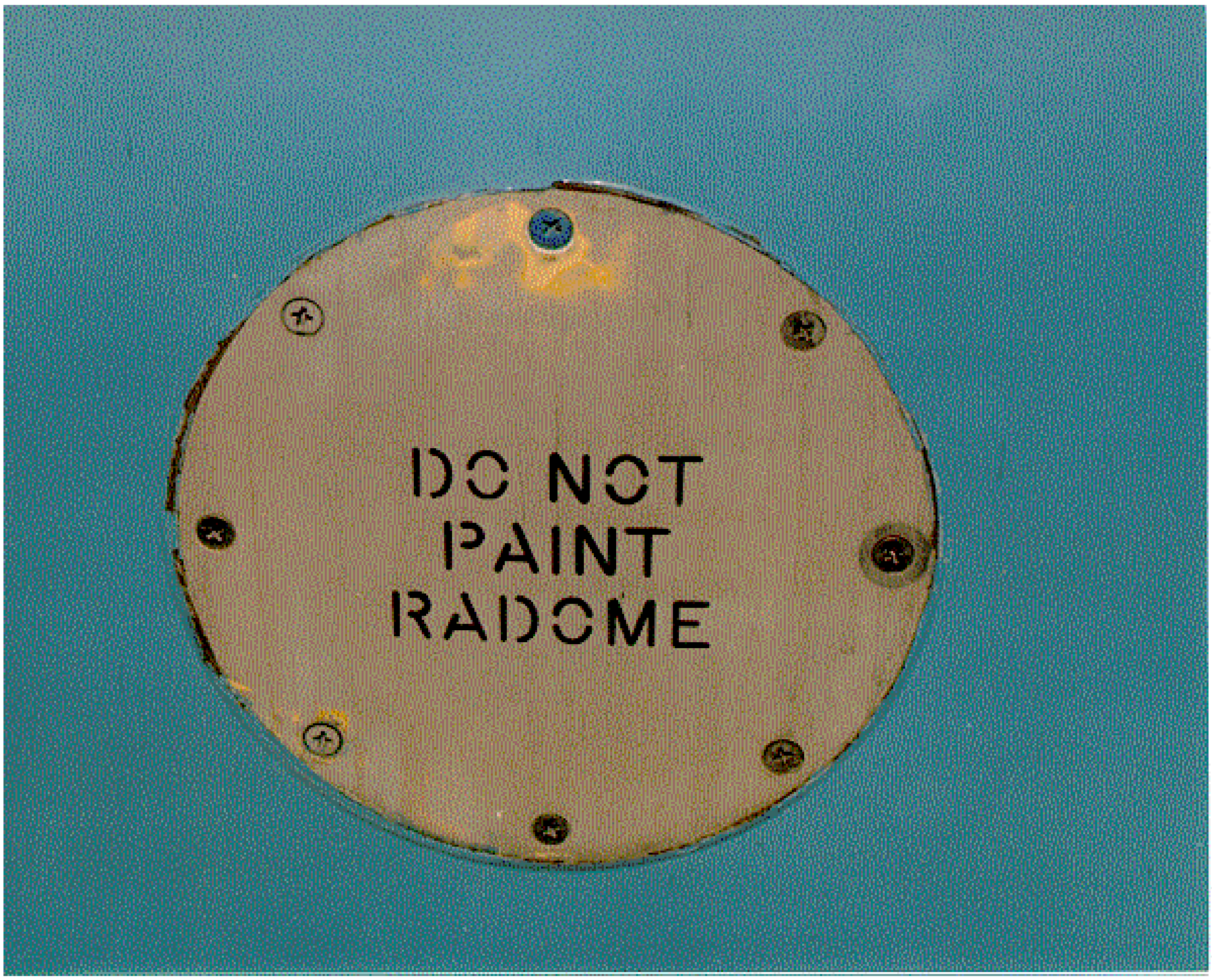
(f) Clean and seal the antenna base to the fuselage skin/structure and fastener heads in accordance with subparagraphs 603a(3)(e)*6*, *7*, and *8*.

(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 subparagraph 603a(2).

(b) Install the 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-PRF-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-DTL-85054, on the exterior of the antenna, coaxial connectors, and all other exposed metallic hardware. Mount the 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-PRF-81733 or AMS-3276, within the two parallel strips of tape around the periphery of the antenna cover and mated aircraft structure/skin in accordance with Chapter 5, subparagraph 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 percent 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 A-A-1048, or an abrasive nylon mat, conforming to A-A-58054, Type I.

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

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

NOTE: Unless the area is subject to a significant amount of abrasion from operation or handling, MIL-DTL-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 their 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 A-A-1048, or an abrasive nylon mat, conforming to A-A-58054, Type I. Repeat step (a) following corrosion removal.

(c) Spray a coat of Water-Displacing Corrosion Preventive Compound, conforming to MIL-DTL-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 multipin and coaxial, in accordance with subparagraphs 603k(2) through (5).

(10) Ultrahigh Frequency (UHF)/Very High Frequency (VHF)/Automatic Direction Finder (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 A-A-1048, or an abrasive nylon mat, conforming to A-A-58054, 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-PRF-81733, Type II. Mix sealant in accordance with the manufacturer's instructions (see Chapter 6, subparagraph 603a(6)). 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-DTL-85054, on the antenna mount.

(j) Clean and preserve the electrical connectors in accordance with the instructions of subparagraphs 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 (see Chapter 6, subparagraph 603a(6)). 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 subparagraph 603a(2), while antenna mounting procedures are described in subparagraph 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-DTL-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-DTL-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-DTL-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-DTL-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, subparagraphs 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 milliohm meter that will allow a reading of 2.5 milliohms 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 milliohm meter 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 milliohms.

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.

(1) 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 subparagraph 602b.

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

(c) Equipment covers with hinges and latches should be lubricated and preserved in accordance with subparagraphs 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. See 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 subparagraph 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 subparagraph 602e(4). Do not preserve water seal gaskets.

(d) Equipment covers with hinges and latches should be lubricated and preserved in accordance with subparagraphs 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 subparagraphs 602d(1) through (6).

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

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

(5) Meters. Voltmeters, ammeters, and multimeters 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 the surface to air dry.

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

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

(d) Clean meter face plates in accordance with subparagraph 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 A-A-58054, Type I.

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

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

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

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

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

(h) Clean and treat light bulb assemblies in accordance with subparagraph 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, subparagraph 405f, describes sealing methods.

(d) Remove oil, grease, and hydraulic fluids using a solvent ultrasonic cleaner. See the ultrasonic cleaning instructions in Chapter 4, subparagraph 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 (see Chapter 4, subparagraph 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, subparagraph 404b.

(g) Treat and paint internal areas of the support equipment in accordance with Chapter 5, subparagraphs 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-PRF-81309, Type III. Take necessary steps to avoid getting preservative on components that should not be preserved. (See Chapter 4, subparagraphs 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, subparagraph 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 (see Chapter 4, subparagraph 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, subparagraph 404b.

(g) Treat and paint internal areas of the support equipment in accordance with Chapter 5, subparagraphs 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-PRF-81309, Type III. Take necessary steps to avoid getting preservative on components that should not be preserved. (See Chapter 4, subparagraphs 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 subparagraph 603b(8). Those assemblies that cannot be moved and mechanically cleaned should be cleaned and preserved as follows:

(a) Open cabinet doors, remove the 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, subparagraph 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, subparagraph 405g, using a water detergent solution as described in subparagraph 404b(5), 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-PRF-81309, Type III. Take necessary steps to avoid getting preservative on components that should not be preserved (see Chapter 4, subparagraphs 407d and 407e, Table 4-4, and the caution statement for the preceding, subparagraph 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 the external surface in accordance with subparagraph 603c.

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

(c) Inspect the wave guide for corrosion.

(d) Remove corrosion from external surfaces using an abrasive nylon mat, conforming to A-A-58054, 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-DTL-85054.

CAUTION: Do not apply preservative materials to internal surfaces or areas of wave guide sections or angled physical contact (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 subparagraph 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 subparagraph 603g, and as follows:

1. Apply Spray Cleaning and Lubricating Compound, conforming to MIL-PRF-29608, Type I, to the internal portion of the switch.

CAUTION: Do not apply Spray Cleaning and Lubricating Compound, MIL-PRF-29608, to printed circuit boards (PCB) 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.

2. 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.

3. Spray cleaned areas that require lubrication with Spray Cleaning and Lubricating Compound, conforming to MIL-PRF-29608, Type I. A silicone lubricant residue will remain. Do not apply preservative materials.

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

1. 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, subparagraph 405g.

2. Rinse the microminiature PCBs with deionized water.

3. Dry the microminiature PCBs in accordance with Chapter 4, subparagraph 406e.

(e) Multipin Electrical Connectors and PCB Edge Connectors. Clean, treat, and preserve multipin electrical connectors and PCB edge connectors in accordance with subparagraph 603h, and subparagraphs 603k(1) through (4).

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

1. 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.

2. 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 the 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.

3. Lubricate sliding components with an application of Spray Cleaning and Lubricating Compound, conforming to MIL-PRF-29608, 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 (use Chapter 4, subparagraph 405j).

4. Spray a thin coating of Water-Displacing Corrosion Preventive Compound, conforming to MIL-PRF-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:

1. 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.

