TECHNICAL MANUAL

ORGANIZATIONAL/UNIT AND INTERMEDIATE MAINTENANCE

AVIONICS CLEANING AND CORROSION PREVENTION/CONTROL

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SAFETY SUMMARY

The following general safety procedures are not related to any specific procedures and, therefore, do not appear anywhere else in this publication. These are precautions that personnel must understand and apply during all phases of operation and maintenance.

KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must observe safety regulations at all times. Do not replace components or make adjustments inside the equipment when potentially lethal voltages are present. Turn off system power before making/breaking electrical connections. Regard any exposed connector, terminal board, or circuit board as a possible shock hazard. Components which retain a charge shall be discharged only when such grounding does not result in equipment damage. If a test connection to energized equipment is required, make the test equipment ground connection before probing the voltage or signal to be tested. To avoid casualties, always remove power, discharge, and ground a circuit before touching it.

DO NOT SERVICE OR ADJUST ALONE

Under no circumstances shall any person reach into or enter an enclosure for the purpose of servicing or adjusting the equipment, except in the presence of someone who is capable of rendering aid.

CARDIOPULMONARY RESUSCITATION AND FIRST AID

Personnel working with or near high voltages should be currently certified in Cardiopulmonary Resuscitation (CPR). Additional information may be obtained from the appropriate medical commands.

NOISE HAZARDOUS AREAS

Personnel when working in noise hazardous areas shall wear specified hearing protection and perform other locally specified procedures to minimize exposure.

EJECTION SEAT MECHANISMS

Safety precautions shall be strictly observed when working around aircraft equipped with an ejection seat. These safety precautions cannot be overemphasized. Each ejection seat has several ground safety pins. These safety pins are provided on red-flagged lanyards for use at every point of potential danger. They shall be installed whenever the aircraft is on the ground or deck and must never be removed until the aircraft is ready for flight. The following general precautions should always be kept in mind:

a. Ejection seats shall be treated with the same respect as a loaded gun.

b. Always consider an ejection seat system as loaded and armed.

c. Before entering a cockpit, know where the ejection seat safety pins are and be certain of their installation.

d. Only authorized personnel may work on or remove and install ejection seats and components and only in an authorized area.

FLIGHT LINE SAFETY PRECAUTIONS

Personnel working in or around aircraft on the flight line shall observe flight line safety precautions and regulations.

USE SAFETY SHIELDS

Observe applicable safety regulations and use safety shields on power tools where provided. Adequate shielding to protect eyes and face shall be used at all times when operating power tools or performing pressure tests.

USE OF POTENTIALLY HAZARDOUS MATERIALS

Many of the consumable materials listed in Appendix A are potentially hazardous. Hazardous items are defined by 29CFR1910.1200, The Hazard Communication Rule of the Occupational Safety and Health Administration (OSHA).

Each facility using hazardous items will have a written hazard communications program. Users of these materials will have adequate documented training in the use, operation, and disposal of these materials, including personal protective equipment and emergency procedures, prior to the use of any materials. Specific information is contained in material safety data sheets (MSDS) , which are available at each worksite for each hazardous item. Individual warnings listed in this publication and availability of MSDS are not substitutes for training and written hazard communication program.

WARNINGS AND CAUTIONS USED IN THIS MANUAL

Warnings and cautions are inserted throughout the text of this manual to notify personnel of potential hazards. Warnings are used to alert personnel to potential safety and health hazards. Cautions are used to alert personnel to conditions that could result in damage to equipment or property.

CHEMICAL SAFETY

Aircraft maintenance chemicals (such as abrasive materials, cleaners, corrosion preventives, paint strippers, surface treatments, sealants, paints, solvents, etc.) may be hazardous to skin, eyes, and respiratory and digestive tracts when misused, when used without proper precautions or safety devices, or when used without personal protective equipment.

Learn the warnings and cautions for using specific maintenance chemicals and procedures. Observe manufacturer's warning labels and the warnings and cautions in this manual and other applicable maintenance instruction manuals.

Obtain and use personal protective equipment (such as goggles, respirators, gloves, boots, aprons, etc.) as recommended by the local safety office, industrial hygienist, bioenvironmental engineer, material safety data sheet (MSDS), DOD 6050.5LR or this manual.

Ensure that sufficient ventilation exists. Cartridge respirators only filter out the airborne contamination for which they were designed; a respiratory hazard exists if oxygen is depleted or displaced.

When flammable materials are used, ensure that all sources of ignition have been removed from the area and that only explosion proof or pneumatically powered equipment is used. Ensure that fire fighting equipment is readily available and in working order.

Do not mix maintenance chemicals with each other, unless written instructions specifically direct a mixing procedure. Many combinations of chemicals are incompatible and may produce toxic fumes and/or violent reactions. Liquid oxygen is not compatible with most organic materials; explosions have occurred on contact with greases and oils.

Use only the materials recommended by this manual and other applicable maintenance instruction manuals. Use only the maintenance chemicals and procedures recommended for specific aircraft components. Some chemicals are incompatible with certain aircraft materials. For example, acidic surface treatments can cause embrittlement of high strength steel and chemical paint removers will dissolve canopy materials.

MECHANICAL SAFETY

Without the proper safety devices and tools, aircraft maintenance procedures may present severe mechanical hazards (such as loss of control of tools, falling, cuts from sharp surfaces, impact of debris from high speed tools, etc.).

Learn the warnings and cautions required for specific maintenance procedures. Observe manufacturer's warning labels and the warnings and cautions in this manual and other applicable maintenance instruction manuals.

Obtain and use personal protective equipment (such as goggles, respirators, gloves, boots, aprons, etc.) as recommended by the local safety office, industrial hygienist, bioenvironmental engineer, material safety data sheet (MSDS), DOD 6050.5-LR or this manual.

Obtain and use the necessary safety devices (such as safety harnesses, safety lines, etc.) and tools fitted with safety devices (such as chip guards, belt guards, etc.).

Use only those procedures recommended by this manual and other applicable maintenance instruction manuals. Unauthorized procedures can result in personal injury, damage to equipment and property, and loss of aircraft flight worthiness.

Unless specifically allowed by shop safety procedures, remove rings, watches, and other metallic objects that may get caught in moving parts.

Use compressed air carefully. Objects propelled with compressed air can produce severe personal injury.

ELECTRICAL SAFETY

Without the proper safety devices and tools, aircraft maintenance procedures may present severe electrical hazards (such as burns or electrocution).

Open all circuit breakers associated with battery power (refer to applicable maintenance manuals) prior to using flammable materials on aircraft. Before cleaning electrical and avionic equipment ensure that electrical power is disconnected. Electrically ground aircraft during all cleaning and painting operations.

Do not inspect or perform maintenance on aircraft when an electrical storm is in the immediate area.

If electrical/electronic equipment has been contaminated with conductive liquids (water, saltwater, cleaners, etc.) or conductive dusts or fibers (metallic particles, graphite fibers, etc.), decontaminate the equipment prior to powering up.

Use only those procedures recommended by this manual and other applicable maintenance instruction manuals. Unauthorized procedures can result in personal injury, damage to equipment and property, and loss of aircraft flight worthiness.

WARNINGS APPLICABLE TO HAZARDOUS MATERIALS

1. Warnings for hazardous materials listed in this manual are designed to warn personnel of hazards associated with such items when they come in contact with them by actual use. Additional information related to hazardous materials is provided in OPNAVINST 5100.23, Navy Occupational Safety and Health (NAVOSH) Program Manual, OPNAVINST 4110.2, Hazardous Material Control and Management, and the DOD 6050.5, Hazardous Material Information System (HMIS) series publications. For each hazardous material used a Material Safety Data Sheet (MSDS) is required to be provided and available for review by users. Consult your local safety and health staff concerning any question on hazardous chemicals, MSDS, personal protective equipment requirements, and appropriate handling and emergency procedures and disposal guidance.

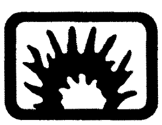
2. Complete warnings for hazardous materials referenced in this manual are identified by use of an icon, nomenclature and specification or part number of the material and a numeric identifier. The numeric identifiers have been assigned to the hazardous materials in the order of their appearance in the manual. Each hazardous material is assigned only one numeric identifier. Repeated use of a specific hazardous material references the numeric identifier assigned at its initial appearance. Numeric identifiers for hazardous materials added as a result of a change will be added to the end of the list provided in the Hazardous Materials Warning Sheets (HMWS) and shall not be renumbered to coincide with the order of their appearance in the manual. The approved icons and their applications are shown in Figure 1.

3. In the text of the manual, the WARNING caption will not be used for hazardous materials. Such warnings will be identified by an icon and numeric identifier. The material nomenclature will also be provided. The user is directed to refer to the following corresponding numeric identifiers for complete warnings applicable to the hazardous materials.

EXPLANATION OF HAZARD SYMBOLS

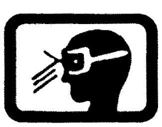
CHEMICAL

The symbol of drops of a liquid onto a hand shows that the material will cause burns or irritation of human skin or tissue.



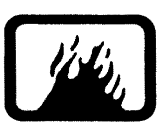
EXPLOSION

The rapidly expanding symbol shows that the material may explode if subjected to high temperatures, sources of ignition, or high pressure.



EYE PROTECTION

The symbol of a person wearing goggles shows that the material will injure your eyes.



FIRE

The symbol of a flame shows that a material can ignite and burn you

POISON

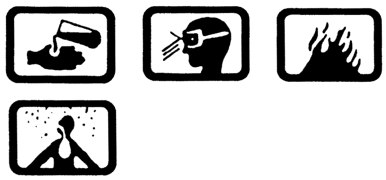
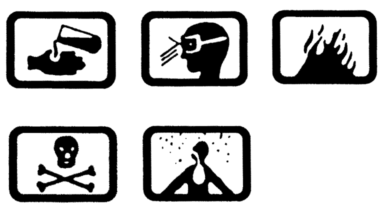
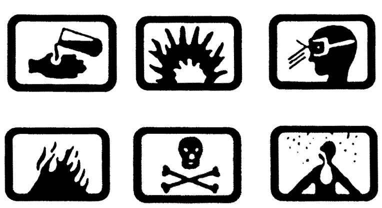
The symbol of a skull and crossbones shows that a material is poisonous or is a danger to life.

VAPOR

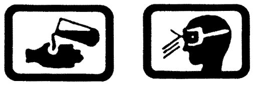
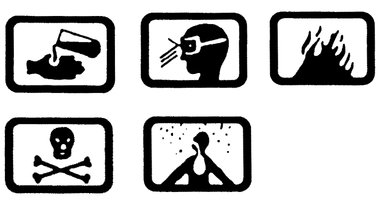
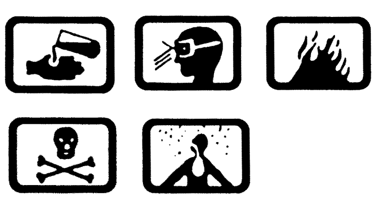
The symbol of a human figure in a cloud shows that vapors of a material present a danger to your life or health.

Figure 1. Icons for Hazardous Materials and Examples of Application

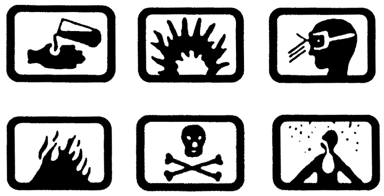
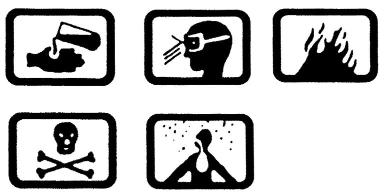
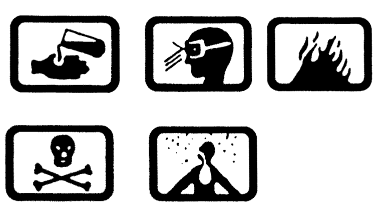
HAZARDOUS MATERIAL WARNINGS

INDEX	MATERIAL	WARNING
1.	**ADHESIVE/SEALANT, SILICONE RTV, NON-CORROSIVE, MIL-A-46146, GROUP 1, TYPE I/II OR GROUP II, TYPE 1** 	Non-corrosive, silicone RTV adhesive/sealant MIL-A-46146, Group I, Type I/II or Group II, Type I, is flammable and a skin and eye irritant. Avoid contact with skin and eyes. Use in well ventilated area and avoid prolonged breathing of vapors. Avoid contact with oxidizing materials. Store below 90°F. Wash hands before eating and at end of work shift. Protection: rubber gloves, chemical goggles, and protective skin compound; half-mask respirator with organic vapor cartridge required in poorly ventilated areas.
2.	**SEALING AND COATING COMPOUND, CORROSION INHIBITIVE, MIL-PRF-81733, CLASS OPTIONAL** 	Sealing and coating compound corrosion inhibitive, MIL-PRF-81733 is toxic and flammable. Avoid prolonged breathing of vapors and prolonged or repeated skin contact. Keep away from heat, sparks, and open flame. Use with adequate ventilation to prevent vapor buildup. Protection: rubber gloves, chemical goggles and protective skin compound.
3.	**COMPOUND, CORROSION PREVENTIVE, WATER-DISPLACING, MIL-C-81309, CLASS 2** 	Water displacing, corrosion preventive compound, MIL-C-81309, Type III, Class 2, is toxic and flammable. Avoid contact with skin and eyes. Avoid breathing vapors. Keep away from heat, sparks and flame. Vapor accumulations may explode if ignited. Protection: rubber gloves and chemical goggles, faceshield and laboratory apron required when working with large quantities; half-mask respirator with acid/organic vapor cartridge and mist pre-filter required during spraying operations or in poorly ventilated areas.
4.	**COMPOUND, AIRCRAFT CLEANING, MIL-PRF-85570, TYPE II** 	Aircraft cleaning compound, MIL-PRF-85570, Type II, is a skin and eye irritant. Avoid contact with skin and eyes. Wash hands and face after using. Avoid breathing vapors. Launder contaminated clothing before re-use. Store in cool, dry, well-ventilated and low fire risk area. Protect from heat, shock and friction. Keep containers closed when not in use. Avoid contact with strong acids or oxidizing agents. Protection: rubber gloves, chemical goggles, face-shield and protective clothing; half-mask respirator with organic vapor cartridge required in poorly.

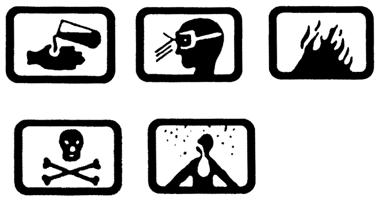
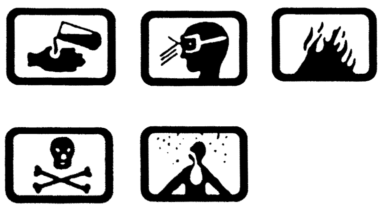
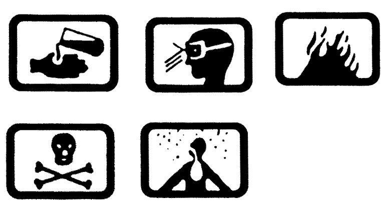
HAZARDOUS MATERIAL WARNINGS (CONTINUED)

INDEX	MATERIAL	WARNING
5.	**DETERGENT, NON-IONIC, MIL-D-16791, TYPE I** 	Non-ionic detergent, MIL-D-16791, Type I, is a skin and eye irritant. Avoid contact with skin and eyes. Store away from heat sources. Avoid contact with strong oxidizing or reducing agents. Material is corrosive to copper and brass on long storage. Protection: rubber gloves and chemical goggles.
6.	**ALCOHOL, ISOPROPYL, TT-I-735** 	Isopropyl alcohol, TT-I-735, is toxic and flammable. Avoid contact with skin and eyes. Use in a well ventilated area and avoid breathing vapors. May be fatal if swallowed. Keep away from heat, sparks and flame. Store in clean, cool, well-ventilated area away from ignition sources and oxidizing agents. Keep containers tightly closed when not in use. Protection: neoprene gloves and chemical goggles; faceshield and protective clothing required when splashing is possible or expected; half-mask respirator with organic vapor cartridge required in poorly ventilated areas.
7.	**DEGREASING SOLVENT, MIL-PRF-680, TYPE III** 	Degreasing solvent, MIL-PRF-680, Type III, is toxic and flammable. Avoid contact with skin and eyes. Avoid breathing vapors. Use with adequate ventilation. Keep away from heat, sparks and flame. Avoid contact with strong oxidizing agents. Protection: neoprene gloves and chemical goggles; faceshield and protective clothing required when splashing is possible or expected; half-mask respirator with organic vapor cartridge required in poorly ventilated areas.
8.	**COMPOUND, CORROSION PREVENTIVE, MIL-PRF-16173, GRADE OPTIONAL** 	Corrosion preventive compound, MIL-PRF-16173, Grade Optional, is toxic and flammable. Avoid contact with skin and eyes. Avoid breathing vapors. Store in sealed containers away form heat, sparks and flame. Avoid contact with oxidizing agents. Protection: rubber gloves, chemical goggles and laboratory apron; faceshield required when pouring large quantities; half-mask respirator with acid/organic vapor cartridge and mist pre-filter required during spray operations or in poorly ventilated areas.

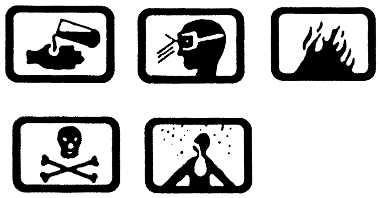
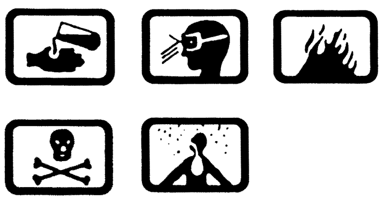
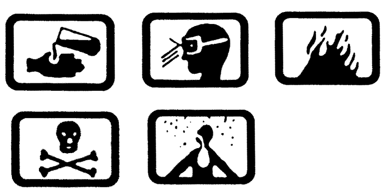
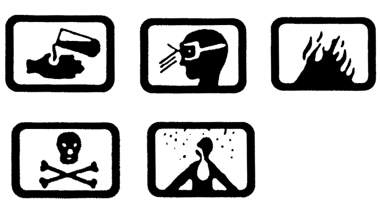
HAZARDOUS MATERIAL WARNINGS (CONTINUED)

INDEX	MATERIAL	WARNING
9.	**SILVER NITRATE, A-A-59282** 	Silver nitrate, A-A-59282, is toxic and flammable. Avoid contact with skin and eyes. Wash hands thoroughly before eating, drinking or smoking. Store away from light, combustibles, organic/other readily oxidizable materials. Protection: rubber gloves, dust-resistant safety goggles, appropriate protective clothing and a respirator for conditions where exposure to dust or fumes is apparent.
10.	**COATING, CHEMICAL CONVERSION, MIL-C-81706, CLASS 1A, FORM III; CLASS 1A, FORM V; OR CLASS 3 FORM III** 	Chemical conversion coating MIL-C-81706 Class 1A, Form III, Class 1A, Form V, or Class 3, Form III is toxic and flammable. Avoid contact with skin and eyes. Avoid breathing vapors; upper respirator tract irritation or damage may occur. May be harmful or fatal if swallowed. Contains chromic acid, a systemic poison and may aggravate pre-existing conditions. Wash hands and face with soap and water after use and before smoking or eating. Immediately remove contaminated clothing and launder before re-use. Avoid humidity, strong acids, alkalies, reducing compounds, flammable or combustible materials. Store in a dry area in tightly closed containers. Store away from oils, greases, and corrosives. When mixing: add slowly to water while mixing. Protection: rubber gloves, chemical goggles, face-shield, and laboratory apron; dust mask required when mixing MIL-C-81706, Class 1A, Form V; half-mask respirator with acid/organic vapor cartridge and mist pre-filter is required during spray operations in poorly ventilated areas.
11.	**MAGNESIUM ALLOY, PROCESSES FOR PRETREATMENT AND PREVENTION OF CORROSION ON, SAE-AMS-M-3171** 	Chemical conversion material, SAE-AMS-M-3171, is toxic and flammable. Avoid contact with skin and eyes. Avoid breathing fumes. Store in dry, cool but above freezing temperature area away from acids and organic compounds. Recommended local exhaust. Protection: chemical resistant gloves/ rubber, chemical safety goggles with side shield, chemically resistant coveralls, hat and shoes; half-mask respirator with organic vapor cartridges and mist pre-filter required in poorly ventilated areas.

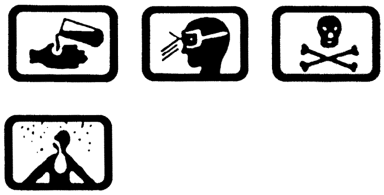
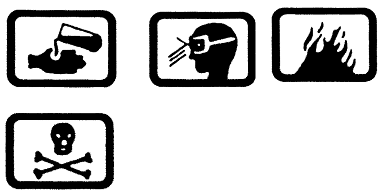
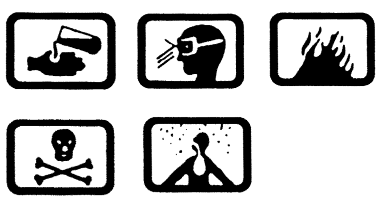
HAZARDOUS MATERIAL WARNINGS (CONTINUED)

INDEX	MATERIAL	WARNING
12.	**COATING ALIPHATIC, POLYURETHANE, CHEMICAL AGENT RESISTANT, MIL-C-46168** 	Aliphatic polyurethane coating, chemical agent resistant, MIL-C-46168, is toxic and flammable. Avoid contact with skin and eyes. Avoid breathing vapors. Avoid storing near high temperature or ignition sources. Store in well-ventilated area. Protection: splash/side guards, goggles, faceshield. Protective clothing (use of long sleeve and long leg clothing) and respirator protection for air purifying or fresh air supplied respirator for organic vapor environment.
13.	**PRIMER COATINGS, EPOXY WATERBORNE, MIL-PRF-85582, TYPE I/II, CLASS OPT** 	Waterborne epoxy primer coatings, MIL-PRF-85582, Type I/II, Class optional, is toxic and flammable. Avoid pro-longed or repeated breathing of vapors. Wash hands before eating, smoking or using washroom Wash contaminated clothing before re-use. Keep away from heat, sparks and flame. Store only in ventilated areas. Protection: full face-piece continuous-flow supplied air respirator, neoprene gloves, chemical goggles, faceshield and protective skin compound; protective clothing required during spraying operations.
14.	**COATING, EPOXY, HIGH SOLIDS, MIL-PRF-22750** 	VOC - compliant epoxy coating, MIL-PRF-22750, is toxic and flammable. Avoid prolonged or repeated skin contact. Avoid contact with eyes; produces severe eye irritation. Use with adequate ventilation. Keep away from heat, sparks and flame. Avoid contact with strong oxidizing agents. Vapors may form explosive mixtures with air. Protection: neoprene gloves, chemical goggles, faceshield and protective skin compound; protective clothing and half-mask respirator with organic vapor cartridge and paint mist pre-filter are required during spray operations; full face-piece continuous-flow supplied air respirator required in poorly ventilated areas.

HAZARDOUS MATERIAL WARNINGS (CONTINUED)

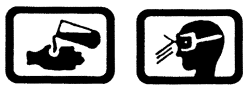
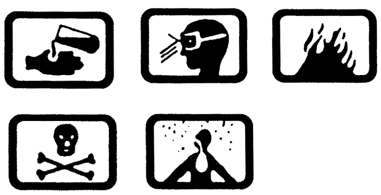
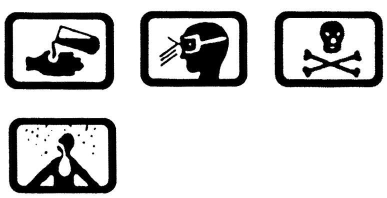
INDEX	MATERIAL	WARNING
15.	**PRIMER COATINGS, EPOXY, CHEMICAL AND SOLVENT RESISTANT, MIL-PRF-23377, TYPE I/II, CLASS OPT** 	Chemical and solvent resistant epoxy primer coatings, MIL-PRF-23377, Type I/II, Class optional, is toxic and flammable. Prevent prolonged or repeated breath-ing of vapors or spray mist. May cause allergic reaction. Avoid contact with skin and eyes. Store tightly closed in a cool, dry, well-ventilated area. Launder contaminated clothing before reuse. Protection: full face-piece continuous-flow suppliedair respirator, neoprene gloves, chemical goggles, faceshield and protective skin compound; protective clothing required during spraying operations.
16.	**COATING, AIRCRAFT TOUCHUP (WHITE 17875) MIL-PRF-81352** 	Coating, Aircraft touchup, MIL-PRF-81352, is toxic and flammable. Avoid contact with skin and eyes. Avoid breathing vapors. Avoid oxidizing agents, heat sparks, open flames and contact with hot liquids. Store in cool, dry, vented area. Protection: heavy duty neoprene gloves, safety glasses side/shield goggles, resistant protective garment. Ventilate area to keep exposure below current exposure limits.
17.	**COATING, AIRCRAFT TOUCHUP, (BLACK 37038), MIL-PRF-81352** 	Coating, Aircraft touchup, MIL-PRF-81352, is toxic and flammable. Avoid contact with skin and eyes. Avoid breathingvapors. Avoid oxidizing agents, heat, sparks, open flames and contact with hot liquids. Store in cool, dry, vented area. Protection: heavy duty neoprene gloves, safety glasses, side/shield goggles, resistant protective garment. Ventilate area to keep exposure below current exposure limits.
18.	**THINNER, AIRCRAFT COATING, MIL-T-81772, TYPE I, II or III** 	Aircraft coating thinner, MIL-T-81772, is toxic and flammable. Avoid prolonged breathing of vapors. Use adequate ventilation. Avoid contact with skin. Store in cool, dry, well-ventilated area. Keep away from heat, sparks and flame. Do not apply to hot surfaces. Avoid contact with oxidizing agents, corrosives, and peroxides. Protection: neoprene gloves and chemical goggles.

HAZARDOUS MATERIAL WARNINGS (CONTINUED)

INDEX	MATERIAL	WARNING
19.	**SEALING COMPOUND, MIL-PRF-8516, TYPE II** 	Sealing compound, MIL-PRF-8516, Type II, is toxic. Avoid contact with skin and eyes. Avoid breathing vapors. Wash hands thoroughly after each use; do not smoke, eat, or drink in work area. Keep away from heat and flames. Protection: rubber gloves, chemical goggles and protective skin compound.
20.	**OIL, LUBRICATING, GENERAL PURPOSE, VV-L-800** 	General purpose lubricating oil, VV-L-800, is toxic and flammable. Avoid contact with skin or eyes. Keep away from heat, sparks and flame. Do not re-use containers. Protection: rubber gloves and chemical goggles.
21.	**CLEANING COMPOUND, LUBRICATING, MIL-PRF-29608** 	Cleaning-Lubricating compound, MIL-PRF-29608, is toxic to skin, eyes and respiratory tract and is flammable. Use in a well-ventilated area and avoid breathing vapors. Store in cool, dry place away from heat/sparks/flames. Keep container closed when NOT in use. Wear positive pressure air-supplied respirator in situations where there may be potential for air-borne exposure. Protection: rubber gloves, safety glasses/goggles with side shield, full faceshield.
22.	**AMMONIUM HYDROXIDE, A-A-59370** 	Ammonium Hydroxide, A-A-59370, is highly toxic to eyes, skin, and respiratory tract. Avoid contact with strong oxidants. Use in well-ventilated area. Keep away from heat, sparks and flames. Protection: rubber gloves, chemical splash goggles, lab coat and boots. Respiratory protection: chemical cartridge respiratory with ammonium cartridge or use a self-contained breathing apparatus for high-concentrated areas.

HAZARDOUS MATERIAL WARNINGS

HAZARDOUS MATERIAL WARNINGS (CONTINUED)

INDEX	MATERIAL	WARNING
23.	**DAMPING FLUID, VV-D-1078 GRADE 100/100K CS** 	Damping fluid, VV-D-1078, Grade 100/100K cs, is an eye irritant. Avoid contact with skin and eyes. Wash hands thoroughly after each use. Protection: rubber gloves and chemical goggles.
24.	**REMOVER, PAINT, MIL-R-81294 TYPE I/II** 	Paint remover, MIL-R-81294, Type I/II, is corrosive. Avoid contact with skin and eyes. Avoid breathing vapors. Keep away from heat, flames and strong oxidizing agents and alkalies. Protection: neoprene gloves, chemical goggles, faceshield, and laboratory apron; full face-piece continuous-flow supplied air respirator required in poorly ventilated areas.
25.	**SODIUM HYDROXIDE** 	Sodium Hydroxide is toxic. Avoid contact with skin and eyes. Use in a well-ventilated area and avoid breathing vapor. Protection: neoprene gloves and chemical goggles; faceshield and protective clothing required when splashing is possible.

CHAPTER 1
INTRODUCTION

1-1. GENERAL.

a. Today's military avionic systems assume a significant share of the responsibility for mission completion, performance capability, and overall system safety. The role of avionics includes mission essential equipment, flight critical equipment, and aircraft hardware. For example, navigation, communications, electronic warfare, weapon management, flight/engine controls and displays, and wiring are all considered avionics. Electronics and electrical power systems are also considered avionics. The reliability of these complex systems in any environment is critical for aircraft flight and mission essential functions.

NOTE

In this manual, use of the term "avionic systems" shall refer to any device that uses electrical power. The term "avionic technician" shall include the aviation electrician, aviation electronic technician, or any personnel authorized to perform maintenance on avionic systems.

b. Corrosion is a major cause of avionic equipment failures, particularly while installed in military aircraft. In many cases, even minute amounts of corrosion can cause intermittent malfunction or complete failure of the equipment. Past experience shows that in order to obtain certain electrical characteristics, for example, low electromagnetic interference (EMI), a compromise in the design selection of materials might be needed (for example, the use of conductive adhesive). Sometimes such compromises can lead to corrosion problems that are aggravated by exposure to varying environmental conditions (for example, EMI corrosion). Avionic equipment is routinely exposed to varying environmental conditions. These conditions include changing temperatures and pressures, varying humidity, dust, dirt, and industrial pollutants in the atmosphere that often initiate corrosion.

c. The types of corrosion that occur on avionic equipment are similar to those found on airframe structures. The difference between avionic and airframe corrosion is that small amounts of corrosion in avionic equipment can cause intermittent malfunction or complete failure, while it may not impact airframe structures.

1-2. PURPOSE.

a. This manual provides Organizational/Unit and Intermediate maintenance instructions necessary to prevent, control, and repair corrosion of avionic equipment afloat or ashore.

b. Supervisory and maintenance personnel shall use this manual for all avionic corrosion control and maintenance efforts. Contractors who are required to maintain and repair corrosion of avionic systems shall also use this manual.

1-3. USAGE AND CONFLICTS.

a. This manual shall be used to provide corrosion control of avionic systems at the Organizational/Unit and Intermediate maintenance levels using authorized materials, techniques, and equipment.

b. Use this manual in conjunction with and in support of the appropriate Army Technical Manuals (TMs), Technical Bulletins (TBs), Department of the Army Pamphlets (DA PAMs), Navy Maintenance Instruction Manuals (MIMs), Navy Structural Repair Manuals (SRMs), Maintenance Requirement Cards (MRCs), or Air Force Technical Orders (TOs).

c. In the case of a conflict between this manual and other Navy manuals, this manual shall take precedence.

d. The Army and Air Force specific systems/ components manuals shall take precedence over this manual.

1-4. SCOPE AND ARRANGEMENT OF MANUAL.

1-4.1. General. The material in this manual contains basic avionic corrosion prevention and corrective maintenance information to be used at the Organizational/Unit and Intermediate levels.

1-4.2. Description. The manual is divided into ten chapters, four appendices, a glossary, and an alphabetical index. The scope of each chapter is described in the following paragraphs.

a. Chapter 1, Introduction.

b. Chapter 2, Avionic Corrosion Principles and Descriptions. This chapter explains what avionic 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 environment and fungus growth that apply to avionic equipment.

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

d. Chapter 4, Cleaning and Preservation. This chapter describes the materials, equipment and techniques to assist the avionic technician in the mechanical cleaning and preservation of avionic equipment at the Organizational/Unit and Intermediate maintenance.

e. Chapter 5, Corrosion Removal, Surface Treatment, Painting and Sealing. This chapter outlines the established methods for the removal of corrosion damage, application of sealants, and the particular application of treatments and coatings that can be applied to various external and internal avionic equipment. This chapter describes the particular application of treatments and coatings that can be applied to various external and internal avionic equipment.

f. Chapter 6, Treatment of Specific Avionic Equipment. This chapter describes the materials and techniques for removing corrosion from various types of avionic equipment.

g. Chapter 7, Corrosion Control Measures for Electrical Bonding/Grounding. This chapter describes the best hardware and techniques to be used when repairing or replacing existing bonding or grounding connections.