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

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

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

(b) Paint Finish Restoration. Inspect, clean, treat, and apply protective paint finish in accordance with subparagraph 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, subparagraph 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 A-A-58054, 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 the 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-DTL-85054, on the exterior surfaces.

(b) For wave guides that will be installed, spray a thin coating of Corrosion Preventive Compound, MIL-DTL-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 the 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-PRF-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 anticollision 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 A-A-58054, Type I. Scrub the affected area to loosen corrosion and contaminants.

(c) Clean the 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-PRF-81309, Type III.

(f) Preserve light assemblies as follows:

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

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

3. Install the bulb in the bulb socket.

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

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

5. Assemble the light assembly. Touch up exterior paint finish as required and in accordance with Chapter 5, subparagraphs 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 subparagraphs 603e(1)(a) through 603e(1)(f)*3*.

(b) Preserve the exterior of the light assembly using Water-Displacing Corrosion Preventive Compound, MIL-PRF-81309, Type II. Assemble the 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 the remainder of the 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-PRF-81309, Type III, to all areas of the relay or circuit breaker, avoiding contact and mating areas.

NOTE: After the 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 the 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, MIL-PRF-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 (see Chapter 4, paragraph 405, and Table 4-3).

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

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

(3) Switches should be preserved as follows:

NOTE: After the 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-PRF-81309, Type III, to the switch assembly. The 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, MIL-PRF-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 microminiature 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, MIL-PRF-680, using an acid brush. Rinse the affected area with Isopropyl Alcohol, TT-I-735, and wipe with a clean cloth or cheesecloth. Allow the component to air dry.

(3) Edge connectors should be preserved as follows:

(a) Spray a thin coating of Water-Displacing Corrosion Preventive Compound on both male and female sections of the connector, conforming to MIL-PRF-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, and 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 A-A-59282.

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 subparagraphs 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 the affected area by scrubbing with a nonabrasive pad. Thoroughly rinse the area with Isopropyl Alcohol, TT-I-735. Wipe the area with a clean cloth or cheesecloth.

(5) Air dry the component.

(6) Install the replacement capacitor.

(7) Preserve the area as follows:

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

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

(8) Replace the conformal coating in accordance with the OEM's maintenance instructions or Chapter 5, subparagraph 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 the affected area by scrubbing with a nonabrasive pad. Thoroughly rinse the area with Isopropyl Alcohol, TT-I-735. Wipe the area with a clean cloth or cheesecloth.

(3) Air dry the component.

(4) Install the replacement capacitor.

(5) Preserve the area as follows:

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

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

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

k. Multipin Electrical Connectors Cleaning and Preservation.

(1) General. Multipin 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.

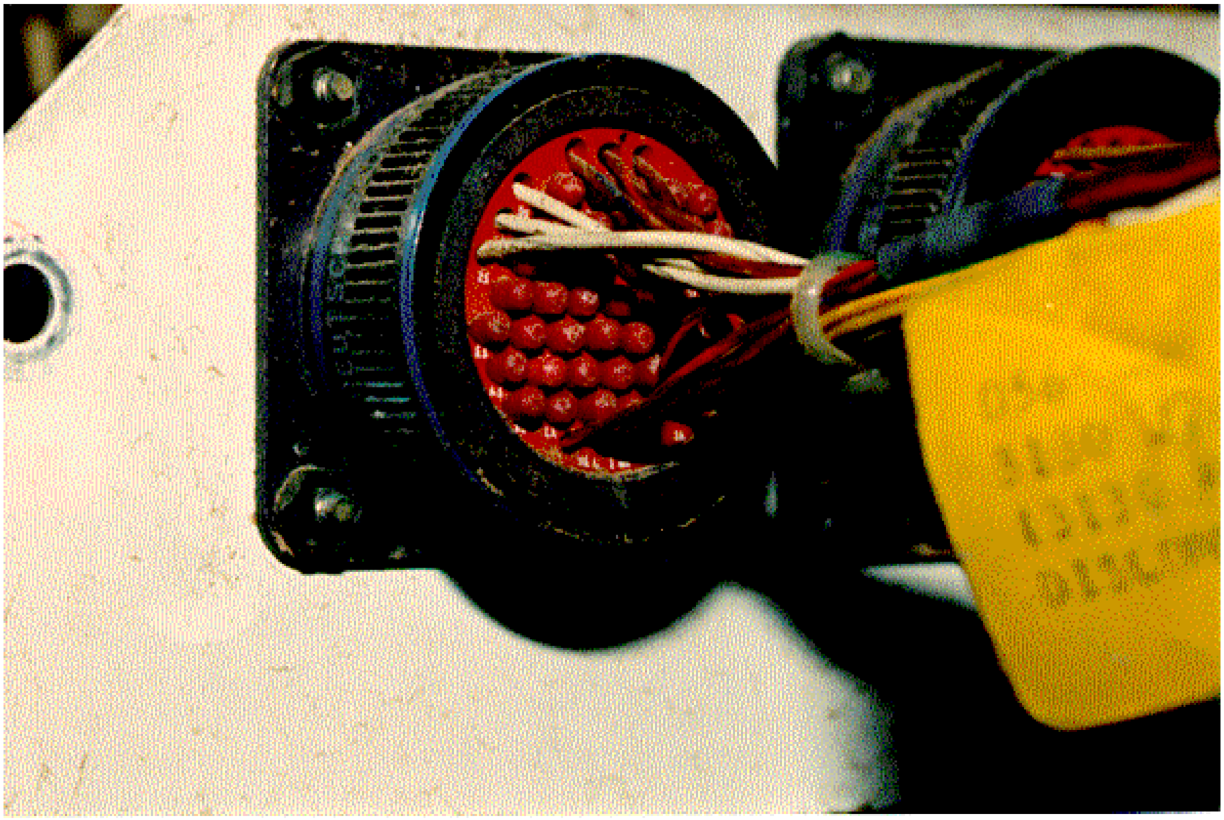
WARNING: Ensure that all electrical and hydraulic power is removed from the aircraft or component. Install the applicable safety devices. Disconnect all batteries.

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. See 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, and as specified in Chapter 4, subparagraph 409e, is an alternate method of sealing connectors if proper caps are not available.

FIGURE 6-14. MULTIPIN 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 multipin 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, subparagraph 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.

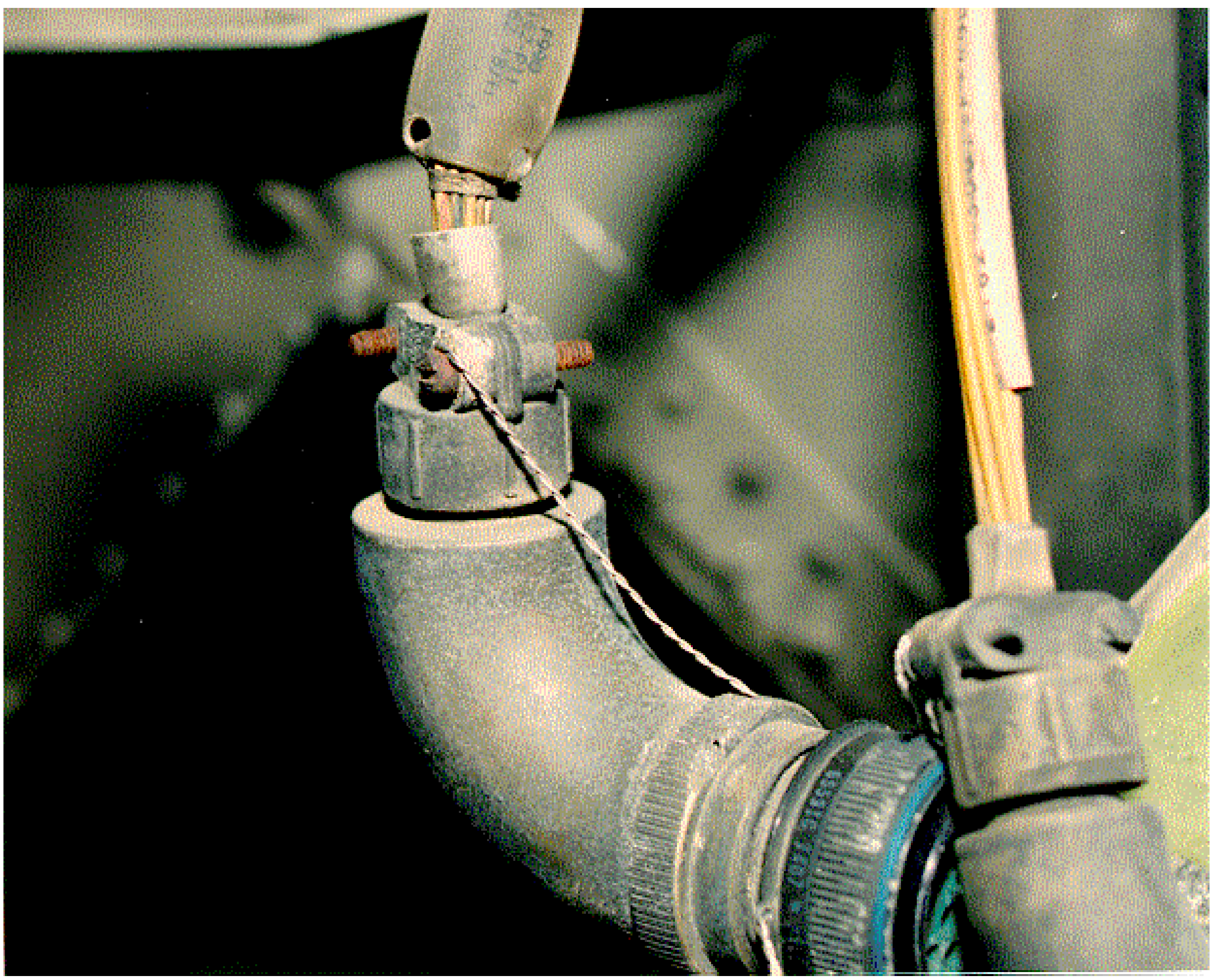
(b) Remove corrosion by scrubbing with a nonabrasive pad or an abrasive nylon mat, conforming to A-A-58054, Type I, as appropriate. Ensure connector mating surface threads, shell, and mounting plate (if used) are cleaned.

(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 MULTIPIN 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:

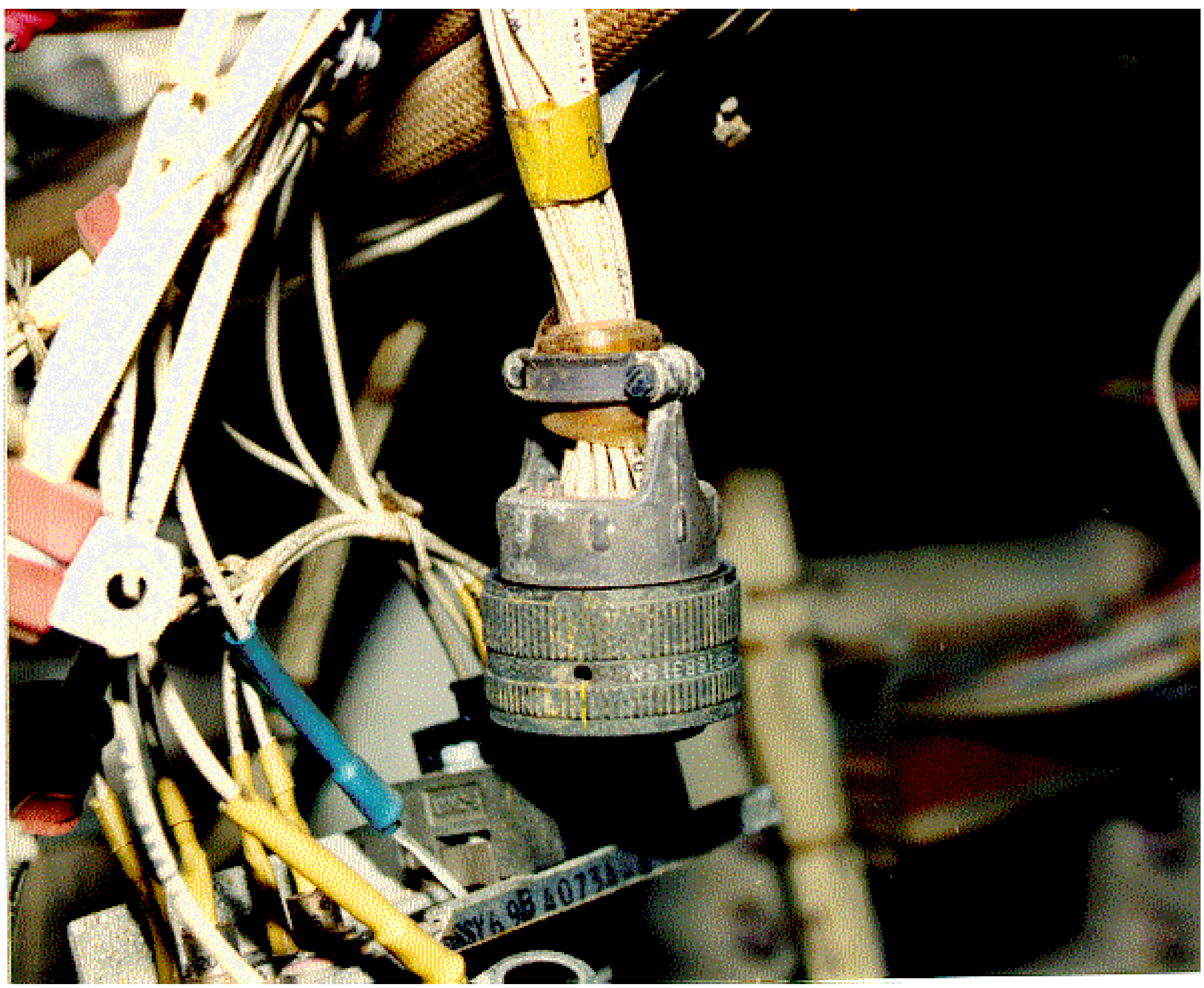
NOTE: On most connectors it is difficult to clean and remove corrosion from the receptacle (female) contacts. If corrosion is noted, the most practical solution is to replace the pin.

(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 MULTIPIN 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:

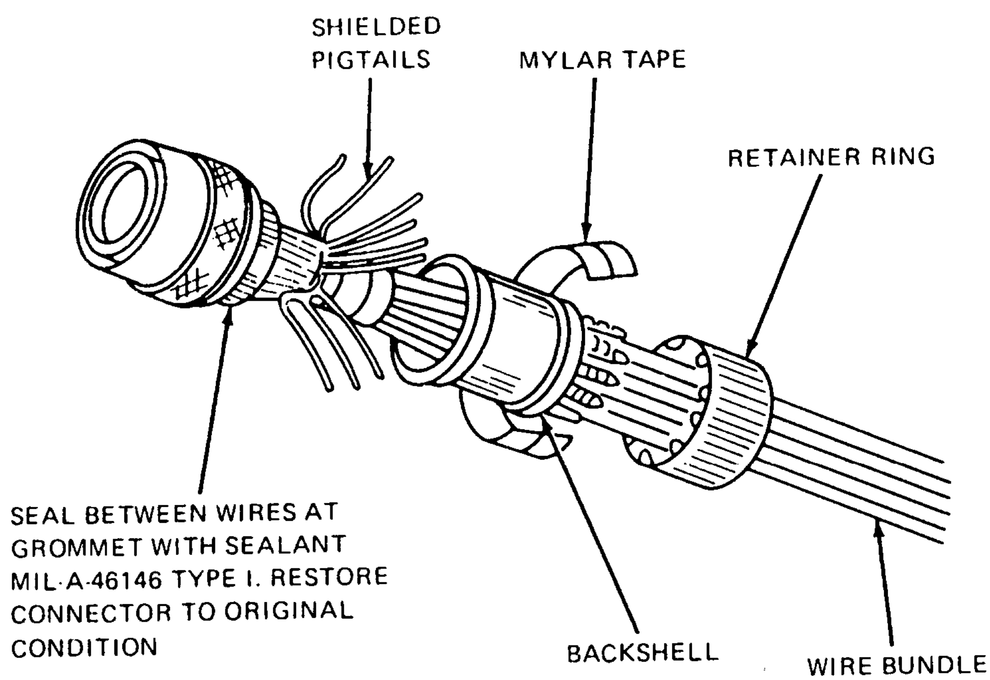
(a) Verify that sealing plugs ("dog bones") are installed in unused contact cavities.

(b) Remove the 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 (see 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 the connector in the vertical position until the sealing compound sets. The sealing compound will self-level in approximately 15 minutes.

FIGURE 6-17. CONNECTOR SEALING PROCEDURE



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

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-PRF-8516, 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 the connector with a clean cloth or cheesecloth. Allow the connector to air dry.

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

(c) If possible, tilt or rotate the 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-PRF-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-DTL-85054, to the exterior surfaces of connector plugs and receptacles.

CAUTION: Corrosion Preventive Compound, MIL-DTL-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-DTL-85054 should be avoided. For connectors requiring frequent disconnecting and connecting, use Corrosion Preventive Compound, MIL-PRF-81309, Type III, in lieu of MIL-DTL-85054.

l. Coaxial Connectors. Coaxial connectors require special steps in order to avoid water intrusion. In most cases, water intrusion in the 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 subparagraphs 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 the 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 the wire harness and cable covering.

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

n. PCBs. Edge connectors (and mating plugs) used in miniature and microminiature PCBs should be cleaned and preserved in accordance with subparagraph 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 the filter in a deep sink and flush thoroughly with fresh water.

(2) Scrub the 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-PRF-85570, Type II. Scrub the 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 pounds per square inch (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 the 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 the 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 the affected area with Isopropyl Alcohol, TT-I-735, and wipe dry with a 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, subparagraph 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-PRF-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 the mounting area with a nonabrasive pad. Scrub the affected area until all corrosion and contaminants are loosened.

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

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

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

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

(7) Install the 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-DTL-85054, on all metal surfaces and attachment points. Avoid excessive application or overspray of preservative.

604 through 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 (see 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. Refer to 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, MIL-PRF-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, MIL-PRF-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 A-A-58054, 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.