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

i. Chapter 9, Effect and Treatment of Corrosion on Electrostatic Discharge Sensitivity. This chapter describes the basic theory surrounding electrostatic discharge (ESD) and outlines some methods currently available to keep ESD from occurring.

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

k. Appendix A, Consumable Supplies and Materials. This appendix lists the accepted consumable supplies and materials available for avionic corrosion control.

l. Appendix B, Tools and Support Equipment. This appendix lists the accepted corrosion removal and cleaning tools available for avionic corrosion control.

m. Appendix C, Special Support Equipment. This appendix lists the special cleaning and corrosion removal tools for use in the avionic corrosion control work center.

n. Appendix D, Track Eight Cleaning Procedures. This appendix discusses the track eight cleaning equipment, chemicals, and procedures.

o. Glossary. The glossary provides and defines the terms commonly used by avionic and corrosion control personnel.

p. Alphabetical Index. The index locates specific subjects in the manual.

1-5. RELATED PUBLICATIONS.

1-5.1. Navy Publications.

Number	Title
NA 00-80R-14	NATOPS U.S. Navy Aircraft Firefighting and Rescue Manual
NA 01-1A-1	Structural Repair, General Manual and Engineering Handbook for Aircraft Repair

Number	Title
NA 01-1A-8	Aircraft Missile and Related Aerospace Ground Equipment Repair Structural Hardware
NA 01-1A-16	Nondestructive Inspection Methods Technical Manual
NA 01-1A-17	Aviation Hydraulics Manual, Organizational/Intermediate/ Depot Levels
NA 01-1A-22	Radomes and Antenna Covers, Aircraft, Organizational, Intermediate and Depot Maintenance
NA 01-1A-23	Standard Maintenance Practices for Electronic Assembly Repair
NA 01-1A-35	Aircraft Fuel Cells and Internal/ External Tanks, Organizational, Intermediate, and Depot Maintenance Instructions
NA 01-1A-505	Installation Practices for Aircraft Electric and Electronic Wiring
NA 01-1A-507	Cements, Sealants, and Coatings, General Use of, Technical Manual
NA 01-1A-509	Aircraft Weapon Systems Cleaning and Corrosion Control
NA 01-1A-520	Anti-icing, De-icing and Defrosting of Parked Aircraft
NA 13-1-6-X	Rescue and Survival Equipment, Aviation Crew System, Manual for
NA 15-01-4	Desert Storage Preservation and Process Manual for Aircraft
NA 15-01-500	Preservation of Naval Aircraft
NA 15-02-1	Engines, Aircraft and Aircraft Auxiliary Power Unit Engines, Desert Storage Preservation and Processing
NA 15-02-500	Preservation of Aircraft Engines, Organizational, Intermediate, and Depot Levels
NA 17-1-125	Ground Support Equipment Cleaning and Corrosion Control, Maintenance Instructions, Organizational and Intermediate Levels
NA 17-15BA-17	Vaccum, Portable 400-A #Hewlett-Packard#, Operation and Service Instructions
NA 17-5BM-1	Dry Honing Machine (Vacu-Blast), Portable, Operation, Ser-vice and Overall Instructions
NA 17-5BM-3	Dry Honing Machine (Zero), Operation, Service and Overhaul Instruction
NA 17-600-22-6-1	Dry Honing Machine (Zero/ Vacu-Blast), Portable Preoperational Checklist
NA 17-600-22-6-2	Dry Honing Machine (Zero/ Vacu-Blast), Portable Periodic Maintenance Requirements
NA 19-20D-1	Corrosion Control, Operational Service Instructions

Number	Title
NA 19-20D-2	Spray Unit, Corrosion Control, Trailer Mounted, Operation and Intermediate Maintenance
NA 19-25E-508	Aircraft Deicer, Truck Mounted, Organizational, Intermediate, and Depot Level Maintenance Instructions
NA A1-NAOSH-SAF-000/P-5100-1	NAVAIROSH Requirements for the Shore Establishment
A/M32M-28,000	Aircraft Cleaning Machine, Organizational and Maintenance Levels
NAVFAC P-80	Navy & Marine Corps Shore Installations, Facility Planning Factor Criteria
NAVFAC P-272	Naval Shore Facilities, Definitive Design for
NSUP 4105	LIRSH - List of Items Requiring Special Handling
OPNAVINST 4790.2	Naval Aviation Maintenance Program (NAMP)
OPNAVINST 5100.23	Navy Occupational Safety and Health (NAVOSH) Program

1-5.2. Air Force Publications

Number	Title
AFM 91-11	Solid Waste Management
AFOSH 91-66	General Industrial Operations
AFOSH 48-137	Respiratory Protection Program
AFP 85-14	Commanders Facility Improvement Guide
AFR 19-1	Pollution Abatement and Environmental Quality
AFR 91-9	Water Pollution Control Facilities
AFI 21-105	Air Force Corrosion Program
TO 00-5-1	AF Technical Order System
TO 00-20-1	Aerospace Equipment Maintenance, General Policies and Procedures
TO 00-20-2	The Maintenance Data Documentation
AFMAN 31-110	Inspection and Control of USAF Shelf-life Equipment
TO 00-25-107	Maintenance Assistance
TO 00-25-115	AFLC Maintenance Engineering Management Assignment
TO 00-25-172	Ground Servicing of Aircraft and Static Grounding/Bonding
TO 00-25-203	Contamination Control of Aerospace Facilities, US Air Force
TO 00-25-234	General Shop Practice Requirements for the Repair, Maintenance, and Test of Electrical Equipment
TO 00-35D-54	USAF Material Deficiency Reporting and Investigating Services

Number	Title
TO 00-85-3	Protective Packaging and Preservation Packing - General
TO 00-110A-1	Guidelines for Identification and Handling of Aircraft and Material Contaminated and Radioactive Debris (Fallout)
TO 00-110A-3	Decontamination of Radio-actively Contaminated Aircraft External Surfaces
TO 00-110A-5	Decontamination of Radio-active Aircraft Engines and their Parts
TO 00-110A-10	Decontamination of Radio-actively Contaminated Aircraft Accessories
TO 00-110N-2	Radioactive Waste Disposal
TO 1-1-3	Preparation, Inspection, and Repair of Aircraft Fuel, Oil, and Water-Alcohol Cells and Integral Tanks
TO 1-1-4	Exterior Finishes, Insignia, and Markings Applicable to Aircraft and Missiles
TO 1-1-8	Application and Removal of Organic Coatings Aerospace and Non-Aerospace Equipment
TO 1-1-17	Storage of Aircraft and Missile Systems
TO 1-1-24	Maintenance Repair and Electrical Requirements for Fiberglass Airborne Radomes
TO 1-1-686	Desert Storage Preservation and Process Manual of Aircraft
TO 1-1-691	Aircraft Weapon Systems Cleaning and Corrosion Control
TO 1-1A-1	Engineering H/B Series for Aircraft Repair - General Manual for Structural Repair
TO 1-1A-8	Engineering Manual Series for Aircraft and Missiles Repair Structural Hardware
TO 1-1A-9	Engineering Series for Aircraft Repair Aerospace Metal General Data and Usage Factors
TO 1- 1A-14	Installation Practices for Aircraft Electric and Electronic Wiring
TO 5-1-17	Corrosion Control and Treatment of Aircraft Instruments
TO 10-1-179	Corrosion Control Manual for Photographic Equipment
TO 11-1-40	Corrosion Control Manual for Munitions
TO 31-1-221	Field Instructions for Painting and Preserving Electronics Command Equipment
TO 33B-1-1	Nondestructive Inspection Methods

Number	Title
TO 42A1-1-1	Evaluation and Service Testing of Materials - Cleaning, Painting, Sealing, Protective Treating, Anti-Corrosion, Inspection Materials, and Related Items
TO 42A3-1-2	General Use of Cements, Sealants, and Coatings
TO 42B-1-6	Corrosion Preventive Lubricants and Anti-Seize Compounds
TO 42C-1-2	Anti-Icing, De-Icing, and Defrosting of Parked Aircraft
TO 42C-1-4	Use and Control of Bromochloromethane Fire Extinguisher Liquid
TO 42C-1-11	Cleanliness Standards - Cleaning and Inspection Procedures for Ballistic Missile Systems
TO 42C2-1-7	Process Instructions - Metal Treatment of Electrodeposition of Metals and Metal Surface Treatments to Meet Air Force Requirements
TO 44B-1-122	General Maintenance Instructions for Anti-Friction Bearing

1-5.3. Army Publications.

Number	Title
AR 200-1	Environmental Quality: Environmental Protection and Enhancement
AR 385-11	Ionize Radiation/Protection (Licensing/Control), Transportation, Disposal, and Safety
AR 746-1	Packaging of Army Material for Shipment and Storage
AR 750-59	Army Corrosion Prevention and Control
DA PAM 738-750	The Army Maintenance Management Systems (TAMMS)
DA PAM 738-751	Functional Users Manual for the Army Maintenance Management Systems - Aviation (TAMMS-A)
FM 3-5	Nuclear, Biological, and Chemical Decontamination
TB 43-0118	Field Instructions for Painting and Preserving Communications-Electronics Equipment
TB MED 502/DLAM 1000.2	Occupational and Environmental Health Respiratory Protection Program
TM 1-1500-328-25	Aeronautical Equipment Maintenance Management Policies and Procedures
TM 3-250	Storage, Shipment, Handling, and Disposal of Chemical Agents and Hazardous Chemicals
TM 11-6140-203-14-2	Operators Organizational Direct Supply General Support Maintenance Manual for Aircraft Nickel-Cadmium Batteries

Number	Title
TM 38-750	The Army Maintenance Management System (TAMMS)
TM 43-0158	General Shop Practice Requirements for the Repair, Maintenance, and Test of Electrical Equipment - Cadmium Batteries
TM 55-1500-204-25/1	General Aircraft Maintenance Manual
TM 55-1500-323-24	Installation Practices for Aircraft Electric and Electronic Wiring
TM 55-1500-335-23	Nondestructive Inspection Methods
TM 55-1500-344-23	Aircraft Weapon Systems Cleaning and Corrosion Control
TM 55-1500-345-23	Painting and Marking of Army Aircraft
TM 743-200-1	Storage and Material Handling

1-5.4. Other Publications

Number	Title
DOD 6050.5-LR	Hazardous Material Information System
FED-STD-595	Colors
J-STD-001	Requirements for Soldered Electrical and Electronic Assemblies
MIL-E-17555	Packaging of Electronic and Electrical Equipment Accessories, and Provisioned Items
MIL-HDBK-263	Electrostatic Discharge Control Handbook for Protection of Electrical and Electronic Parts, Assemblies, and Equipment (Excluding Electrically Initiated Explosive Devices)
MIL-HDBK-729	Corrosion and Corrosion Prevention - Metal
MIL-HDBK-773	Electrostatic Discharge Protective Packaging
MIL-STD-129	Marking For Shipment and Storage
MIL-STD-461	Requirements for the Control of EMI, Electromagnetic Emission, and Susceptibility
MIL-STD-464	Electromagnetic Environmental Effects Requirements for Systems
MIL-STD-1686	Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies, and Equipment (Excluding Electrically Initiated Explosive Devices) (Metric)

Number	Title
MIL-STD-1757	Lightning Qualification Test Techniques for Aerospace Vehicles and Hardware
MIL-STD-2073/1	Standard Practices for Military Packaging
MIL-STD-2161	Paint Schemes and Exterior Markings for U.S. Navy and Marine Corps Aircraft

1-6. REPORTING ERRORS AND IMPROVEMENT RECOMMENDATIONS.

1-6.1. General. All activities using this manual are invited to submit recommended changes, additions, or deletions.

1-6.2. Specific Reporting Requirements. Recommended changes, additions, or deletions shall be reported as follows:

a. Navy personnel should submit recommended changes to the appropriate technical services facility using the reporting system outlined in OPNAVINST 4790.2.

b. Air Force personnel should refer to TO 00-5-1 to report changes.

c. Army personnel should submit completed DA 2028/2028-2 forms to Commander, U.S. Army Aviation and Missile Command, ATTN: AMSAM-MMC-LS-LP, Redstone Arsenal, AL 35898-5220.

1-7. CORROSION-RELATED FAILURE DATA FEEDBACK.

a. Since corrosion prevention and control of military avionics is a continuing concern, it is vitally important that corrosion problems are properly reported. Problems can be corrected and improvements made to prevent reoccurrence in future equipment design.

b. All activities using this manual are required to use the current maintenance data collection system(s) of the parent service organization. This will enable a record of the corrosion-related failures to be submitted to the appropriate technical services facility for analysis.

1-8. SAFETY.

1-8.1. Responsibility of Supervisors. Work center supervisor shall receive annual training in:

a. The recognition and elimination of hazards.

b. Occupational safety and health.

c. The safety of the individual.

d. Accident investigation and reporting.

e. The inspection and maintenance of personal protective equipment.

In addition, supervisors shall ensure that an adequate supply of safety equipment is in a ready-for-issue condition. Supervisors shall inform corrosion control personnel of the following:

a. Current safety procedures.

b. Characteristics of materials to which they will be exposed.

c. Required protective clothing to ensure safety of personnel.

1-8.2. Responsibility of Personnel. Corrosion control personnel should be given and use appropriate protective equipment to prevent accidents, injuries and occupational illness. Maintenance personnel shall use appropriate equipment while exposed to hazardous conditions, and report any protective equipment that is broken, damaged, defective, or inadequate. No one shall use protective equipment that is not in a satisfactory and serviceable condition. Personnel shall comply with occupational safety and health requirements. This includes medical examinations, respirator training and fit testing, and protection for eyes, ears, head, skin, and feet.

1-8.3. Material Handling. Many of the materials and procedures outlined in this manual are potentially hazardous to personnel and potentially damaging to aircraft, especially with improper use. When using any chemicals, such as paint strippers, detergents, conversion coatings, and solvents, follow the correct procedures with appropriate protective gear to prevent personnel injury and aircraft damage. Read the appropriate warnings and cautions in this manual prior to use of any hazardous materials, Misuse of certain materials can damage parts or cause corrosion which may lead to catastrophic failure. Refer to DOD 6050.5-LR, Hazardous Materials Information System, or the appropriate parent service organization documents for the handling, storage, and disposal of hazardous materials. When in doubt, contact the local safety office, industrial hygienist, or regional medical center.

CHAPTER 2
AVIONIC CORROSION PRINCIPLES AND DESCRIPTIONS

2-1. OVERVIEW.

a. Maintenance of miliary avionic equipment requires knowledge of aircraft electrical/electronic system corrosion control. The theory lies in the definition and description of mechanisms that cause avionic equipment to fail in field service. Corrosion is the chemical or electrochemical deterioration of a material. This deterioration is complex in nature due to the following:

(1) The various types of corrosion.

(2) The frequent simultaneous presence of several types.

(3) The design characteristics and maintenance/environmental factors that make avionic systems more susceptible to corrosion.

b. Corrosion can cause complete failure of equipment or undesirable changes in electrical characteristics. It is a process that is active on a 24-hour basis. Equipment does not necessarily have to be installed, operated, or resident in a particularly harsh environment. Some form of corrosion will take place even in near ideal environments. Avionic technicians should recognize that corrosion is the natural continuing process of materials returning to their normal states. Inadequate corrosion prevention and control will ultimately affect equipment life cycles, downtime, an over all system reliability.

2-2. FACTORS INFLUENCING CORROSION.

2-2.1. Environmental Factors. Maintenance of avionic systems for corrosion prevention requires an understanding of the fundamental factors that contribute to corrosion. All aircraft electrical and electronic systems are susceptible to conditions that cause corrosion such as changing temperatures and pressures, varying humidity, industrial pollutants, moisture and other fluids, and sand and dust. These conditions compound other factors that cause equipment deterioration and premature failure or shortened life.

2-2.2. Avionic Equipment and System Design. The best time to prevent corrosion is at the design stage which includes the science and technology of corrosion control Each piece of avionic equipment is designed to withstand its intended operating environment. However, some design compromises have to be made to provide unique electrical, mechanical, and thermal characteristics of avionic equipment. This can cause equipment designed for field operation to be vulnerable to corrosion during nonoperating periods.