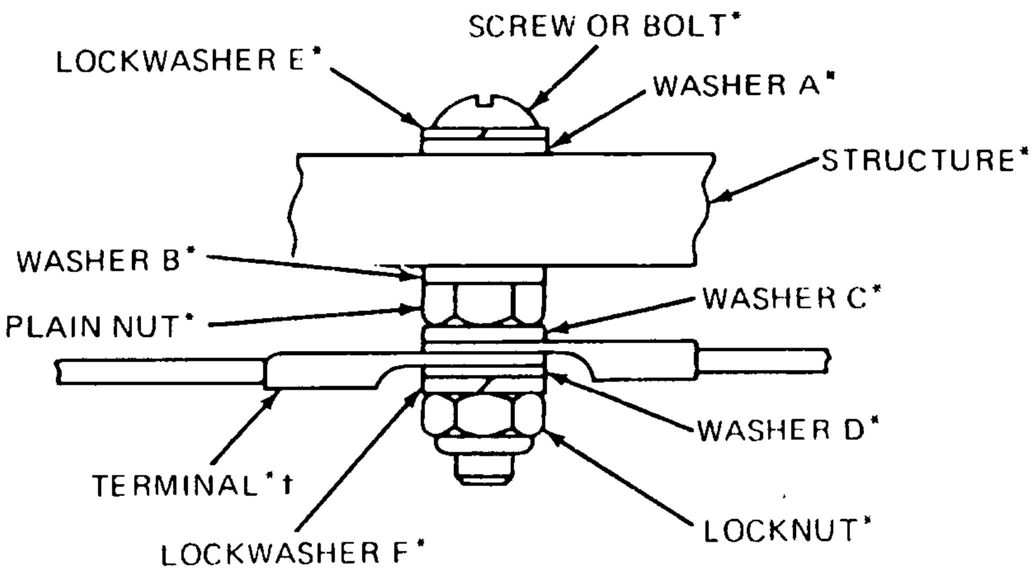
(7) Remove all dirt, oil, grease, and other contaminants from the bonding cable terminal with a clean cloth or cheesecloth dampened with Isopropyl Alcohol, TT-I-735.

(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, subparagraph 603a(12).

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



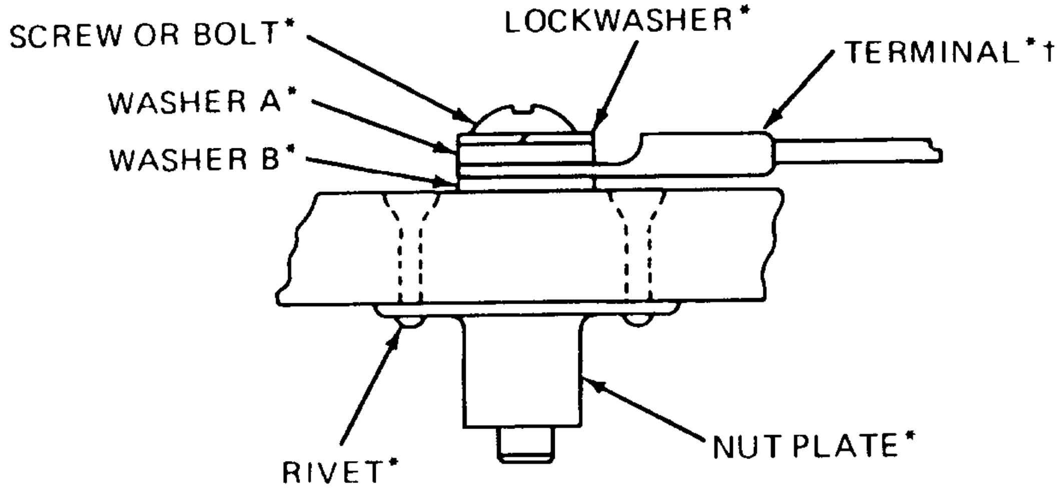
Notes:
*See Table 7-1 for specific materials.
†Limited to a quantity of four (4).

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.

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



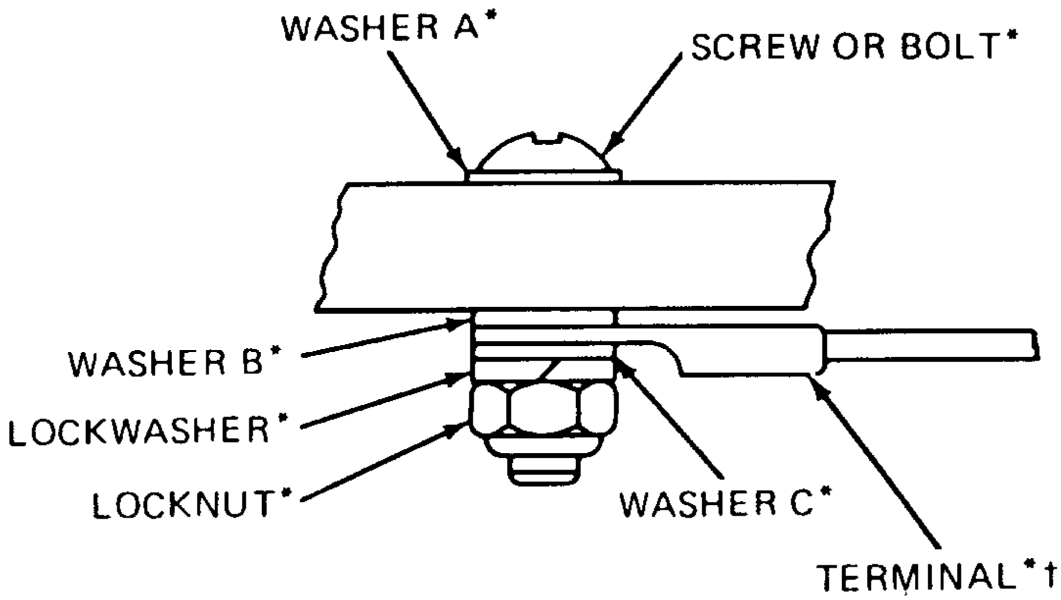
Notes:
*See Table 7-2 for specific materials.
†Limited to a quantity of four (4).

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

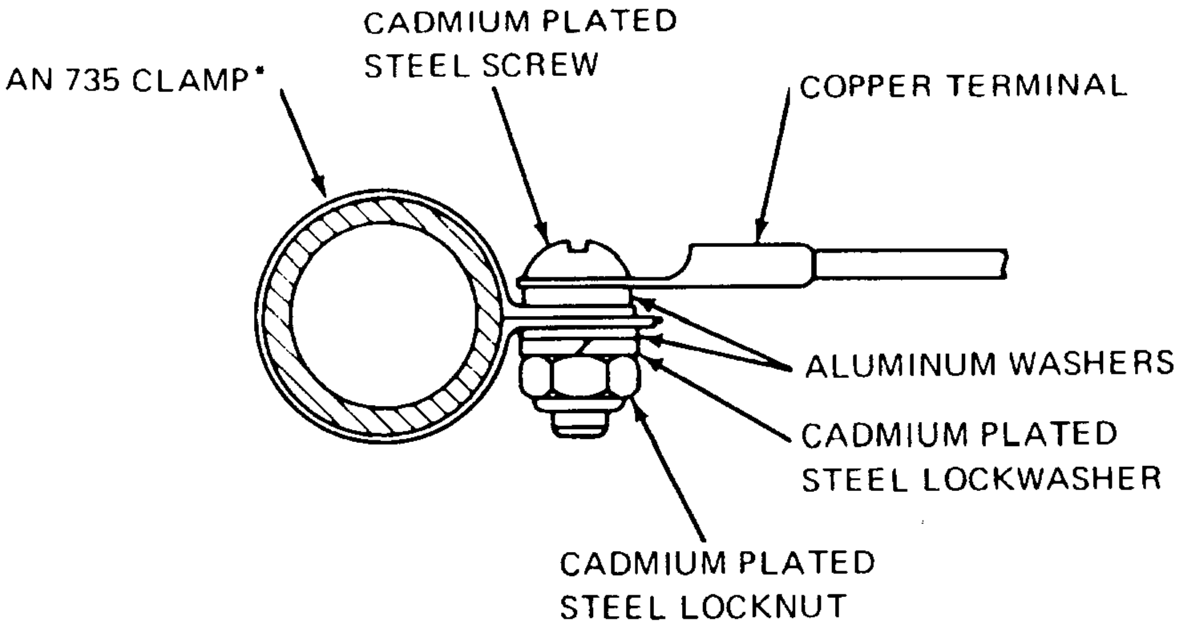
*When not available, use aluminum alloy.