2-2.3. Type of Materials. Proper material selection is critical for the protection of equipment against harmful environmental effects. Many types of corrosion that occur in avionic systems are similar to those found on airframe structures. However, some types of corrosion are unique to avionic equipment. For example, silver in contact with aluminum can cause rapid galvanic corrosion of the aluminum when salt water is present. The following indicates the uses made of some of the different alloys in the construction of various electrical and electronic components:

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

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

c. Magnesium alloys are used extensively throughout avionic systems as antennas, structures, chassis, supports, and frames (radar).

d. Nickel and tin-plating are used for protective coatings and compatibility purposes. The use of tin in solder is a well known application. Tin-plating is also common on radio frequency (RF) shields, filters, crystal covers, and automatic switching.

e. Silver is used as a plating material over copper in waveguides, miniature and microminiature circuits, wires, contacts, high frequency cavities, tank circuits, and RF shielding.

f. Aluminum and aluminum alloys are widely used in equipment housings, chassis, mounting racks, supports, frames and electrical connector shells.

g. Cadmium is used to coat ferrous hardware, such as bolts, washers, screws and electrical connectors as a sacrificial protective coating. Potential replacements for cadmium are ion vapor deposited (IVD) aluminum, electroless nickel, zinc, etc.

h. Gold is common on electrical connector contacts, edge connectors, leaf-type relays, miniature coaxial connectors, PCB conductors, semiconductor leads, and microminiature and hybrid circuits.

2-2.4. Operational and Maintenance Environment. The rate of corrosion is determined by the temperature, humidity, type of metal or material, and chemicals in the surrounding environment. Avionic technicians should familiarize themselves with the effects of the natural environment such as moisture, temperature, atmospheric pressure, salt, water, sand, and dust, etc. In addition to the dangers of natural environments, avionic equipment is also exposed to a variety of man-made environments.

2-2.5. Type of Aircraft. Fixed-wing and rotary-wing aircraft have some airframe flexibility, resulting in seal deterioration. This allows moisture/fluid intrusion. Vulnerable areas include:

a. Gaskets on access doors/panel

b. Fuselage flexure points

c. Vents, ducts, and static pressure sensor

d. Equipment bay door and electromagnetic interference (EMI) gaskets

e. Radome and antenna seals

f. Opening for steps

2-2.5.1. Effects of Aircraft Mission. A number of field electrical and electronic corrosion problems are a result of the mission operation of the aircraft. For example, during a search and rescue (SAR) operation, helicopter flights are performed with the doors and windows open for optimum visibility. This causes water to enter the cabin, bilge areas, and lower mounted equipment. During low-level over water flights involved in anti-submarine warfare (ASW), moisture inducted into aircraft via the fine ocean spray prevalent at lower altitudes. This moisture saturates wiring harnesses, connectors, antennas, waveguides, switches, etc, and causes frequent equipment failure. Flight operations in tropical environments can produce conditions that support the growth of fungus and other micro-organisms.

2-2.5.2. Protection of Aircraft During Ground Operations. Avionic equipment can also be damaged during maintenance periods. Many problems are encountered while aircraft are parked. In general, the majority of aircraft ground time is spent with the aircraft opened up or unbuttoned. It is often required that canopies and access panels be open during certain maintenance functions. This produces situations where moisture, rain, or ocean-spray may soak cockpit and internal avionic components. Inspection and timely corrosion control of avionic equipment is essential for proper operation and full life cycle. Maintenance operation time varies widely between types of equipment and depends largely on reliability and troubleshooting time. Most front-line combat aircraft average 1 to 2 hours per day in flight operations. In some cases, aircraft may be nonoperational for extended periods while waiting for spare parts, etc. This increases the vulnerability of the entire system to corrosion. Some of the potential problems associated with increased maintenance operation time are as follows:

a. The avionic system(s) involved may be open (radomes up, equipment bay doors open, canopies raised, etc) for extended periods.

b. Maintenance may damage seals and the locking integrity of fasteners, scratch protective finishes, and otherwise impact wear and tear to the avionic system.

c. Avionic equipment may be moved several miles exposed to the environment between the removing/installing activity and the repair shops.

2-3. CORROSIVE CONDITIONS.

2-3.1. General. A major cause of declining avionic equipment reliability is corrosion. Moisture is the single most important contributor to corrosion in avionic systems. However, the degree of corrosion damage depends on many environmental factors. Specific conditions are discussed in the following paragraphs.

2-3.2. Moisture. Moisture is either a gas (water vapor) or finely divided droplets of liquid (mist or fog). This moisture often contains contaminants such as chlorides, sulfates, and nitrates, which increase its corrosive effects. Moisture enters all area of an aircraft that air can enter. All enclosed areas that are not sealed allow air to enter and leave as the difference in pressure between inside and outside changes. These pressure differences occur when the aircraft changes altitude, when atmospheric pressure changes, when the air temperature inside an enclosed area changes. Moisture condenses out of air when the air becomes too cool to hold all of the moisture in it. The dew found on aircraft after a cool night is the result of condensation.

2-3.2.1. Condensed Moisture. Condensed moisture usually evaporates as surrounding air warms but leaves contaminants (residues), including salts, behind. This can result in the buildup of soils and salt contamination. Condensed moisture and its contaminants can also be trapped in close fitting, wettable joints, such as faying surfaces. Some gasket and packing materials absorb several times their weight in water and, when heated, transmit this retained moisture into the sealed area. Moisture can accumulate in such areas through successive cycles of warming and cooling. In addition, moisture can be drawn along poor bond lines by capillary action (wicking). Temperature and humidity conditions can vary widely in separate sections of aircraft. This depends on the success of environmental sealing, condensation, and location near heat-generating equipment. All non-metals absorb some moisture. This moisture may cause changes in dimensional stability, dielectric strengths, ignition voltages, and volume insulation resistances.

2-3.2.2. Salt Atmosphere. Salt forms a strong electrolyte when dissolved in water, which causes rapid corrosion of unprotected metal surfaces. The primary source of the world's salt is the ocean, which is 3.5% to 3.9% salt. Normal sea winds can carry from 10 to 100 pounds of sea-salt per cubic mile of air. Since dissolved salts are strong electrolytes, it is easy to understand why corrosion is such a severe problem in shipboard and coastal environments.

2-3.3. Other Fluids. Many fluids can be present in various areas of an airframe. Table 2-1 lists the types of fluid intrusion and the possible effects. Some of these fluids are corrosive to metals, while others are destructive to seals. The destruction of seals leads to fluid penetration into areas that are considered protected from fluids. Some fluids are from external sources, while others are present due to internal leaks or servicing spills.

2-3.4. Temperature. High temperature either improves or impairs the performance of avionic equipment, depending on conditions. Corrosion and other harmful processes (outgassing, decomposition, etc) increase as temperature rises. In some instances, moderate increases in temperature prevent condensation. Most fungus growth is inhibited by temperatures above 104ºF (40ºC). Low temperatures pose no real threat of corrosion except that as temperature drops relative humidity rises. The greatest problem in extremely low temperatures, as in polar regions, is the shrinkage of seals and gaskets. This results in leakage and embrittlement of organic materials. If temperatures vary sufficiently, moisture may condense to form liquid water in the equipment. Similarly, the introduction of cooling air may cause condensation.

2-3.5. Pressure. Most military avionic equipment is intended for service in low pressure (high altitude) environments. These environments create the familiar corona, arcing, and poor cooling familiar to the avionic technician. Another problem is that of cyclic low and high pressures. These varying pressures create leaky seals and cause breathing. Breathing promotes condensation and creates a corrosive environment. Low pressure also causes outgassing (loss of volatile components, such as plasticizers) of plastics and other organic materials. Very low pressure causes outgassing the changes the physical and chemical properties of some materials.

Table 2-1. Detrimental Effects of Airframe Fluid Intrusion

Type of fluid intrusion	Effect or deterioration
Engine fuel	Softening or swelling of some polymers.
Hydraulic fluid	Lack of coating adhesion; introduction of insulative films on electrical connector contracts.
Lubricants	Attack some seal and gasket material.
Dielectric coolant	Attacks organic seals.
Anti-icing fluids	Increased condensation and attack on electrical wiring.
Aqueous contaminants (free water, urine, condensation, desiccants)	Increased condensation causing pooling of fluids in bilge areas; corrosive attack of unprotected bimetallic couples; introduction of insulative films on electrical connector contact surfaces.
Maintenance fluids (solvents, detergents, cleaners, strippers)	Softening and/or reduced adhesion of some organic coatings and cracking of some wire insulation.

2-3.6. Pollution. Carbon from turbine engine internal combustion engine exhaust, nitrates from agricultural fertilizers and industrial processes, ozone from electrical motors and welding operations, sulfur dioxide from engine exhaust and industrial and ship smoke stacks, and sulfates from automobile exhaust are important pollutants. Corrosive solutions form when these contaminants are absorbed by condensed moisture.

2-3.7. Sand and Dust. One of the least recognized contributors to corrosion is sand and dust. Sand and dust carried by winds, storms, and turbulence caused by operating aircraft can penetrate equipment seals. Sand and dust on the surface of an electronic component absorbs and holds moisture. This provides an electrolyte for corrosion and the growth of fungus. Sand and dust on surfaces can cause an abrasive action when the surfaces are moved or vibrated. This removes the protective oxide coatings and leaves the metal exposed for corrosion to begin.

2-3.8. Micro-organism, Insect, and Animal Attack. Modern avionic equipment, because of complexity, dense packaging, and higher sensitivity, is more susceptible to damage from microbes than earlier systems. Condensed moisture can provide conditions that promote the growth of molds, bacteria, and fungi. Once established, these growths continue to absorb and hold moisture. Acid secretions from the micro-organisms are strong electrolytes. These electrolytes corrode the underlying metal. Some nonmetals provide nutrients that can accelerate growth. The complexity of synthetic materials makes it difficult to determine in advance whether a material will support the growth of fungus. Many resistant synthetics become susceptible to fungal attack if a plasticizer or hardener is applied. The service life, size, shape, surface smoothness, type of fungi, etc, all determine the degree of fungal attack. Table 2-2 lists some common materials and corresponding effect of moisture and fungi. Damage to avionic systems can also be caused by small insects and animals, especially in tropical environments. Equipment in storage is most susceptible to this type of attack. Insects and small animals may enter through vents holes or tears in packaging and build nests that absorb moisture. This moisture, plus excretions and salts from these animals, can cause corrosion. Another type of damage can occur when electrical insulation, varnishes, and circuit board coatings are eaten by insects. When bare wires or circuit components are exposed, more areas become available for corrosion and shorting to occur.

Table 2-2. Effects of Moisture and Fungi on Various Materials

Part or material	Effect of moisture and fungi
Fiber: washers, supports, etc	Moisture causes swelling that causes the support to misalign, resulting in binding of supported 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 boards, switchboard panels, etc, tube sockets and coil forms, and connectors	Insulating properties are lost. Leakage paths cause flashovers and crosstalk. Delamination occurs and fungi grow on surface and around edges. Expansion and contraction under extreme temperature changes.
Molded plastics: terminal boards, switch-boards panels, connector, etc, tube sockets and coil forms	Machined, sawed, or ground edges of surfaces and supporters of fungi, causing shorts and flashovers. Fungi growth reduces resistance between parts mounted on plastic to such an extent that the parts are useless.
Cotton linen, paper, and cellulose derivatives: insulation, coverings webbing, belting, laminations, dielectrics, etc	Insulating and dielectric properties are lost or impaired, causing arcing, flashovers, and crosstalk. Destroyed by fungi.
Wood: cases, houses and housings, plastic fillers, masts, etc	Dry rot, swelling, and delamination 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 rapid corrosion. Fungus and bacterial growth produce acid and other products that speed 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 condensers, etc, which in turn causes noise, loss in sensitivity, and arc-overs.
Metal, dissimilar	Metals may have different corrosion potentials. When moisture is present, one of the metal (anode) corrodes.
Soldered joints	Residual soldering flux on terminal boards holds moisture, which speeds up corrosion and growth of fungi. Soldering iron should not come in contact with wire insulation.

2-3.9. Man-made Environments. In addition to the dangers of natural environments, avionic equipment is also exposed to a variety of man-made environments. Even ideal environments aboard a ship can be detrimental to avionic equipment. Those man-made environments that are most detrimental to avionic equipment are defined in the following paragraphs.

2-3.9.1. Assembly and Repair. Assembly or repair of avionic components in areas contaminated by fumes or vapors from adjacent operations (such as welding, paint spraying, and solvent cleaning) may result in entrapment of fumes in the equipment and may cause corrosion. The simple task of soldering a component in a circuit board can cause corrosion, often due to failure to remove flux residues. Air conditioning systems in avionic shops are inherently lower in temperature than surrounding spaces. In shops without humidity control, the air conditioning system can create condensation. This is of particular concern as temperatures tend to be much lower after working hours because of the absence of the shop personnel (body heat) and the lack of heat generated by operating various equipment. Thermostats should be adjusted to prevent excessive cooling and condensation after working hours.

2-3.9.1.1. Solder Flux Corrosion.

CAUTION

Solder fluxes will contribute to corrosive attack. Refer to ANSI/J-STD-001 for general solder information. Refer to ANSI/J-STD-004, 005, 006 for solder flux requirements for securing connections in electrical or electronic equipment.

NOTE

Refer to NAVAIR 01-1A-505 (Navy), TO 1-1A-14 (Air Force), or TM 55-1500-323-24 (Army) for additional information on solder fluxes and soldering techniques.

Most metals exposed to the atmosphere develop a thin film of oxide. This film is not visible and solder alone cannot dissolve it. During soldering operations, the addition of flux removes the oxide film and prevents further metal oxidation. Although most flux is burned away during the soldering process, some residues remain and must be removed. Residues from solder fluxes can degrade circuitry by:

a. Causing solder joints to corrode.

b. Causing corrosive flux vapors that settle on adjacent components.

c. Reducing insulation resistance.

d. Changing the resistivity of the solder joint.

e. Attracting dirt and other contaminants that may absorb moisture to cause corrosion.

2-3.9.2. Equipment Handling. Equipment removed from aircraft for maintenance or inspection may become exposed to various environments. Equipment that requires handling or protection against the environment should be packaged accordingly. In some cases, special containers are furnished for the purpose of protecting the equipment. Where containers or special packaging are not furnished, steps shall be taken to provide the protection required. For example, a printed circuit board (PCB) that has been repaired but not coated with conformal coating requires protection against electrostatic discharge and contaminants. It should be placed in an antistatic bag and transported using a covered antistatic tote tray or fast pack from the repair station to the test bench. Corrosion that develops as a result of improper handling or inadequate packaging, storage, and shipment is extremely destructive. It is often harder to detect that the causes previously described. Some of the same design characteristics that support corrosion in equipment on board aircraft also lead to deterioration in inadequately packaged, stored, and shipped avionic components. Store and handle all uninstalled avionic equipment in shock and moisture resistant packaging with an active desiccant. The following unacceptable conditions should be corrected:

a. Equipment with a high replacement rate that is kept unprotected.

b. Equipment moved on an open flat bed vehicle between the removing/installing activity and the repair shops that is unprotected.

c. Equipment exposed to the environment awaiting transfer to the repair shop or depot activity that is unprotected.

2-3.9.3. Packaging. Packaging is intended to protect equipment or components against corrosion, deterioration, and physical damage during transportation and storage. Avoid the use of unsuitable materials, or corrosion attack may occur as a result of improper packaging materials. Proper packaging techniques are not necessarily limited to the manufacturing or shipping activity but concern the avionic shop technician as well. Certain woods, cottons, foams, and papers absorb moisture and are suspectible to mold and fungus attack. These materials and shredded newspaper, excelsior, fiberboard, etc, may emit acidic vapors. Corrosive vapors are not only a product of wood but other incompletely cured organic materials such as glues, paints, varnishes, resins, and preservatives. Outgassing (decomposition) of organic materials such as adhesives, gaskets, sealants, wire insulation, sleevings, tubing, plastics, and circuit board varnishes may produce corrosive organic acid vapors. When corrosive vapors are released in a confined space or in a piece of avionic equipment, serious corrosion attack will occur in the presence of moisture.

2-3.9.4. Storage. Do not store avionic equipment in wooden boxes, fiberboard containers, or similar packaging. Take steps to prevent damage that could be caused by corrosive vapors. Avoid the use of wooden storage racks. Also, avoid storing avionic equipment in vented containers, especially during air shipment. These containers may allow moisture to enter the equipment.

2-3.9.5. Shipment. During shipment, avionic equipment is often exposed to different environments. Air shipment subjects materials to changes in atmospheric pressure and can lead to outgassing of organic materials. Vibration and mechanical shock can damage protective coatings or platings. Some containers may hold residual corrosive vapors from previous shipments and become damaged during handling operations.

2-4. TYPES OF CORROSION.

2-4.1. General. Many forms of corrosion may occur, depending on the type of materials, configuration of the material, and environment. This section describes the types of materials and various forms of corrosion common to avionic equipment. The rate and magnitude of corrosion depends on the environment, type of materials used, and particular application of the material.

2-4.2. Uniform Surface Corrosion. Uniform surface corrosion is probably the most common type of corrosion. This takes place when oxygen, water, ozone, salt and/or other materials chemically attack a metal surface. A dull or etched surface is usually observed at first, followed by roughness and “frost” if this corrosion continues (for example, the etching of metal exposed to acid). Coating/ sealing the exposed surface will protect it from this type of attack. Also, corrosive elements may be removed through air movement and drain holes.

2-4.3. Galvanic Corrosion. Galvanic corrosion occurs when different metals contact each other and an electrolyte such as salt water is present. It is usually characterized by a buildup of deposits at the surface between the metals. For example, an aluminum equipment enclosure attached to a copper mesh gasket forms a galvanic couple if moisture is present. The corrosion of a galvanic couple is a function of the reactivity of the metals. The galvanic series outlined in Table 2-3 is an arrangement of elements based on their relative reactiveness in seawater. The further apart two metals are on the chart the faster the active metal will corrode. In contrast, the closer two metals are on the chart, the slower the rate of corrosion of the active metal. Equipment that includes drain holes, good air flow, and no areas for moisture to collect tends to reduce corrosion.

2-4.4. Fretting Corrosion. Fretting corrosion occurs when there is slight relative motion between two materials. This corrosion is typical in close-fitting, highly-loaded interfaces. Although fretting corrosion can take place on all metals, aluminum, stainless steel, and titanium alloys are most susceptible. These metals depend on oxide surface film to inhibit further corrosion. With rapid movement under pressure at the interface, the oxides are removed and rapid oxidation occurs. In the case of steel, only oxygen appears to be necessary for fretting corrosion to take place. Moisture does not appear to increase the corrosion. In fact, it tends to slow down the reaction. The water appears to lubricate the interface. Some practical means of reducing fretting corrosion include:

a. Reduce the amount of relative motion at the interface.

b. Add a lubricant to the interface to reduce friction and seal out oxygen.

2-4.5. Stress Corrosion. Stress corrosion occurs when tensile stress and corrosion combine to produce greater damage than either applied separately. Tensile stress can be residual or externally applied. This type of failure can be catastrophic and occur without warning. Stress corrosion is normally localized and appears in the form of cracks. For example, cracking can occur in stressed copper alloys exposed to ammonia and its compounds. This is particularly true in the presence of oxygen and carbon dioxide. In general, stress corrosion can be minimized by:

a. Use of protective coatings.

b. Removal of (filter) corrosive elements from environment.

2-4.6. Crevice Corrosion. Crevice corrosion is one of the most familiar types of corrosion. Field experience shows that this type corrosion may occur in any crevice where a stagnant solution has pooled. It takes place when the electrolyte has a different concentration from one area to another. Electrolyte inside the crevice contains less oxygen and more metal ions than electrolyte just outside the crevice. This causes corrosion to occur in the crevice.

2-4.7. Fatigue Corrosion. Normal fatigue occurs when metal fails under repeated stress. This usually takes place at loads below the normal strength of the metal. The fatigue limit is the highest stress that can be applied an indefinite number of times without causing fracture. Fatigue corrosion is the combination of corrosion and normal fatigue leading to a reduction in fatigue resistance. In all cases, the number of cycles required to produce failure are reduced due to corrosion. Fatigue corrosion will produce a failure after some number of cycles regardless of how minimal the applied stress.

2-4.8. Intergranular Corrosion. Intergranular corrosion is a chemical attack that occurs at the grain boundaries of certain metals. These boundaries consist of quantities of individual grains which differ chemically from the metal within the grain. Often, the grain boundaries are anodic and tend to corrode more easily than the metal within the grain. When an electrolyte is present, rapid selective corrosion of the grain boundaries occurs. For instance, when certain stainless steels are heated, precipation of chromium carbide may occur. The grain boundaries of these steels then become the preferred sites for carbide formation. The grain boundary is depleted of corrosion protective chrome while the grains of steel still contain chrome. Chrome depleted grain boundary areas become small anodic areas electrically connected to large cathodic grains. This may cause severe intergranular corrosion.

2-4.9. Exfoliation Corrosion. Exfoliation is a form of intergranular corrosion. It lifts up surface grains of metal by expanding corrosion products at grain boundaries just below the surface. This type corrosion most often occurs on extruded sections of metal and is found primarily in aluminum sheet around steel fasteners. Its prevention involves separating the aluminum and steel with a barrier, such as zinc-chromate primer.

2-4.10. Pitting. Pitting is a common and severe form of localized corrosion that occurs on thin metal sheets such as printed circuit paths. These sheets of metal become so weak at pit sites that perforation may result. Pitting usually occurs in grain boundaries and porous finish areas on the metal surface. For example. pitting occurs with porous gold plating on copper alloy contacts. The plating pores create a small corrosion cell that continues to expand until a hole or pit is created. This occurs because of incomplete films or coatings (damaged protective oxide films, conformal coating, etc). Substances that partially shield small areas on the metal surfaces (oxide scale or debris) can also cause this to occur. Corrosive agents in solution will further accelerate pitting in these cases.

2-4.11. Nonmetallic Deterioration. In addition to corrosion of metals, deterioration of nonmetallic materials also occurs (physical swelling, distortion, disintegration, cracking, changes in electrical characteristics, etc). This deterioration is caused by environmental conditions such as ultraviolet light, moisture, fungi attack, etc. Examples of nonmetallic deterioration are as follows:

a. Encapsulants and conformal coatings are used to envelop an avionic component, module or assembly.

Table 2-3. Galvanic Series of Metals and Alloys in Sea Water

CORRODED END (ANODIC, ACTIVE, OR LEAST NOBLE)

↑ INCREASING CORROSION POTENTIAL

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 Steels 350, 310, 301, 304 (active)
Stainless Steels 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 Steels 321, 316 (active)
Stainless Steels 309, 13-8, 17-7 PH (passive)
Stainless Steels 304, 301, 321 (passive)
Stainless Steels 201, 316L (passive)
Stainless Steel 286 (active)
AM355 (active)
Stainless Steel 202 (passive)
Carpenter 20 (passive)
AM355 (passive)
Titanium Alloys
AM 350 (passive)
Silver
Palladium
Gold
Rhodium
Platinum
Carbon/Graphite

DECREASING CORROSION POTENTIAL ↓

PROTECTED END (CATHODIC, PASSIVE, OR MORE NOBLE)

These materials are considered nearly as effective as hermetic sealing. Typical materials used for this purpose are epoxy, polyurethane, silicone rubber, acrylic, varnish, etc. Because these materials are organic, they are susceptible to moisture, varying temperature, and fungus. Moisture accumulates when incorrect repair procedures cause imperfections and bubbles, or when the coating is applied too thick.

b. High temperatures may cause corrosive vapor to outgas from encapsulants and conformal coatings. This problem is of special concern if a circuit component burns on a conformal coated circuit board. These gaseous vapors can penetrate under circuit board coatings and cause major corrosion.

c. Potting compounds are used to encase a part or component, such as in an electrical connector. Usually, the process of potting involves the use of a mold to form the potting compound. These molds are made of plastic and may become the source of moisture intrusion. All molds should be removed after the potting compound has cured. Refer to paragraph 5-5.2.

d. Generally, potting compounds are considered to be a good seal against moisture when correctly applied. Problems occur when potting compounds, are cured too fast, not mixed properly, or the surface is not cleaned. Aging of certain potting compounds can cause the potting compound to harden and become brittle, or soften and revert.

e. Laminate circuit boards typically use encapsulants or conformal coatings as sealers. In some cases, the laminate is not sealed along the edge or at the contact tabs. This causes the laminate board to absorb moisture and delaminate.

f. Overcleaning with abrasive materials may damage the resin surface of the laminate board. High temperature caused by the burning of a circuit component may char the laminate surface and increase moisture intrusion.

g. Rubbers and elastomers are used for insulation, seals, gaskets, caps, tubing, films, coatings, etc. Natural rubber, silicone rubber, and polyurethane are normally susceptible to attack by fungi, microbes, ozone and ultraviolet light. Polyurethane and silicone rubber are to some extent permeable to moisture.

h. Some pressure sensitive tapes are effective moisture barriers. Problems arise with cloth or paper-based tapes. These materials absorb moisture and support fungal attack. This is particularly true when wicking action has taken place on the cloth or paper material.

i. Some tapes deteriorate and outgas, emitting an acid that is corrosive to metals.

j. The lubricants used in some electronic equipment are capable of minimizing moisture intrusion and corrosion attack. However, at high temperatures and pressures, oils can chemically react to produce acids.

k. Oil can hold a limited amount of water. Excess water will separate from the oil if the holding capacity is reached at a given temperature.

2-4.12. Incompatibility of Nonmetallics. The complexity of modern avionics makes it difficult to predict what problems may result from reactions between materials. Incompatibility of materials can cause deterioration of the nonmetallic substances. This may result in the release of chemical or gases that react with other circuit components. In some cases, cleaning solutions, high temperature, or moisture will cause a reaction in nonmetallic substances. Common examples of nonmetallic materials incompatibility are as follows:

a. Some encapsulants, conformal coatings, and acrylic plastics soften or dissolve when they come in contact with cleaning solvents.

b. The heating of conformal coatings for removal or repair may outgas corrosive vapors onto metal components.

c. Some commercial conformal coating strippers contain acids that attack PCB laminates and discolor or corrode copper.

d. Certain room temperature vulcanizing (RTV) silicone sealants contain acetic acid that is highly corrosive to metal components.

NOTE

RTV silicone sealants are listed in Chapter 5, Table 5-2.

e. Some potting compounds revert to liquid form under certain conditions. This reversion causes a maintenance problem and reduces the moisture protection in electrical connectors.

f. Degradation of polyvinylchloride (PVC) gives off acid fumes that are corrosive to most materials used in avionics.

g. Shrinkage elastomers (heat-shrinkable tubing) can damage adjacent circuitry when heat guns are applied to shrink the tubing.

h. Application of conformal coatings, adhesives, and paint finishes is difficult when silicone oil film is present on base material.

i. Some dry film lubricants containing graphite are corrosive. Graphite and moisture will promote galvanic corrosion in many metals. Some dry film lubricants contain uninhibited molybdenum disulfide which, with moisture and heat, may form sulfuric acid.

j. Certain oils (such as silicones) and greases “creep” as temperature increases. This causes contamination of adjacent surfaces, degradation of organic coatings, and attraction of particulates.

k. Some lubricant will attack neoprene, plastics, rubber, organic materials, and most paints.

l. Plastics can be damaged by solar heating and cosmic radiation. The damage is a visible darkening, discoloration, or color fading of the plastic. Lower pressures and vacuum can cause outgassing and loss of plasticizers/ flexibilizers. This can cause a change in structural properties such as loss of strength. The damage is apparent by embrittlement and crazing of the surface, as well as loss of electrical properties.

m. Graphite or carbon fiber composites can be found in connectors, enclosures, EMI seals and gaskets, etc. These composites will accelerate the corrosion rate of any avionics metal to which they are coupled.

CHAPTER 3
CORROSION CONTROL PROGRAM AND INSPECTION

3-1. GENERAL.

Investigations during the past ten years have identified corrosion as a major factor in electronics failure in the field. As much as 30% to 40% of military avionic failures are due to the corrosion process. This is despite steady improvements in reliability of avionic systems fielded to date and outlines the need for an effective preventive maintenance program.

3-2. PREVENTIVE MAINTENANCE PROGRAM.

3-2.1. Program Requirements. Successful avionic cleaning and corrosion prevention/control efforts depend on a coordinated, comprehensive preventive maintenance program. Everyone involved in maintenance, repair, and operation of avionic systems must be concerned with corrosion, cleaning, inspection, prevention, and treatment. Specifically, avionic corrosion prevention/control is everyone's responsibility. Each command must place special emphasis on the corrosion control program and lend their full support. This ensures the program receives sufficient priority to be accomplished along with other required maintenance. The goal of a preventive maintenance program is to halt corrosion before significant decline in equipment performance occurs. As such, it is important to recognize the difference between prevention of corrosion and repair of damage caused by corrosion. A preventive maintenance program at the Organizational/Unit and Intermediate Maintenance Activities should:

a. Reduce the maintenance time spent repairing corrosion damage.

b. Improve avionic system reliability, durability, and service life.

c. Make the military avionics community aware of the extent of the problem.

d. Report any deficiencies with materials and processes associated with corrosion control.

3-2.2. Applicable Guidelines. All activities responsible for the maintenance of military aircraft and avionic systems shall establish a corrosion prevention/control program. This program shall be structured as required by OPNAVINST 4790.2 (Navy), TO 00-20-1 (Air Force), or AR 750-59 (Army) and ensure that personnel receive hazardous material/waste handlers training. The type of program depends on the conditions or environments to which the aircraft/avionic systems are exposed. Those aircraft and avionic systems exposed to salt-air and tropical environments required the most stringent corrosion prevention and control programs.

3-2.3. Maintenance Functions. Experience has shown that all activities have a corrosion problem. This is regardless of whether the equipment is an installed avionic system, ground support equipment, missile system, etc. Accordingly, corrosion control efforts by all hands is mandatory. This must be a day-to-day requirement to prevent corrosion before it starts. Figures 3-1 and 3-2 depict the minimum maintenance functions applicable to Organizational/Unit and Intermediate Maintenance programs, respectively.

3-2.4. Corrosion Prevention Philosophy. Corrosion and environmental conditions are natural phenomena that adversely affect equipment in field service. Although never totally eliminated, the problems these factors cause can be minimized so that they are less severe and better controlled. This can be achieved only by understanding equipment failure mechanisms and development/utilization of corrosion control technology.

a. As a general rule, maintenance personnel should assume corrosion is ongoing, irrespective of visible physical evidence. The aim of corrosion prevention is to enable avionic systems to perform satisfactorily for a specified time period. In other words, maintenance efforts should allow equipment to approach its expected maximum lifetime (EML).

b. The general workflow diagram, in Figure 3-3, defines procedures followed to implement a corrosion preventive maintenance program. This procedure is designed to indicate the sequence of events needed to implement the basic philosophy.