FIGURE 7-3. BOLT AND NUT BONDING OR GROUNDING



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

FIGURE 7-4. COPPER JUMPER CONNECTOR TO TUBULAR STRUCTURE



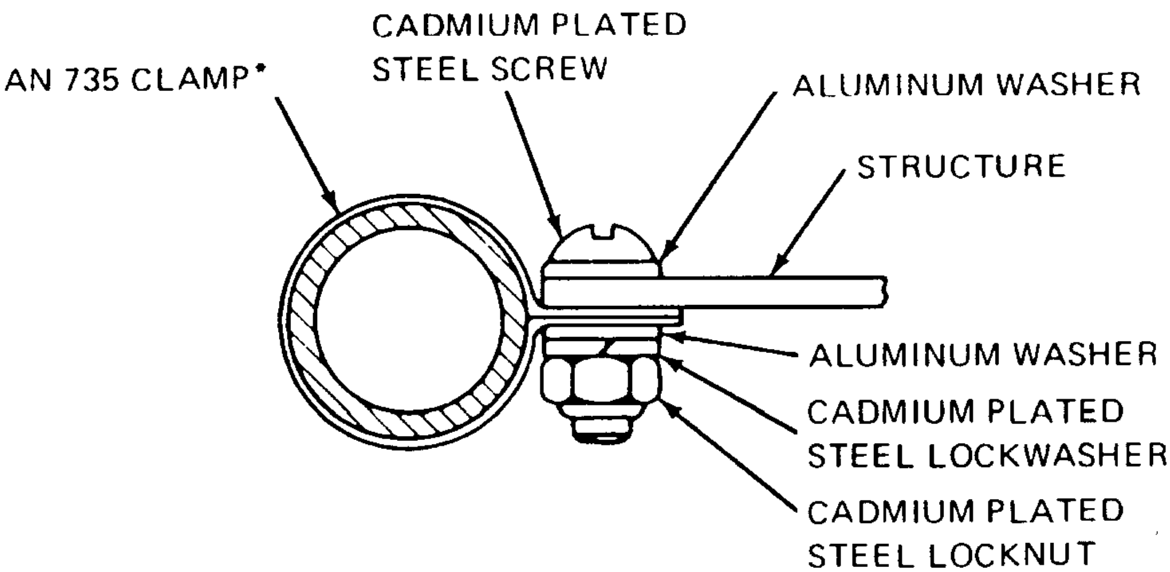
Notes:
*Inside surface of clamp (conduit) is cylindrical.

TABLE 7-3. HARDWARE FOR BOLT-AND-NUT

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

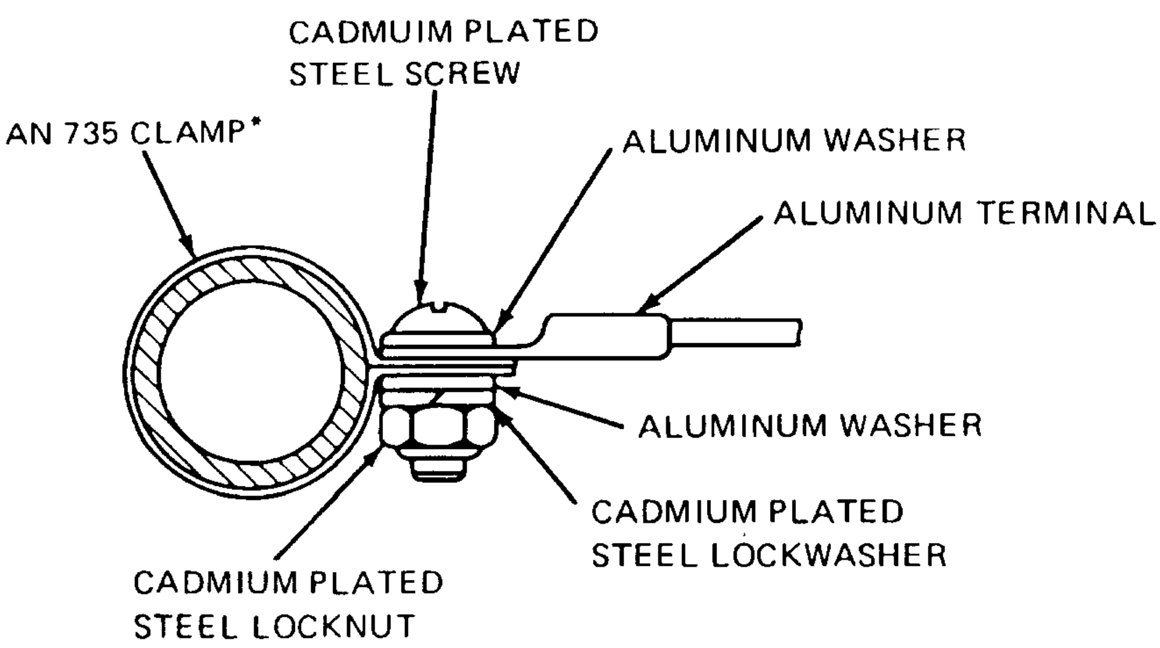
*When not available, use aluminum alloy.

FIGURE 7-5. BONDING CONDUIT TO STRUCTURE



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

FIGURE 7-6. ALUMINUM JUMPER CONNECTOR TO TUBULAR STRUCTURE



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

b. Preservation. Preservation provides a nonconductive film to protect the bonding or grounding connection from corrosion by excluding moisture. Three preservation methods are discussed. See 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-DTL-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-PRF-81309, Type III, followed by a coating of Corrosion Preventive Compound, conforming to MIL-PRF-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-PRF-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-PRF-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-DTL-85054.

703 through 800. RESERVED.

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

801. DEFINITION/DESCRIPTION OF ELECTROMAGNETIC INTERFERENCE (EMI).

a. 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 20-53, Protection of Aircraft Fuel Systems Against Fuel Vapor Ignition Caused by 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. AC 20-158, The Certification of Aircraft Electrical and Electronic Systems for Operation in the High-Intensity Radiated Fields (HIRF) Environment.

f. MIL-STD-464, Electromagnetic Environmental Effects Requirements for Systems.

g. MIL-HDBK-235, Military Operational Electromagnetic Environment Profiles.

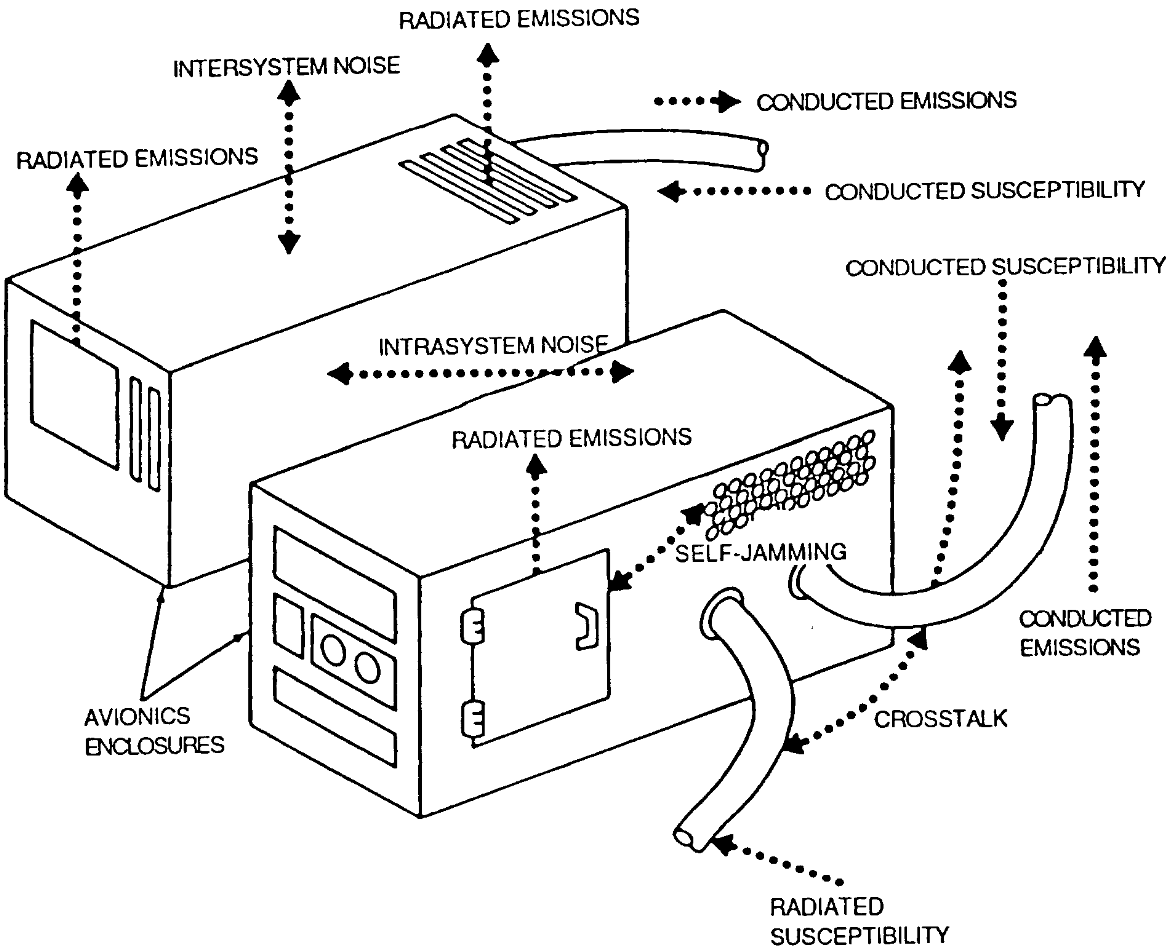
h. DOT/FAA/CT-86/40, Aircraft Electromagnetic Compatibility.

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. 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.