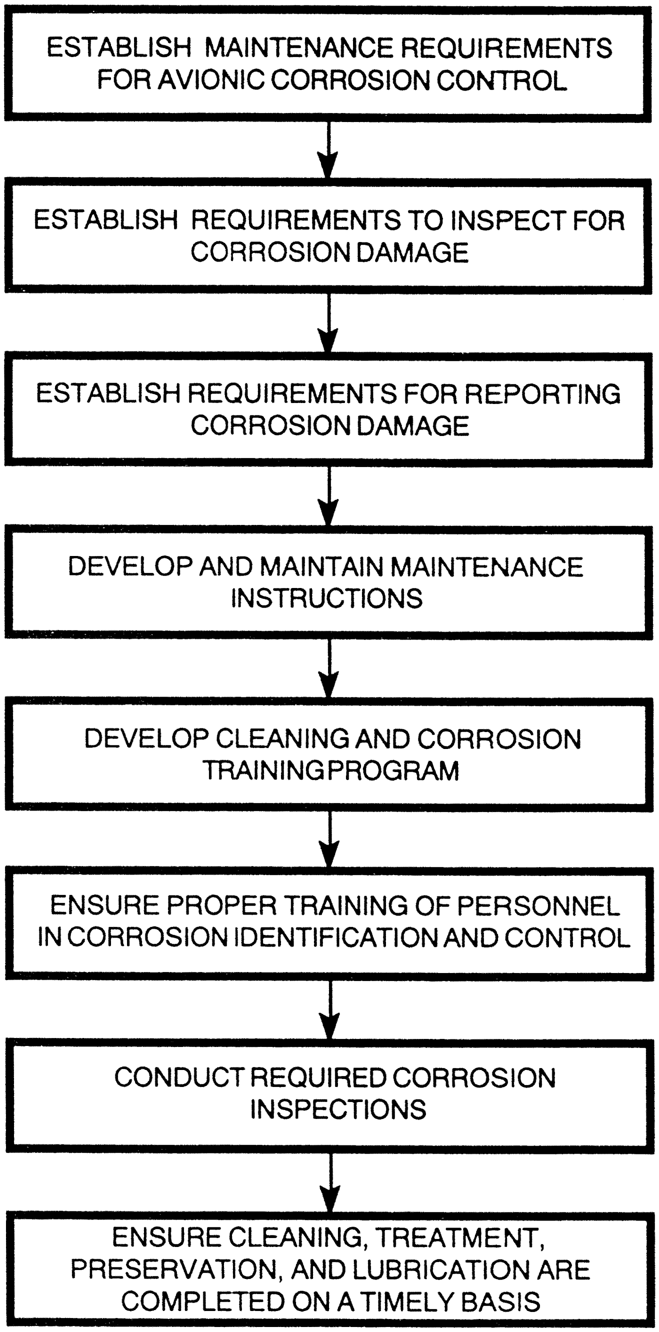


Figure 3-1. Basic Maintenance Functions for Organization/Unit Level

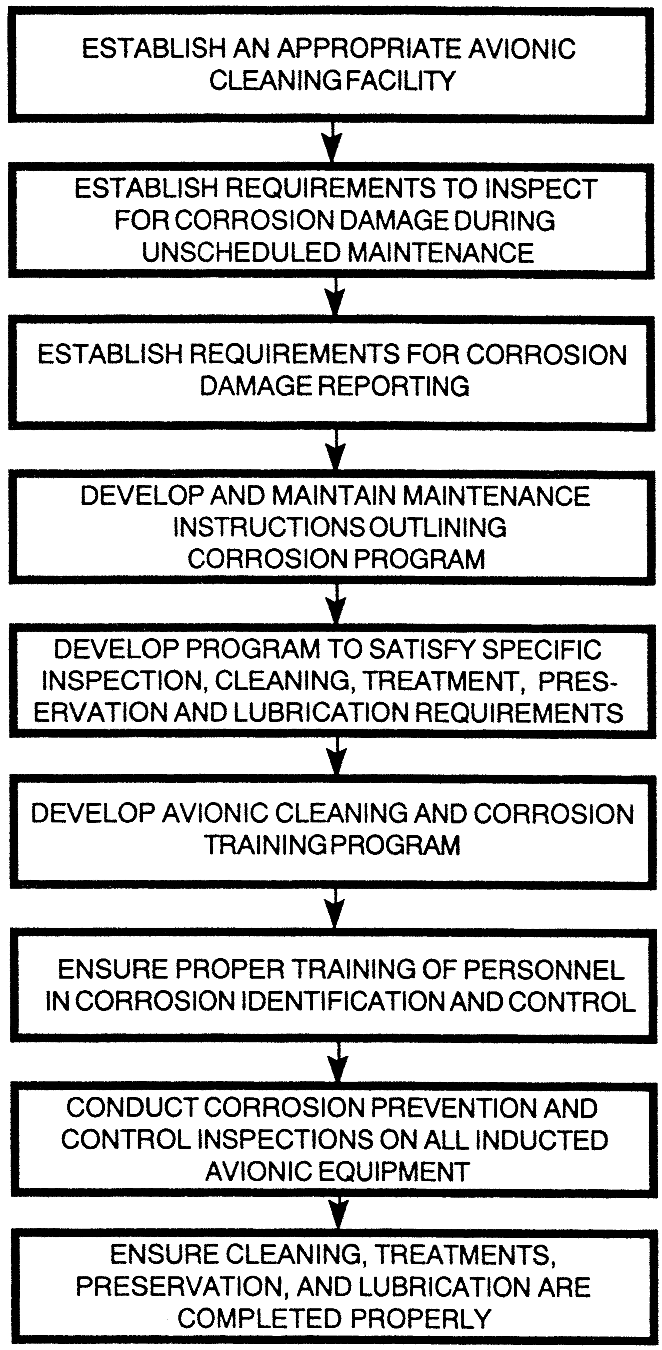


Figure 3-2. Basic Maintenance Functions for Intermediate Level

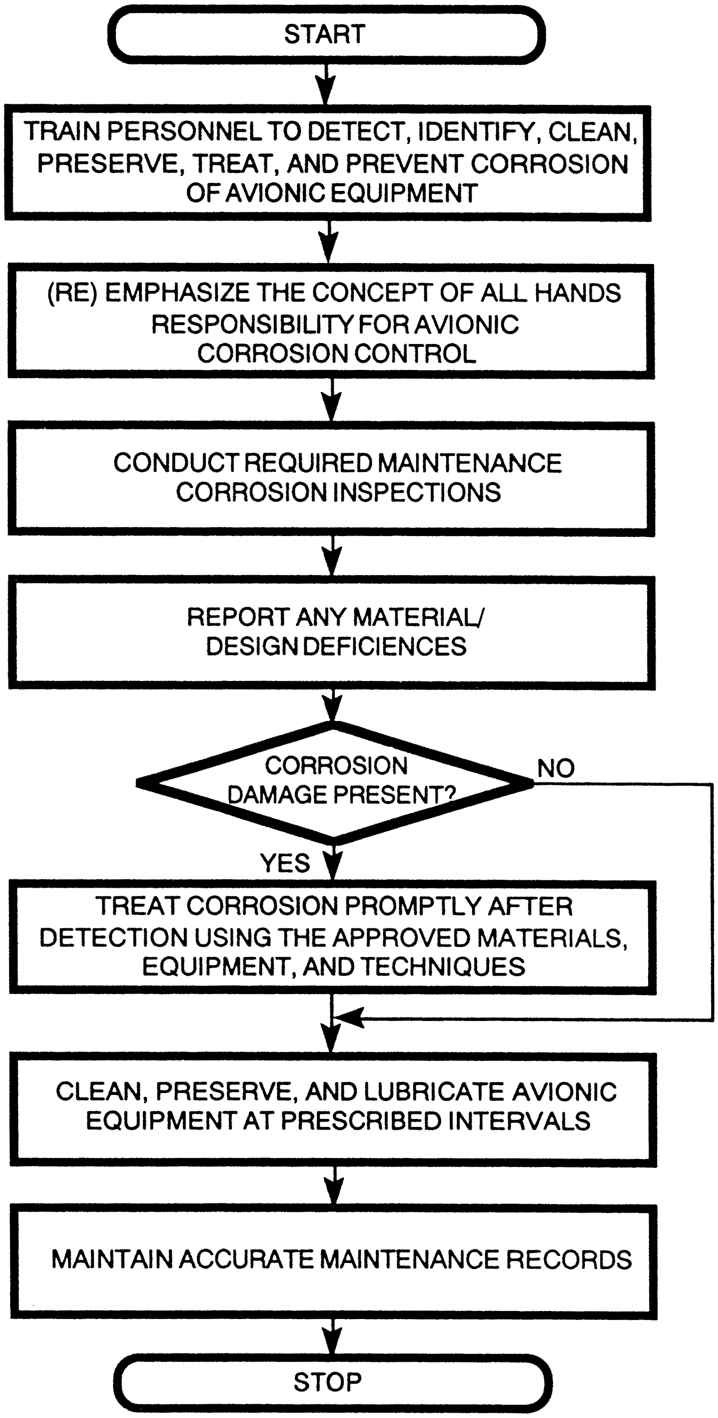


Figure 3-3. Corrosion Prevention General Workflow Diagram

3-2.5. Training and Qualification Requirements. Personnel responsible for corrosion preventive maintenance and treatment shall receive the following training.

a. Organizational/Unit and Intermediate Maintenance facility supervisors/personnel shall attend basic avionic corrosion control courses established by the parent service organization.

b. Avionic cleaning and repair personnel shall be trained in inspection, identification, cleaning, treatment, preservation, lubrication, hazardous material handling/hazardous waste disposal, and proper documentation reporting.

c. Supervisors shall ensure maximum use of in-service and on-the-job-training.

3-2.6. Maintenance and Readiness Data Collection. Identification of the specific causes and extent of avionic corrosion problems is essential. Reporting personnel shall identify/report corrosion discrepancies in accordance with OPNAVINST 4709.2 (Navy), T.O. 00-20-2(Air Force), or DA PAM 738-750/DA PAM 738-751 (Army). Improved equipment performance and maintenance assistance (personnel, equipment, materials, and procedures) are dependent on this data.

3-3. CORROSION-PRONE AREAS.

3-3.1. General. There are certain corrosion-prone areas common to all aircraft. For example, the bilge area of an airframe is particularly susceptible to moisture intrusion. This area is where cable runs, wire bundles, coaxial cables, lights, and antenna are installed. It is almost impossible to seal the equipment and components in this area against moisture and fluid intrusion. Even though the bilge is a rather obvious problem area, there are other areas of concern, such as structural, electromechanical, and electronic components.

a. Fundamental to preventive maintenance aspects of an avionic corrosion control program is the practice of frequent inspections and spot checks. This should be done by personnel familiar with the detection, analysis, and treatment of corrosion and microbial attack.

b. The most useful tool for detection of corrosion is the human eye. Visual inspection can usually reveal the existence of corrosion and microbial attack in their initial stages. This is usually when corrosion treatment is relatively easy. When corrosion or microbial attack is apparent, a specific and immediate program for corrective treatment involves paint and/or surface coating removal and cleaning. In addition, removal of corrosion/fungus, restoration of surfaces, and prompt application of protective coatings/paint finishes are also required. Each type of corrosion has its own peculiarities and will require special treatment.

3-3.2. Moisture and Other Fluid Intrusion Sources. The flexible airframe of modern military aircraft prevents effective sealing. Equipment bay doors, access panels, ducts, static pressure sensors, and other fuselage openings allow moisture intrusion. As a result, moisture and other fluids pool in water-traps or bilge areas not designed for their presence. In addition, the mission profile, mode of operation, and field climatic exposure extremes compound any problems associated with the inadequate environmental integrity of the airframe. When water penetrates the airframe, these lines and cables help direct moisture and fluid contaminants to avionic equipment and components. A simple hydraulic line can direct water many feet through the airframe and deposit it on equipment. This often occurs in areas of the airframe that are assumed to be protected. A wire bundle can carry moisture into the avionic equipment housing via an electrical connector backshell. Military aircraft are generally susceptible to moisture and other fluid intrusion originating from the following sources:

a. Rainstorms

b. Water washdown systems

c. Hand washing cycles

d. Sea water spray

e. Environmental control systems

f. Hydraulic, fuel, and engine oil, anti-icing and coolant line leaks

g. Condensation from cyclic temperature and pressure variation.

h. Emergency firefighting materials

i. Solvents, detergents, strippers, and other cleaning materials

3-3.3. Structural. Parts including housings, covers, supports, brackets, cabinets, and chassis are required for structural support. Corrosion on these parts should be treated to eliminate long term deterioration. Severe corrosion usually results from coatings failure and subsequent attack on exposed metal. The corrosion is caused by handling or environmental attack such as moisture and/or microbial contamination. Major repairs should be performed at Depot level. Preventive maintenance, corrosion control, and touchup procedures may be accomplished at the Intermediate maintenance level. Organizational/Unit maintenance level can provide minor assistance with these procedures.

3-3.4. Electromechanical. Motion is an integral function of electromechanical switches, relays, potentiometers, motors, generators, and synchro parts. Storage or nonuse in certain environments tends to promote corrosion of these parts. The principle causes of malfunction are dust, condensates, resultant corrosion products (oxides) and organic contaminant films. Failure of these parts normally does not occur during operation. The friction tends to keep the critical surfaces clean enough to permit operation. Insulating films form during nonuse and prevent startup of equipment. Once the equipment is activated, the insulating film is removed by friction between surfaces.

3-3.5. Electronic. Moisture and contamination penetrate into electronic systems causing many detrimental effects, corrosion being one of these. In most electronic systems, circuit areas have been minimized for faster signal processing and higher density. This means that most circuit paths are thin, or small in cross-sectional area, and that individual circuit paths are close together. In such systems, trace amounts of moisture and contamination may cause system failure. For example, if the aluminum surface of an integrated circuit (IC) is contaminated, affected circuit paths may become blocked. This extreme sensitivity requires special caution when dealing with corrosion in electronic systems. The typical effects of corrosion on avionic equipment are listed in Table 3-1.

3-3.6. Special Considerations. The control of corrosion in avionic systems is not unlike that in airframes. Procedures used for airframes are applicable to avionics with appropriate modifications. The general differences in construction and procedures between airframe and avionics relative to corrosion control are as follows:

a. Avionics rely on less durable protection systems.

b. Very small amounts of corrosion can make avionic equipment inoperative, as compared to airframes.

c. Dissimilar metals are often in electrical contact.

d. Stray electrical currents can cause corrosion.

e. Active metals and dissimilar metals in contact are often unprotected.

f. Closed boxes can produce condenstation via normal temperature changes during flight.

g. Avionic systems have many areas that trap moisture.

h. Hidden corrosion is difficult to detect in many avionic systems.

i. Many materials used in avionic systems are subject to attack by bacteria and fungi.

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

3-4. INSPECTION PROCESS.

3-4.1. General. Frequent corrosion inspections are essential to the overall corrosion control program. By early detection, identification, and treatment, the costs resulting from corrosion are minimized. Without regular systematic inspections, corrosion will seriously damage avionic equipment. The following paragraphs describe some of the basic aspects of visual inspection for corrosion and the tell-tale signs associated with various types of corrosion damage.

Table 3-1. Effects of Corrosion on Avionic Equipment

Component	Failure mode
Antenna systems	Shorts 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 effectiveness.
Control box mechanical and electrical tuning linkage and motor contacts	Intermittent operation and faulty frequency selection.
Water traps	Structural deterioration.
Relay and switching systems	Mechanical failure, shorts, intermittent operation, and signal loss.
Plugs, connectors, jacks and receptacles	Shorts, increased resistance, intermittent operation, and reduced system reliability.
Multi-pin cable connectors	Shorts, increased 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.
Waveguides	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	Shorts, increased resistance, component and system failures.
Batteries	High resistance at terminals, failure of electrical contact points, and structural deterioration of mounting. Erroneous cockpit signals.
Bus bars	Structural and electrical failures.
Coaxial lines	Impedance fluctuations, loss of signals, and structural deterioration of connectors.

3-4.2. Inspection Factors. Calendar-based and phase maintenance inspections shall be in accordance with parent service or command directives. However, extreme humidity, temperature, atmospheric conditions and time shall be considered when determining the frequency of corrosion inspections. The following factors shall be considered when establishing local inspection intervals:

a. Operational environment.

b. Known corrosion-prone areas such as battery components, ram air turbines, and electrical bonds.

c. Length of storage time, with respect to equipment and components.

d. Length of time aircraft is nonoperational.

e. Nonpressurized equipment and equipment bays.

f. Antenna and externally mounted avionic packages such as electronic countermeasure (ECM) pods.

g. Equipment mounted in water entrapment areas.

h. Equipment susceptible to particularly harsh environments, such as sonobuoys and magnetic anomaly detection (MAD) systems.

NOTE

Specific inspection criteria for individual types of avionic subsystems, equipment, and components are listed in Chapter 6.

3-4.3. General Inspection Procedure. The following general procedures shall be used for avionic corrosion inspection:

a. Clean area or component by wiping with cleaning cloth, CCC-C-46, Class 7 (Appendix A, Item 23), to remove interfering soil or contaminant.

b. Use a 10X magnifying glass (Appendix B, Item 10) to inspect for evidence of corrosion and determine extent of damage. In the case of miniature or micro-miniature circuit boards and components, use the appropriate microscope, as necessary.

c. Refer to the applicable service directives for damage limits.

3-4.4. Water Intrusion Inspection. The avionic technician should routinely inspect the interior of equipment bays for evidence of water intrusion. Any evidence of corrosion damage should be reported so that appropriate maintenance action can be scheduled. To determine and eliminate the source of water intrusion.

a. Verify installation of fasteners. Replace as required.

b. Inspect form-in-place gasket. Repair or replace as required in accordance with the applicable structural repair manual.

c. Verify water drains are open and clear.

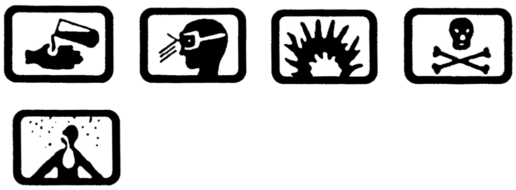
d. Prepare compartment with "witness material" such as blotter paper. paper towels, etc. The "witness material" shall be placed in a manner that will indicate a leakage path during the water test.

e. Secure compartment doors.

f. Where fresh water is in adequate supply, apply water with a hose to the exterior surface for approximately 5 minutes. Where water is in short supply, slowly pour a bucket of fresh water over the exterior surface.

g. Allow 3 to 5 minutes for water to drain.

h. Open compartment doors and examine "witness material" for signs of water.



Adhesive/Sealant, Silicone RTC, Non-Corrosive	1
Sealing and Coating Compound (polysulfide)	2
Compound, Corrosion Preventive, Water Displacement	3

i. If leaks are observed, they shall be sealed with MIL-A-46146 or MIL-PRF-81733 (Appendix A, Items 27 and 29). MIL-PRF-81733 shall be used in contact with fluids such as coolants, fuel, hydraulic oil, etc.