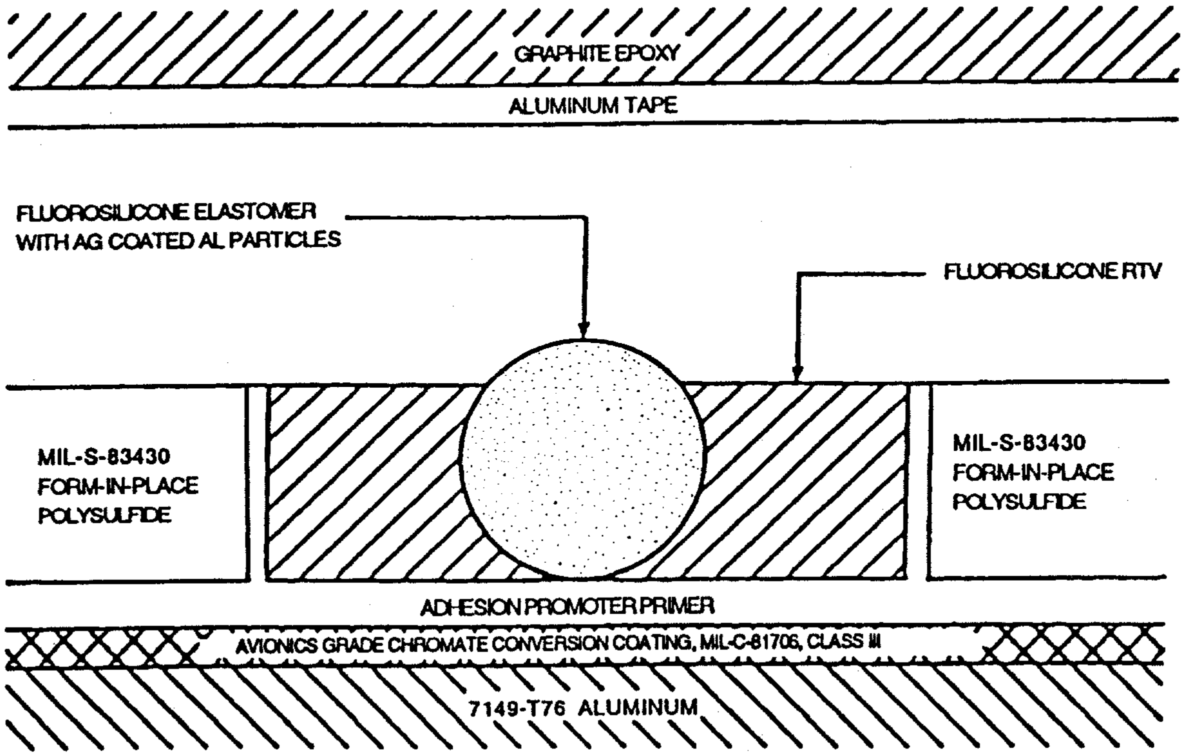
e. Precipitation Static. Precipitation static, or P-static, is the triboelectric charging of the aircraft due to flight through dust, ice, rain, sleet, hail, or snow. When precipitation or dust particles contact the metallic or dielectric surfaces, charge separation occurs. This electric charge can cause 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.

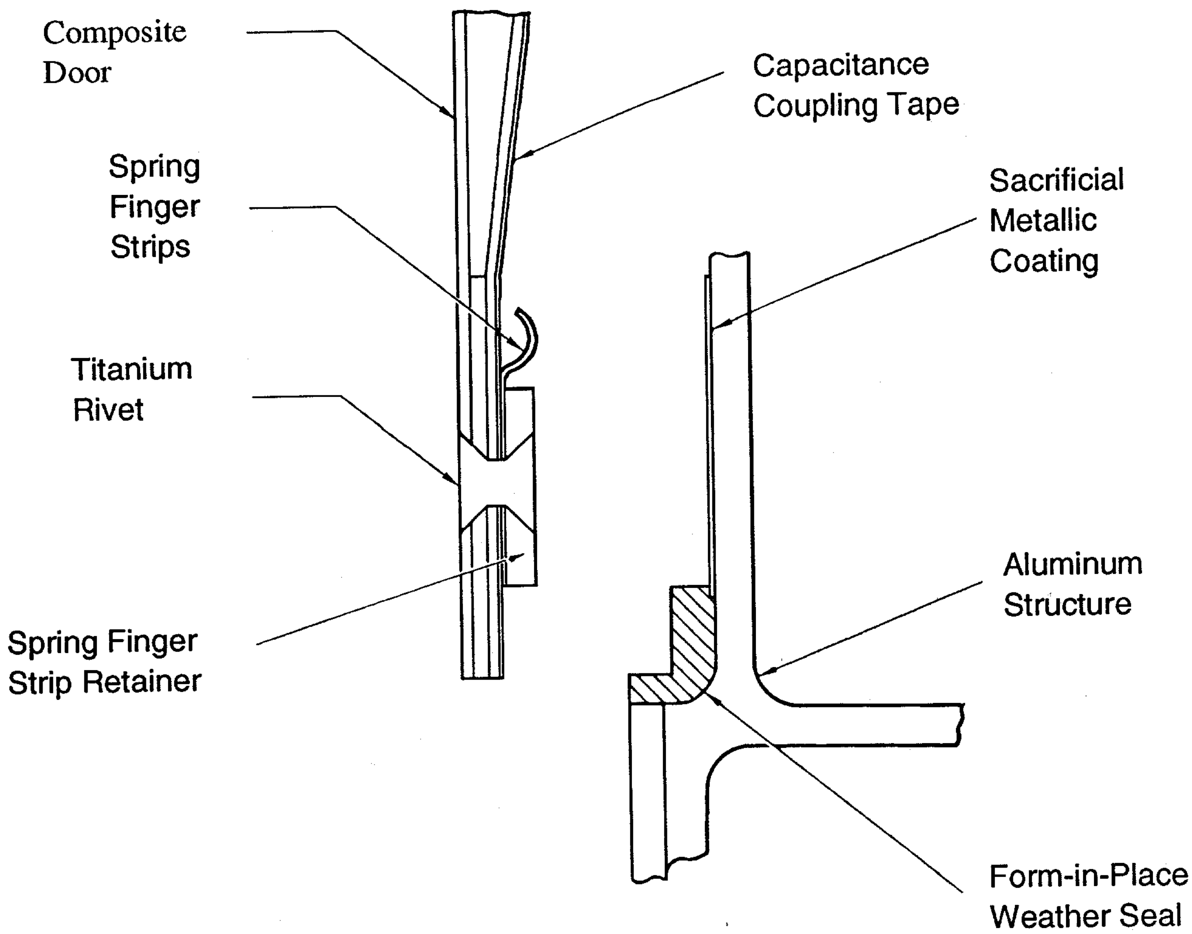
FIGURE 8-2. TYPICAL METAL PARTICLE FILLED ELASTOMER GASKET INSTALLATION



(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. See 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



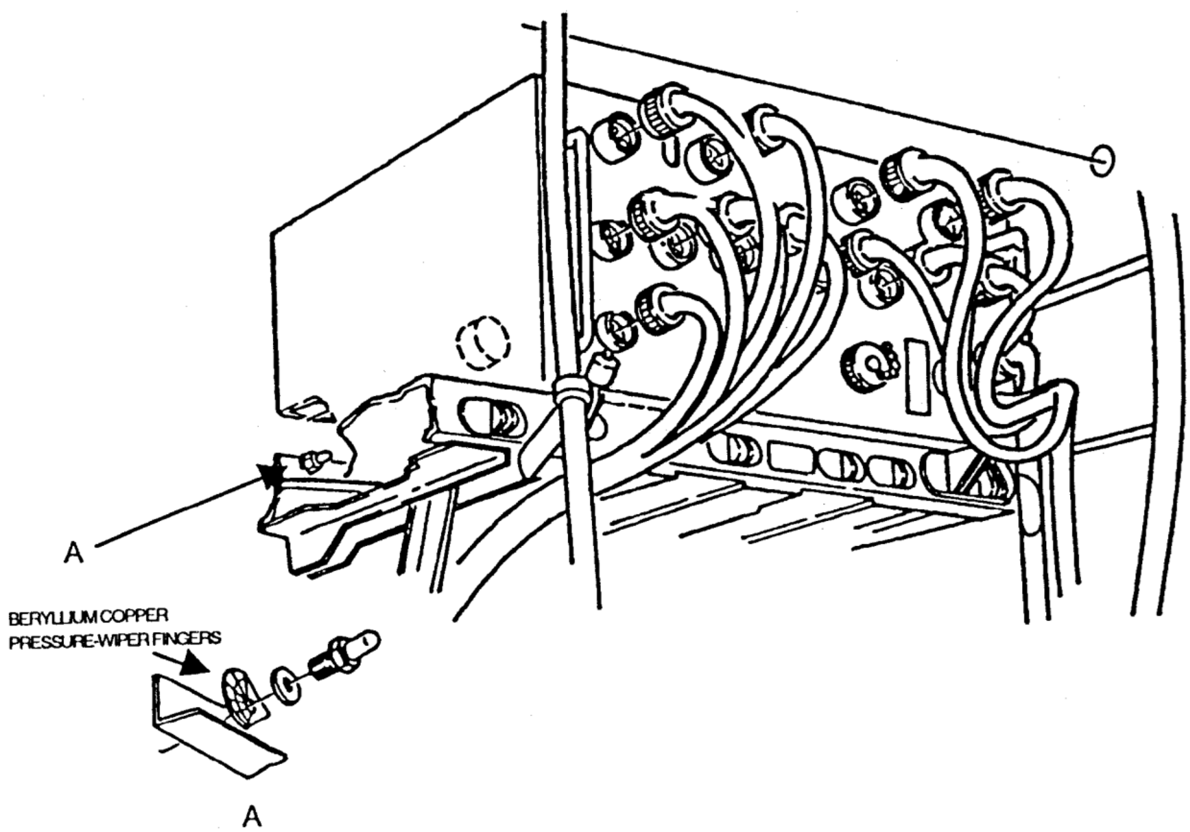
(4) Screens. Screens which cover vents and louvers may be designed to prevent EMI intrusion. The screen mesh should be the correct size to prevent wavelengths of expected EMI from passing through. The screen should also be electrically bonded to the aircraft structure around the entire periphery of the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