NOTE

Where torquing is required to tighten hardware, refer to specific technical manual for proper torque values.

j. Where applicable, apply MIL-C-81309 (Appendix A, Item 16) to threads of fasteners before reinstallation.

k. Secure access/compartment doors.

l. Repeat water test until no leaks are detected.

3-4.5. Evaluation of Corrosion Damage. Correct evaluation of avionic corrosion damage is necesssary, and shall be classified as follows:

a. Repairable damage is damage that does not exceed the limits specified in the applicable service directives. The damaged surface or component shall be cleaned, treated, and a preservative applied, as applicable.

b. Replacement is required when damage exceeds repair limits.

3-5. RECOGNIZING AVIONIC CORROSION.

3-5.1. GENERAL. Recognizing corrosion in metals is an important part of an avionic corrosion control program. Metals are susceptible to corrosion because they tend to return to their natural forms such as oxides, carbonates, and other compounds. Modern avionic systems make use of many metals not normally considered for airframe structures. Some of the rarer metals are found in transistors, miniature and microminiature circuits, and integrated circuits. Table 3-2 lists metals most commonly used in electronics. In addition to recognizing corrosion in metals, the inspection process must include the recognition of corrosion caused by solder flux, microbes, insects, and animal attack. The characteristics of corrosion on metals used in avionic systems are summarized in Table 3-3.

3-5.2. Corrosion Effects On Metals. Deterioration of metals can appear in many forms and is especially prevalent in salt spray or saltwater atmosphere. No metal has perfect environmental integrity and is totally resistant to corrosion. As a result, metals will corrode sooner or later, especially when contacting one another in a damp environment. The following paragraphs provide a description and identification of corrosion with respect to the commonly used metals.

3-5.2.1. Iron and Steel. Iron and steel are used as component leads, magnetic shields, transformer cores, brackets, racks, and general hardware. Hardware made of steel or iron is usually plated with nickel, tin, or cadmium. Corrosion of steel is easily recognized because the corrosion product is red or black rust. When iron base alloys corrode, dark corrosion products usually form first. This material will promote further attack by absorbing moisture from the air. The most practicable means of controlling corrosion of unplated steel or iron is complete removal of the corrosion product. Iron and steel surfaces are normally protected by painting or a preservative compound.

3-5.2.2. Corrosion Resistant Steel. Stainless steel is used for mountings, racks, brackets, and hardware in avionic systems. Stainless steel is not readily susceptible to corrosion because of a tough chromium oxide film on the surface. However, exposure to saltwater will cause pitting. Stainless steel is ordinarily considered corrosion resistant, but is susceptible to crevice corrosion. The corrosion product of stainless steel is a roughened surface with a red,

Table 3-2. Metals Most Commonly Used in Avionic 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.

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	White or gray powder
Titanium alloy	Highly corrosion resistant; extended or repeated contact with chlorinated sole-vents may result in embrittlement; cadmium plated tools can cause embrittlement of titanium	No visible corrosion products
Magnesium alloy	Highly susceptible to corrosion	White powder snowlike 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 to pitting in marine environment (300 series more corrosion resistant than 400 series)	Corrosion evidenced by rough surface; sometimes by red, brown or black stain

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TO 1-1-689
TM 1-1500-343-23

Table 3-3. Nature and Appearance of Corrosion Products on Metals (Cont)

Alloy	Type of attack to which alloy is susceptible	Appearance of corrosion product
Nickel alloy (inconel)	Generally has good corrosion-resistant qualities; sometimes susceptible to pitting	Green powdery deposit
Copper-base alloy (monel)	Surface and intergranular	Blue or blue-green powder deposit
Cadmium (used as a protective plating for steel)	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 electrical connectors	Pitting and flaking of surface plating	Nickel, being cathodic to aluminum, does not corrode itself but promotes corrosion of aluminum base metal where pits occur in the plating

brown, or black stain. Corrosion treatment of stainless steel should be limited to cleaning.

3-5.2.3. Aluminum. Aluminum and aluminum alloys are widely used in avionic systems for housing, cabinets, chassis, structures, and mounting fixtures. In the salt air environment, all aluminum alloys require protection because they are subject to one or more types of corrosion. In some cases, the corrosion products of metal in contact with aluminum are corrosive to aluminum. Paint coatings tend to mask evidence of corrosion. Metal damage usually shows up as blisters, flakes, chips, lumps, or other irregularities in the paint coating. The corrosion products of aluminum are white to gray powdery material. Aluminum surfaces are protected by chemical conversion coating, painting, or preservative compound.

3-5.2.4. Magnesium. Magnesium alloys are the lightest metals used extensively throughout avionic systems. They can be found in antennas, structures, chassis, supports, and frames. Magnesium is highly susceptible to corrosion when exposed to any environment without a protective coating. Magnesium forms a strong anodic galvanic cell with every other metal and is always the one attacked.

Magnesium is subject to direct acid attack, deep pitting, stress-corrosion, intergranular, and galvanic corrosion. The corrosion products are white powdery snow-like mounds. The deposits have a tendency to raise slightly and the corrosion spreads rapidly. When the white puffy areas are discovered, it requires prompt treatment or the corrosion will penetrate entirely through the structure. Magnesium surfaces are protected by chemical conversion coating, painting, or preservative compound.

3-5.2.5. Copper. Copper and copper-based alloys are generally used in avionic systems as contacts, springs, leads, connectors, printed circuit board conductors, and wires. Copper and copper-based alloys (brass and bronze) are quite resistant to atmospheric corrosion. However, copper is cathodic to iron, steel, aluminum, and magnesium when in electrical contact with these metals. Sometimes copper or copper alloy surfaces tarnish to a dull gray-green color and the surface will remain relatively smooth. This discoloration is the result of the formation of a fine-grained, airtight copper oxide crust. This crust offers good protection for the underlying metal in ordinary situations. However, exposure of copper and copper alloys to moisture or salt spray causes the formation of blue-green salts indicating active surface corrosion. Copper and copper alloys are not usually painted.

3-5.2.6. Cadmium. Cadmium is used as a coating to protect steel hardware, such as bolts, washers, and screws and as plating on electrical connectors. It is also used to provide a compatible surface when a part is in contact with other materials. Cadmium, when coupled with steel, is anodic and protects the steel by galvanic action. Corrosion on cadmium is evident by white to brown to black mottling of the surface. When cadmium plate shows mottling and cracks in the coating, the plating is still performing its protective function as an anodic material. The cadmium plate on iron or steel is still protecting the base metal until signs of rust begin to appear. Care should be taken not to remove undamaged cadmium plate adjacent to the corroded area.

3-5.2.7. Silver. Silver is normally used as plating material over copper in waveguides, miniature and microminiature circuits, and wires on contacts. It is also often used in cavities and RF shielding. Silver does not corrode in the ordinary sense, although it will tarnish in the presence of sulfur. The tarnish appears as a brown to black film. The tarnish is silver sulfide and may or may not be detrimental to circuit electrical characteristics, depending on the application.

3-5.2.8. Red Plague. When silver is plated over copper there can be an accelerated corrosion of the copper. This occurs through galvanic action, at pinholes or breaks in the silver plating. One example of this is the deterioration of silver plated copper wire. This problem is compounded because the wire insulation prohibits detection of breaks in the silver plating until damage is extensive. This “red plague” is readily identifiable by the presence of a brown-red powder deposit on the exposed copper. Silver plating over nickel plate does not exhibit the red plaque phenomenon.

3-5.2.9. Gold and Gold Plating. Traditionally considered the best coating for corrosion resistance and solderability, gold used on printed circuits, semiconductors, leads, and contacts. Gold is usually applied in a thin layer over nickel. silver, or copper. Gold is a noble metal (pure metal in nature) and does not normally corrode; however, a slight deposit will appear as a darkening of reflecting surfaces. Tarnish removal is critical on gold components because of the very thin coatings used. Gold plated over silver or copper in thin layers accelerates corrosion over the less noble metals (silver or copper). This occurs at the pores or pinholes in the gold. This corrosion is readily identified as tarnishing of the silver and blue-green deposits on the copper.

3-5.2.10. Purple Plague. Purple plague is a brittle gold-aluminum compound formed when bonding gold to aluminum. The growth of such a compound can cause failure in microelectronic interconnection bonds.

3-5.2.11. Tin. The use of tin in solder is a well-known application. However, tin plating is also common on RF shields, filters, crystal covers, and automatic switching devices. Tin has the best combination of solderability and corrosion resistance of any metallic coating. The problem with tin is its tendency to grow “whiskers” on tin plated wired and other plating applications.

3-5.2.12. Black Plague. Black plague is a black substance that forms in the coolant of high power radars. It adheres to immersed metal surfaces and adversely affects the heat transfer characteristics of the coolant. Corrosion removal shall be the same as defined for the base metal.

3-5.2.13. Nickel. Nickel is primarily used as an electroless coating and is subject to pitting corrosion. Flaking of the nickel coating can also occur when an underlining metals corrodes.

3-5.3. Corrosion Effects on Nonmetals. Deterioration attacks on nonmetallic subassemblies and other hardware cost the military million of dollars. This is in addition to replacement parts costs and reduction of aircraft system availability. In almost all cases the deterioration of a nonmetallic material permits moisture intrusion. This creates physical swelling, distortion, mechanical failure through cracking; altering of electrical characteristics, etc. The most common nonmetals used in avionic systems and their corrosion-produced nature/appearance are listed in Tables 3-4 and 3-5, respectively.

CAUTION

Ultraviolet (UV) light causes negatively charged materials to lose their charge. Prolonged exposure could cause damage to electrostatic discharge sensitive (ESD) devices. Do not use UV light source for long periods of time.

3-5.4. Corrosion Effects of Solder Flux. Solder flux residues may be conductive as well as 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. Ultraviolet light may be used to detect the flux resin residue. Under the Ultraviolet light, traces of flux appear as a fluorescent yellow to light brown residue.

3-5.5. Effects of Microbial Attack. Bacteria and fungi not only feed on organic material but release acids which are corrosive. Bacteria and fungi may be found on encapsulants, conformal coated circuit boards, rubber gaskets, thermoplastics, optical lenses, etc. The presence of bacteria and fungi can readily be identified by damp, slimy, and bad smelling growths. These vary in color from black, blue-green, green, and yellow.

3-5.6. Effects of Insect and Animal Attack. Small insects and animals may enter packaged equipment and feed on various organic material such as polyethylene, insulation, wire coatings, etc. This can result in system or equipment failure. The presence of nests, holes in packaging, and excrement indicate animal or insect attack. This problem is more severe in equipment that is out of service for an extended period. Inspection and equipment integrity are in the best methods of controlling this problem.

Table 3-4. Nonmetals Most Commonly Used in Avionic Systems

Acrylics	Encapsulants	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
Acrylic	UV light, moisture solvents	Discoloration, cracking
Adhesive	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
Elastomer	Heat, UV light, excessive cycling	Cracks, crazing, discoloration
Encapsulation	UV light, moisture	Cracking, peeling, disbonding
Felt	Moisture, mildew	Discoloration, looseness
Glass	Heat, mechanical damage (broken)	Cracked, discolored
Laminates	UV light, moisture solvents	Discolored, disbond, delamination
Paint	Moisture, heat, humidity	Bubbles, peeling, cracking
Plastic	UV light, heat, abrasion	Discoloration, cracks, deformation
Polymers	Extreme heat, solvents	Discoloration, deformation
Potting Compounds	UV light, moisture, heat	Discoloration, cracks, deformation
RTV (noncorrosive)	Moisture, UV light, heat	Peeling, debonding, discoloration
Sealants	Moisture, UV light, heat	Peeling, debonding, discoloration

CHAPTER 4
CLEANING AND PRESERVATION

4-1. GENERAL

a. The materials, equipment, and techniques described in this chapter are intended to assist the avionic technician at the Intermediate Maintenance Activity (IMA). This includes the cleaning, drying, preserving, packaging, handling and shipping of avionic equipment. Generally, where support equipment is available, corrosion removal, cleaning, and drying is more efficient.

b. Gross contamination requires support equipment capable of cleaning and corrosion removal as specified in the cleaning tracks (paragraph 4-4). The alternate cleaning procedures listed (paragraph 4-5) are considered efficient for "day-to-day" cleaning and when support equipment is not available.

c. Pending standardization, use only support equipment that meets the general specifications as outlined in Appendix C.

d. The support equipment that is available in the supply system is listed in Appendix B. The general operating procedures and limitations for all of the various support equipment are listed in this chapter.

4-2. AVIONIC CORROSION CLEANING FACILITY.

4-2.1. Requirements. Where space permits, a separate avionic corrosion control cleaning facility center shall be established as specified in OPNAVINST 4790.2 (Navy) or TO 00-20-1 (Air Force). See Figure 4-1 for an example of an avionic cleaning facility arrangement. The avionic cleaning facility and staffing shall include the following as a minimum:

CAUTION

Maintenance personnel should be concerned about safety at all times. Cigarette smoke, food, and beverages can contaminate and damage avionic equipment. Do not smoke or have food or beverages in the same work space as maintenance operations.

a. Adequate space for safe operation of avionic cleaning and corrosion removal equipment.

b. Personnel trained in the operation of each piece of support equipment.

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

d. Operating instructions for each piece of support equipment.

e. Safety equipment and clothing as required by local directive and this manual.

f. Personnel trained in recognition of corrosion on avionic equipment as specified in this manual.

g. Avionic technicians who can recognize the various electrical and electronic components.

4-2.2. Alternate Requirements. Support equipment shall be placed where fumes, overspray, dust, or other residual materials will not contaminate avionic modules or components. The requirements specified in paragraph 4-2.1 shall also apply wherever cleaning and corrosion removal equipment is operated. Close supervision and sufficient quality assurance personnel/procedures are required at the avionic cleaning facility. Cleaning and corrosion removal equipment can be detrimental to some avionic components. The decision to use cleaning and corrosion removal equipment shall be the responsibility of the avionic cleaning facility supervisor.

4-2.3. Induction Procedures. The induction of avionic equipment for cleaning and/or corrosion control shall be as follows:

a. Induction of avionic equipment shall be documented on the appropriate maintenance action forms (MAFs) in accordance with procedures established under OPNAVINST 4790.2 (Navy), TO 00-20-1 (Air Force), or DA PAM 738-750/DA PAM 738.751 (Army).

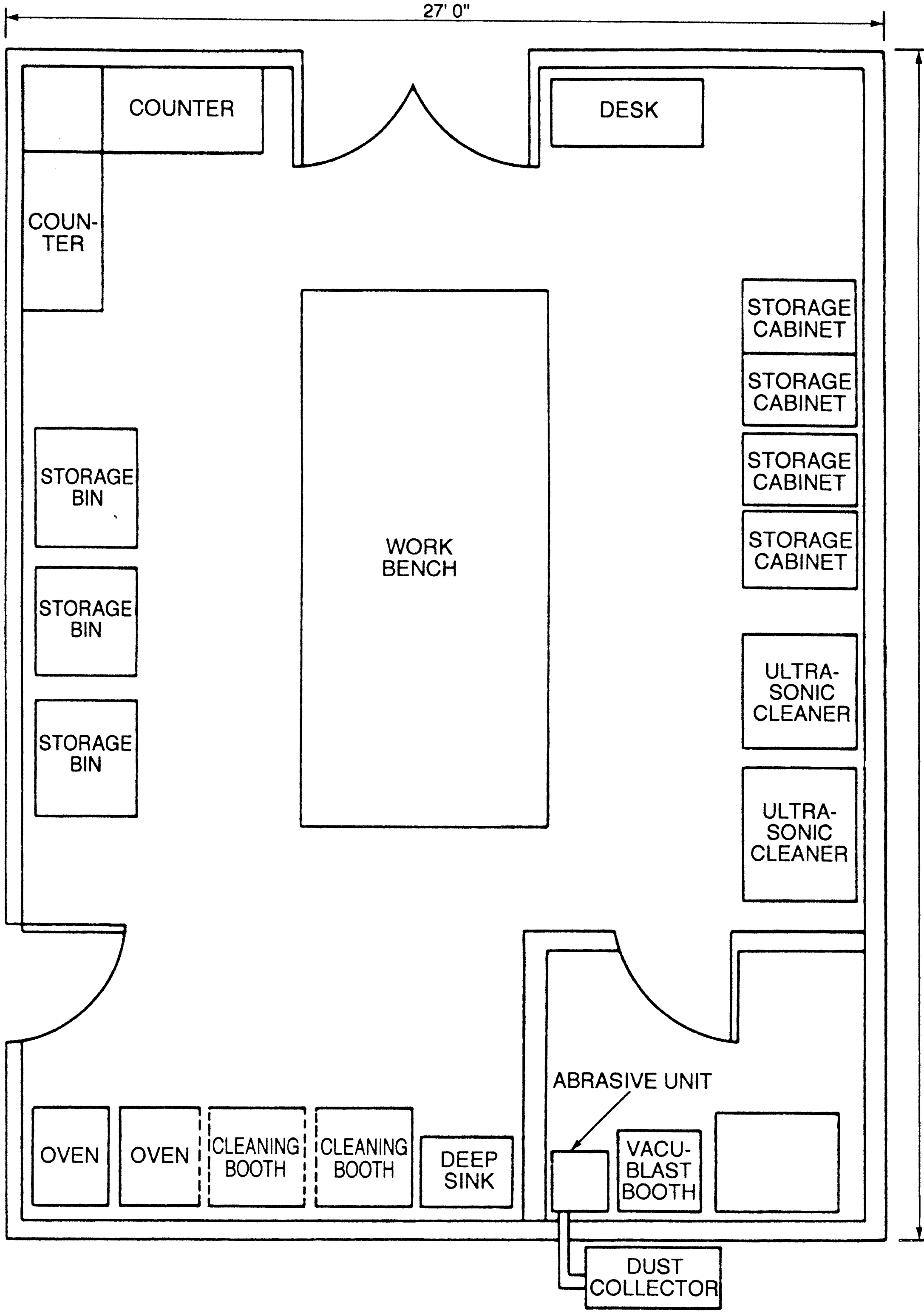


Figure 4-1. Typical Avionic Cleaning Facility

b. Each module or component inducted shall be inspected for:

(1) The type of contamination.