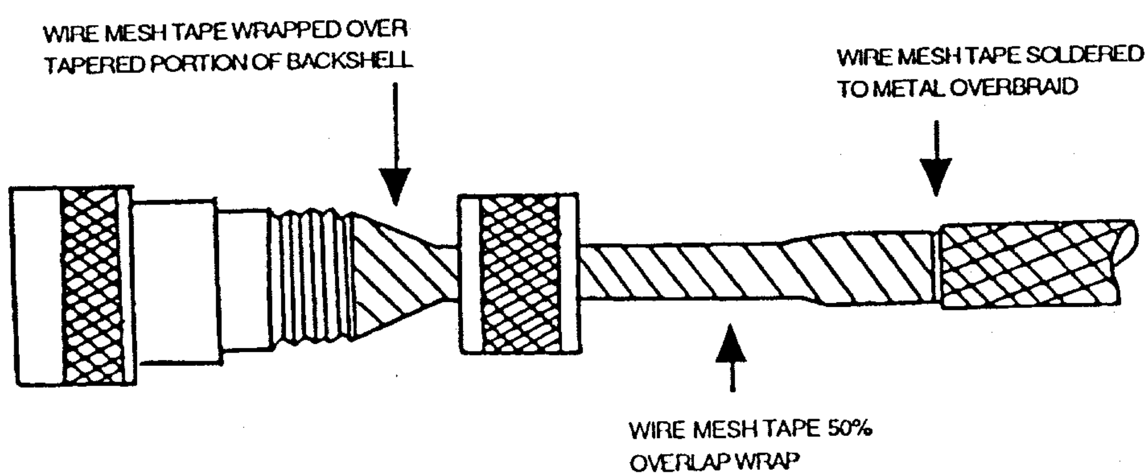


(3) Aircraft external lighting, antennas, probes, fuel vents, and fuel cells are susceptible to lightning, and should be bonded to the aircraft structure. Internal circuitry for any of these may require special isolation or high current carrying design requirements.

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 be 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 direct current (DC) 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. 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 as 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 alternating current (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 to 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 handheld 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 Manufacturer's (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: See 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 through 900. RESERVED.

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

901. DEFINITION/DESCRIPTION OF ELECTROSTATIC DISCHARGE (ESD). 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, as seen in 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)

Most 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 or 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% Relative Humidity	65 to 90% 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 semiconductor (PMOS),

(3) Complementary oxide semiconductor (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 SiO2 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.

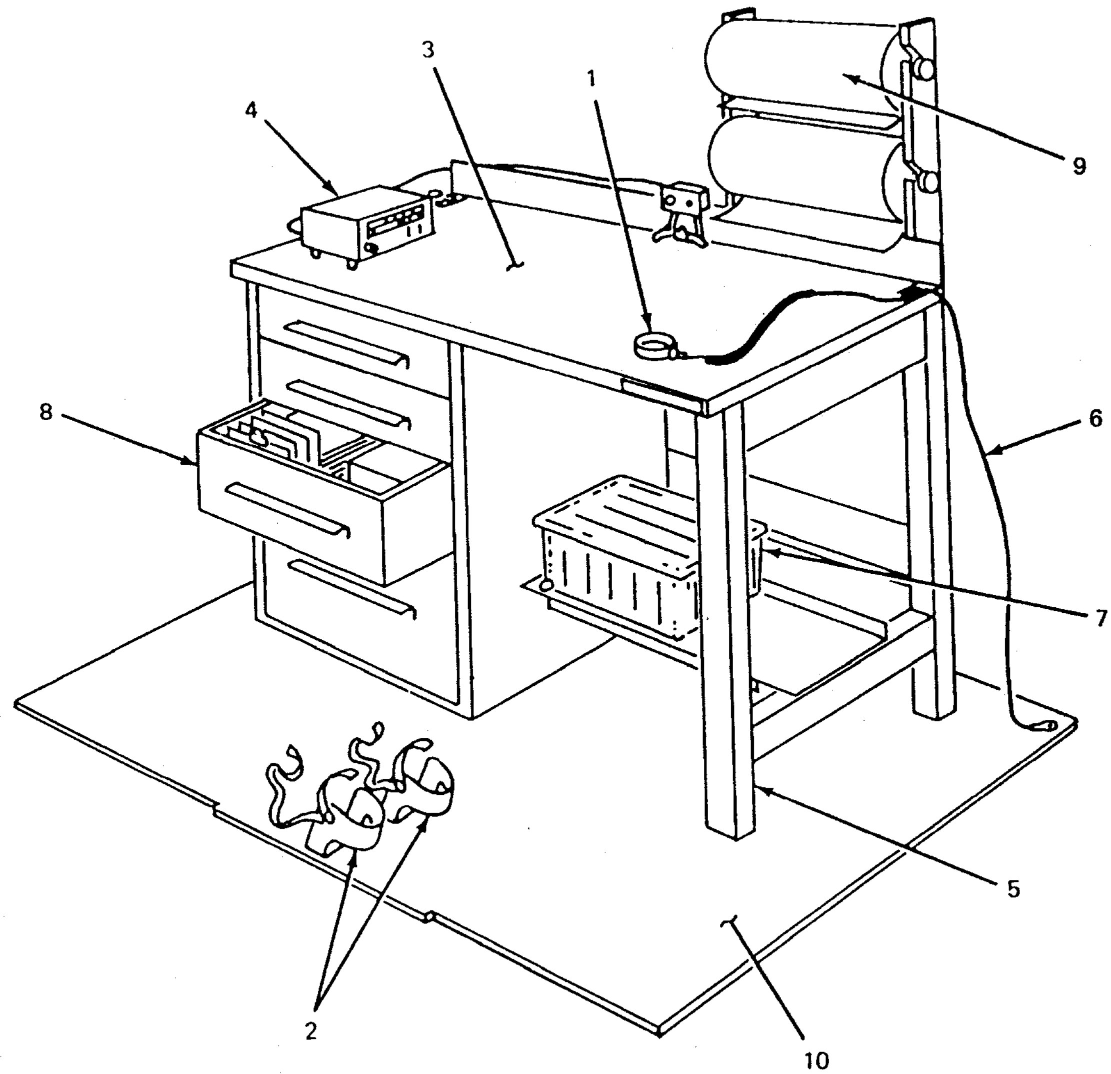
(3) Class 3: Less sensitive: Ranges from 4 to 16 kV.

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 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 (e.g., 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.

FIGURE 9-1. TYPICAL ESD WORKSTATION



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.

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.

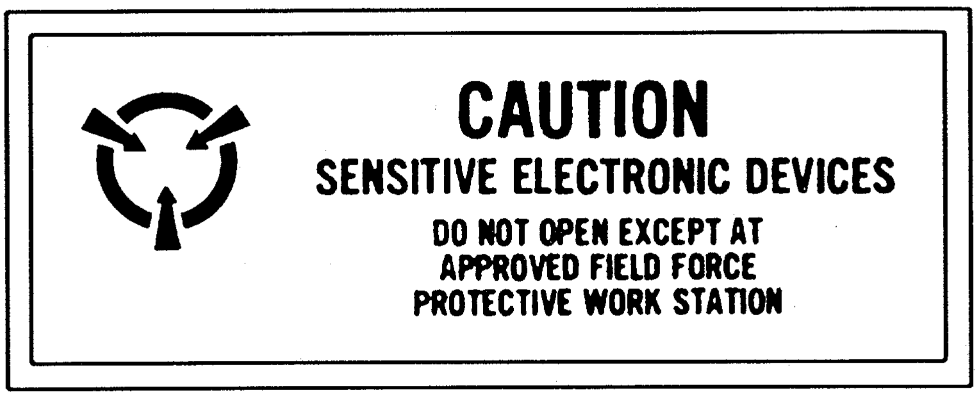
(e) Test through connectors or tabs only.

(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.

(l) 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 Original Equipment Manufacturer’s (OEM) service directives for specific repair procedures or the treatment of specific avionics equipment identified in Chapters 6 and 8.

907 through 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 responsibilities 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. See Chapter 4, Table 4-3, for further restrictions on these materials.

a. General. Where possible, the primary method of emergency cleaning described in subparagraph 1004b should be used. When a sufficient quantity of fresh water is not available, use one of the alternate emergency cleaning methods described in subparagraphs 1004c(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 pounds per square inch (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-PRF-85570, Type II. Scrub the affected 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 subparagraph 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, MIL-PRF-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 subparagraphs 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-PRF-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-PRF-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-PRF-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 subparagraph 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-PRF-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 (inHg) 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-PRF-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-PRF-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-PRF-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-PRF-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. See 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 subparagraph 1004b.

(8) If the primary method cannot be performed for lack of available fresh water, use one of the alternate cleaning methods described in subparagraph 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 subparagraph 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 SAE-AMS-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 subparagraph 1004b or c.

(2) Dry and preserve the equipment in accordance with one of the methods described in subparagraph 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 subparagraph 1004b or c.

(2) Dry and preserve the equipment in accordance with one of the methods described in subparagraph 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, MIL-PRF-680, 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 subparagraphs 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 subparagraph 1004b.

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

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

(6) Cockpit circuit breakers, toggle, rotary, interlock, and push-button switches should be cleaned and preserved in accordance with subparagraph 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, MIL-PRF-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, MIL-PRF-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 subparagraph 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 one part Aircraft Cleaning Compound conforming to MIL-PRF-85570, Type I, to nine 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 subparagraph 1004b.

(3) Dry the mounting racks, shock mounts, and associated hardware in accordance with one of the methods described in subparagraph 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 subparagraph 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 subparagraph 1004c.

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

j. In-place Cleaning. Where access is limited, use a backpack hand pump for one of the cleaning methods described in subparagraph 1004c, except the solvent method described in subparagraph 1004c(1). Dry and preserve limited-access components in accordance with subparagraph 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-PRF-81309, Type III. Wipe off excess preservative with a dry, clean cloth.

l. 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 subparagraph 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 subparagraph 1004c.

(6) For all non-removable avionics components and electrical connectors, dry and preserve in accordance with subparagraph 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, MIL-PRF-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-PRF-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 subparagraphs 1005b(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 subparagraph 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-PRF-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 OEM 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, MIL-PRF-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 subparagraph 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 subparagraph 1004b.

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

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

(d) Preserve in accordance with Chapter 4, paragraph 407.

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

1008. through 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:

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

ITEM NO.	NOMENCLATURE/PRODUCT SPECIFICATION	APPLICATION
ABRASIVES		
1.	Abrasive Mat. Aluminum Oxide Abrasive, A-A-58054, Grade A, Class 1 (Very Fine), or A-A-58054, 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	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 A-A-1048, 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, A-A-1048.**
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.**

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 manufacturer'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-PRF-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-81302, 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, MIL-PRF-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: MIL-PRF-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-95B, 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-PRF-29608, Type I	Cleaner and lubricant for use on small switches and potentiometers where a residual lubricant is required after cleaning. Contains 5% silicone.

ITEM NO.	NOMENCLATURE/PRODUCT SPECIFICATION	APPLICATION
16.	Thinner, Acrylic Nitrocellulose Lacquer, MIL-T-19544	Thinner for Lacquer, Acrylic Nitrocellulose MIL-L-19538C, MIL-C-22750, epoxy topcoats, Item No. 59 and 60, and MIL-P-23377 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 A-A-3007	Used for thinning varnish, MIL-V-173C, Item No. 51. **CAUTION: Do not use in lacquers.**
19.	Thinner, Aliphatic Polyurethane Coating, MIL-T-81772, Type I (Polyurethane) Type II (Epoxy) Type III (Lacquer)	For thinning urethane and polyurethane topcoats, MIL-C-83286B, and MIL-PRF-85285, Item No. 61 and 63; epoxy polyamide coatings, MIL-C-22750, Item No. 60; acrylic nitrocellulose lacquers, MIL-L-19538C, 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-PRF-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-PRF-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-DTL-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-PRF-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), MIL-PRF-32033	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.

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 revolutions per minute (rpm) under heavy loads where the possibility of conventional fluid lubricant contamination exists. Not to be used on bearings containing rolling elements.**
CLEANING CLOTH		
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.

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, Room Temperature Vulcanizing (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-PRF-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, SAE-AMS-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, SAE-AMS-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-PRF-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-PRF-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 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.**

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.**
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 Bicarbonate, 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, AWWA B504-18	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, A-A-59282	For neutralizing electrolyte leakage from nickel-cadmium batteries.
55.	Chemical Conversion Material for Coating Aluminum and Aluminum Alloys, MIL-DTL-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, SAE-AMS-M-3171, Type VI	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-19538C (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 on 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-83286B	Used as a topcoat on all avionics equipment. Touch-up of polyurethane paint systems. (Noncompliant.)
62.	Coating, Aliphatic Polyurethane, Single Component, MIL-C-53039	Used as a topcoat on all avionics equipment.
63.	Coating, Polyurethane High Solids, MIL-PRF-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, QPL-81294	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.
72.	Barrier Material, Water Vapor proof, Protective, Electrostatic and Electromagnetic Shielding, MIL-B-81705, Type I	Provides ESD and electromagnetic interference (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, A-A-59282.
79.	Glass Beads, MIL-G-9954	Used as abrasive in handheld tool in blast cleaning cabinet.
80.	Silver Nitrate, A-A-59282	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
CLEANING COMPOUND, MIL-PRF-85570		
9	Type II	Leeder 1140-F
9	Type II	8505
9	Type II	Calla 855
9	Type II	Aerowash NV
9	Type II	AC-17 8
9	Type II	ED-4 10
9	Type II	EZE-445
9	Type II	MA-102
9	Type II	CeeBee R-682
9	Type II	8002-2-SD
9	Type II	Octagon 855702
9	Type II	LD-38
9	Type II	PENN AIR M5572B
9	Type II	93-1
9	Type II	Turco 6692
CORROSION PREVENTIVE COMPOUND, MIL-PRF-81309, Class 1 (Bulk), Class 2 (Aerosol)		
20	Type III	2080-MLCO
20	Type III	So-Sure 0964-000
20	Type III	LPS-814A
20	Type III	22028C2-3
20	Type III	Ardrox 3205 Aerosol

ITEM NO.	PRODUCT TYPE	MANUFACTURER'S DESIGNATION
20	Type III	CRC 3-36
20	Type III	ACF-50 Aerosol
21	Type II Class 1	Alox 2028C
21	Type II Class 1	Aidchim Alox 2080
21	Type II Class 1	2028 BC-BULK
21	Type II Class 1	Nox Rust 212
21	Type II Class 1	2775
21	Type II Class 1	So-Sure 813
21	Type II Class 1	LPS-813 Bulk
21	Type II Class 1	Octoil 5068
21	Type II Class 1	Omni 4150A
21	Type II Class 1	97-SX092
21	Type II Class 1	22018CM-Bulk
21	Type II Class 1	Ardrox 3204
21	Type II Class 1	BATCO Rust Preventive
21	Type II Class 1	706 P.D.R.P. Bulk
21	Type II Class 1	D-5026 Bulk
21	Type II Class 1	Ardrox 3204 Aerosol
21	Type II Class 2	2028-BCCO Bulk
21	Type II Class 2	So-Sure 0954-000
21	Type II Class 2	LPS-813A
21	Type II Class 2	706 P.D.R.P
21	Type II Class 2	22028C2

CORROSION PREVENTIVE COMPOUND, MIL-PRF-16173

23	Grade 4	TECTYL 846
23	Grade 4	846-BC
23	Grade 4	Braycote 194
23	Grade 4	CONVOY 734
23	Grade 4	Nox-Rust X-110
23	Grade 4	F & L 5846
23	Grade 4	Steelgard MS-31
23	Grade 4	Poly Oleum 5000
23	Grade 4	ST 1846
23	Grade 4	No-Rust X-10

SEALANTS MIL-PRF-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
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
34	Type II-1/2	P/S 870 B-1/2
34	Type II-1/2	PR 1440G B-1/2

ITEM NO.	PRODUCT TYPE	MANUFACTURER'S DESIGNATION
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 SAE-AMS-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
36	Class A-2	
36	Class B-1/2	
36	Class B-1	
36	Class B-2	
36	Class B-2	BR 4005
36	Class B-1/2	FR 1072
36	Class B-2	
36	Class A-1/2	CS-3204
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
36	Class B-2	
36	Class B-4	
36	Class B-1/2	MC-236
36	Class B-1	
36	Class B-2	
36	Class B-2	PR-1440
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
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

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 percent 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 advisory circular (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 (nm) to the border of the x-ray region at about 380 nm, 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.

COMPREHENSIVE INDEX

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Advisory Circular Feedback Form

If you find an error in this AC, have recommendations for improving it, or have suggestions for new items/subjects to be added, you may let us know by contacting the Flight Standards Directives Management Officer at 9-AWA-AFB-120-Directives@faa.gov.

Subject: AC 43-206, Inspection, Prevention, Control, and Repair of Corrosion on Avionics Equipment

Date: ____________________

Please check all appropriate line items:

☐ An error (procedural or typographical) has been noted in paragraph ____________ on page _______.

☐ Recommend paragraph _____________ on page __________ be changed as follows:

____

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☐ In a future change to this AC, please cover the following subject:
(Briefly describe what you want added.)

____

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☐ Other comments:

____

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☐ I would like to discuss the above. Please contact me.

Submitted by: ______________________________ Date: _____________________