(2) The extent of corrosion damage.

(3) Identification of items considered sensitive to cleaning and corrosion removal procedures.

c. After inspection, the “cleaning track” shall be selected by the criteria provided in paragraphs 4-4.5 through 4-4.10.

4-3. MATERIALS AND SUPPORT EQUIPMENT REQUIREMENTS.

4-3.1. General. Avionic technicians must understand the functions, capabilities, and restrictions that apply to each material and piece of support equipment. This prevents damage to personnel and avionic equipment that could result from improper use.

4-3.2. Materials. Consumable materials listed in Appendix A and accessories listed in Appendix B shall be used for corrosion control. These materials have been approved only after extensive testing to prove their ability to perform properly and effectively. Materials or processes considered or be an improvement over existing ones, after local laboratory analysis and evaluation, shall be forwarded to the Aircraft Controlling Custodians (ACC) or System Program Manager (SPM) for submission to the parent service organization for further evaluation. When approved materials are not available, subsitutions shall only be made by the appropriate ACC/SPM.

4-3.3. Materials Use. Only those materials listed in this manual shall be used for cleaning or corrosion control of avionic components. Materials listed in other manuals shall be used only when required procedures are not covered by this manual. Promising materials technology, after local laboratory analysis and evaluation, shall be forwarded to the parent service organization for further evaluation. When several methods or materials are listed, the preferred one is listed first, with alternates following.

4-3.4. Support Equipment. The following is a list of support equipment:

a. Booth, Cleaning, Water Base Solvent Spray (Appendix B, Item 26). Refer to paragraph 4-5.2.4.

b. Circulating Air Drying Oven (Appendix B, Item 27). Refer to paragraph 4-6.5.

c. Forced Air Drying Oven (Appendix B, Item 28). Refer to paragraph 4-6.6.

d. Paint Spray Booth. (Appendix B, Item 30)

e. Aqueous Ultrasonic Cleaner (Appendix C, Item 1). Refer to paragraph 4-5.2.2.

f. Solvent Ultrasonic Cleaner (Appendix C, Item 2). Refer to paragraph 4-5.2.3.

g. Portable Mini-Abrasive Unit (Appendix C, Item 3).

h. Blast Cleaning Cabinet. (Appendix B, Item 29)

i. Paint Spray Tools, paragraph 5-4.3.

4-3.5. Support Equipment Use. Each piece of support equipment has been selected to perform specific functions. These intended functions are identified in Chapter 5 and include general limitations applicable to each type of support equipment. Maintenance personnel should refer to the appropriate support equipment operating manuals for specific operating instructions.

4-4. CLEANING TRACKS.

4-4.1. General. A cleaning track represents a definite process that applies to a particular type of contaminant or corrosion product. This includes consideration for the restrictions that may apply to a specific piece of support equipment and/or avionic component. It is imporatant that cleaning equipment operators have a thorough knowledge of electrical and electronic equipment. This should be supplemented by a knowledge of which components can be processed by a particular cleaning track. These cleaning tracks are shown in Figure 4-2.

4-4.2. Cleaning Track Identification. Cleaning Tracks Diagram, Figure 4-2, shall be used in conjunction with Cleaning Track Legend, Table 4-1. The cleaning track legend defines each element of the cleaning track. Each function and subfunction on the cleaning track is assigned an alphanumeric code. These characters are used to identify the cleaning track for recordkeeping purposes. It may be desirable to keep a log of all avionic equipment and components processed through the cleaning tracks. In such cases, the cleaning track number would identify exactly the process used when cleaning a particular component.

4-4.3. Cleaning Track Example. As an illustrative example of cleaning track use, assume the cleaning track is “BCSR235”. This would correspond to the following maintenance actions (refer to Figure 4-2 and Table 4-1):

a. B - Clean with hand-held abrasive tool and glass beads.

b. C - scrub with brush.

c. S - Clean in Booth, Cleaning, Water Base Solvent Spray (Appendix B, Item 26) with 1 ounce of detergent MIL-D-16791 (Appendix A, Item 10) in 1 gallon of fresh water at 10 lb/in^2.

d. R - Rinse in Booth, Cleaning, Water Base Solvent Spray with fresh water at 30 lb/in^2.

e. 2 - Dry in Circulating Air Drying Oven at 130°F (54°C).

f. 3 - Drying time of 4 hours.

g. 5 - Preserve as required.

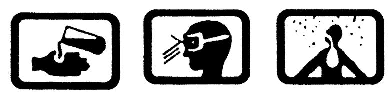
4-4.4. Cleaning Tracks Descriptions. The cleaning tracks are designed to fulfill specific functions. Drying selection depends on availability of drying ovens, volume of the component, and time available for drying. Appropriate painting, preservation, and packaging steps are selected for the individual item being cleaned. The following are description of each cleaning track based on Figure 4-2, and Table 4-1.

a. Track No. 1

(1) This track removes light dirt, dust, and salt spray. Solvent and detergent ultrasonic cleaners are not required. This track is considered the mildest and has the widest application in cleaning of various types of avionic equipment.

(2) The component is cleaned and rinsed in the Booth, Cleaning, Water Base Solvent Spray (Appendix B, Item 26) using Detergent, MIL-D-16791 (Appendix A, Item 10).This is mixed 1 ounce of detergent in 1 gallon of fresh water.

b. Track No. 2



Compound, Aircraft Cleaning 4

(1) This track removes heavy dirt, light corrosion products, and salt spray. The component is hand scrubbed with Cleaning Brush, A-A-2074 (Appendix B, Item 31), and a diluted solution of Cleaning Compound, MIL-PRF-85570, Type II (Appendix A, Item 11). This is mixed one part cleaning compound to ten parts of distilled water.

(2) After the scrubbing cycle, the component is cleaned and rinsed in the Booth, Cleaning, Water Base Solvent Spray (Appendix B, Item 26). If required, the component is processed through Track No. 1 to remove dirt and contaminants in hard to reach areas

c. Track No. 3

(1) This track removes heavy rust and other corrosion deposits. The component is placed in a Blast Cleaning Cabinet and cleaned with a hand-held abrasive tool. This tool, included in cleaning cabinet, is used to clean the rust and corrosion.

Compound, Aircraft Cleaning 4

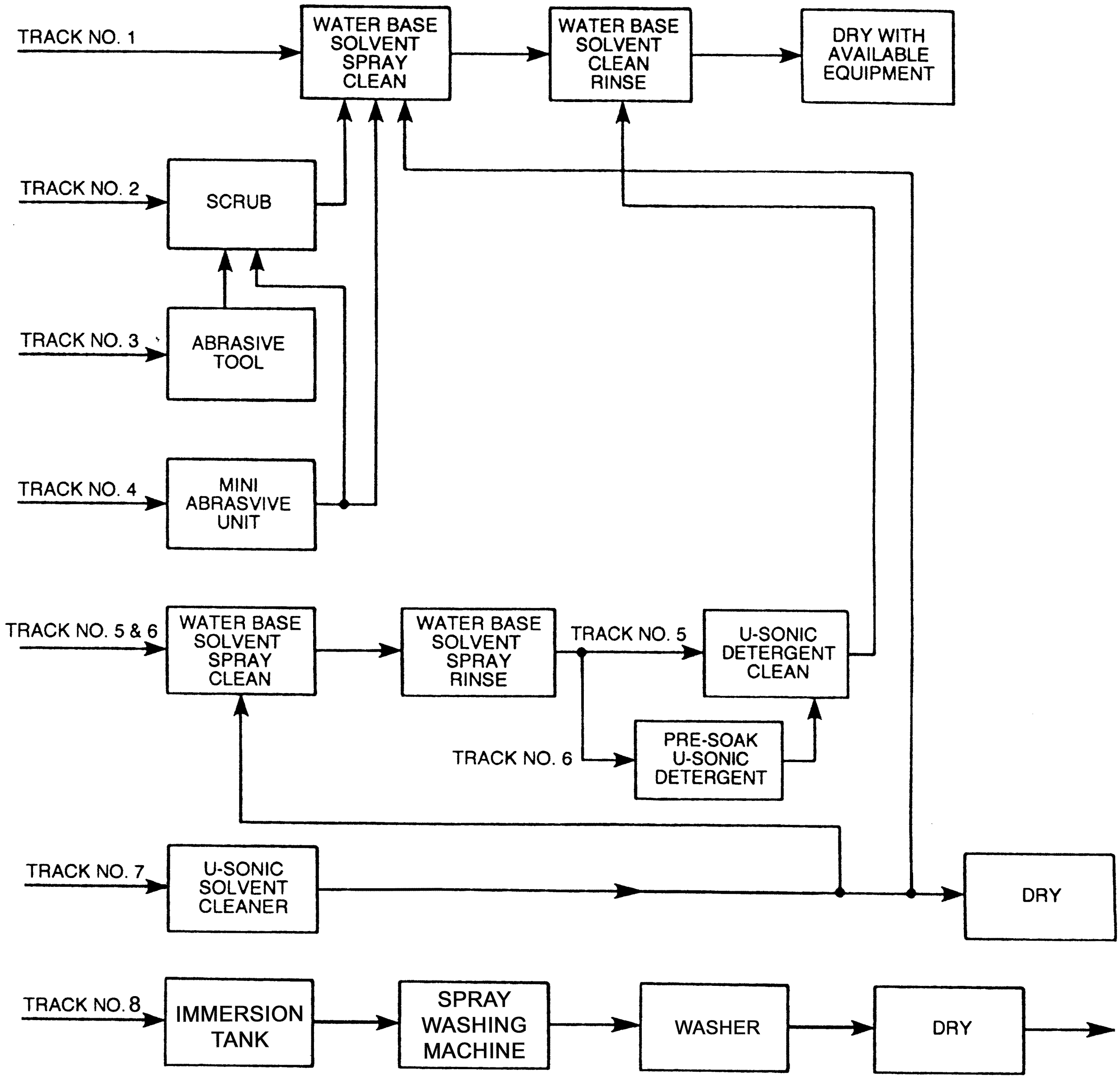


Figure 4-2. Cleaning Tracks Diagram

Table 4-1. Cleaning Track Legend

Code	Equipment	Notes
B	Abrasive Tool	Glass Beads, SAE-AMS-2431 (Appendix A, Item 73)
C	Scrub	Cleaning Brush, A-A-2074 (Appendix B, Item 31)
S	Water Base Spray Clean	Detergent, MIL-D-16791 (Appendix A, Item 10) at 30 psi
R	Water Base Spray Rinse	Fresh Water Rinse at 30 psi.
W	Mini-Abrasive Unit	Sodium Bicarbonate, Technical ASTM D-928 (Appendix A, Item 43)
P	U-Sonic Detergent Presoak	1 ounce Detergent, MIL-D-16791 (Appendix A, Item 10) to 1 gallon of water at 30 psi at 130°F (54°C)
PA	U-Sonic Detergent Presoak	30 seconds
PB	U-Sonic Detergent Presoak	60 minutes
D	U-Sonic Detergent Clean	1 ounce Detergent, MIL-D-16791 (Appendix A, Item 10) to 1 gallon of water at 30 psi at 130°F (54°C)
DA	U-Sonic Detergent Clean	30 seconds
DB	U-Sonic Detergent Clean	3 minutes
DC	U-Sonic Detergent Clean	15 minutes

Table 4-1. Cleaning Track Legend (Cont)

Code	Equipment	Notes
1	Forced Air Drying Oven	130°C (54°C)
1A	Forced Air Drying Oven	30 minutes
1B	Forced Air Drying Oven	1 hour
1C	Forced Air Drying Oven	2 hours
2	Circulating-Air Drying Oven	130°F (54°C)
2A	Circulating-Air Drying Oven	4 hours
2B	Circulating-Air Drying Oven	8 hours
2C	Circulating-Air Drying Oven	16 hours
3	Air Drying	As required
4	Paint	Refer to paragraph 5-4
5	Preservation	Refer to preservation procedures as specified for component requiring preservation in paragraph 4-6.7
6	Conformal coating	Refer to NAVAIR 01-1A-23 (Navy) or TO 00-25-234 (Air Force)
7	Packaging	Refer to paragraph 4-9.4

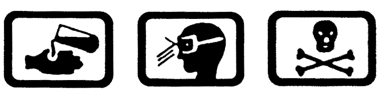
(2) After the abrasive cycle, the component is hand scrubbed with a Cleaning Brush, A-A-2074 (Appendix B, Item 31), and a diluted solution of Cleaning Compound, MIL-PRF-85570 (Appendix A, Item 11). This is mixed one part cleaning compound to ten parts of distilled water.

(3) After the scrubbing cycle, the component is cleaned and rinsed in the Booth, Cleaning, Water Base Solvent Spray (Appendix B, Item 26). If required, the component is processed through Track No. 1 to remove dirt and contaminants in hard to reach areas.

d. Track No. 4

(1) This track removes light or heavy corrosion products from small delicate components. For example, edge connector pins on printed circuit boards, relay contacts, plugs, etc. The component is placed in a Blast Cleaning Cabinet. The Portable Mini-Abrasive Unit (Appendix C, Item 3) is used to remove the rust and corrosion.

(2) Sodium Bicarbonate, Technical, ASTM D-928 (Appendix A, Item 43) is water-soluble, making final cleaning of the component relatively simple.



Compound, Aircraft Cleaning 4

(3) After the abrasive cycle, if required, the component is hand scrubbed with a Toothbrush and Cleaning Compound, MIL-PRF-85570, (Appendix A, Item 11). This is mixed one part cleaning compound to ten parts of distilled water.

(4) After abrasive and scrub cycles, the component is cleaned and rinsed in a Booth, Cleaning, Water Base Solvent spray.

(5) As in the previous tracks, the component is processed through Track No. 1, as required, to remove contaminants from hard to reach areas.

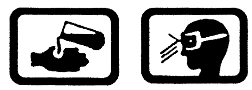
e. Track No. 5

(1) This track removes general dirt and dust, salt spray, and light corrosion, particularly in hard to reach areas of electronic assemblies.

(2) This track follows the same steps as Track No. 6 with the exception of the presoak step.

(3) If the contaminants remain, the process is repeated as required.

f. Track No. 6.



Detergent, Non-ionic 5

(1) This track loosens heavy dirt, corrosion products, and light residues of oil grease, and hydraulic fluids. The component is precleaned and rinsed in a Booth, Cleaning Water Base Solvent Spray.

(2) The Aqueous Ultrasonic Cleaner (Appendix C, Item 1)uses a cleaning solution of water and Detergent, MIL-D-16791 (Appendix A, Item 10). This is mixed 1 gallon of water to 1 ounce of detergent at 130°F (54°C).

(3) The component is suspended in the ultrasonic tank solution in a wire basket approximately 12 inches below the surface. Presoak for a period of 30 to 60 minutes, as appropriate.

(4) After the presoak cycle, the component is cleaned in the same tank by ultrasonic mode at 20 kHz.

(5) The selection of time cycle for ultrasonic mode depends on the amount of contamination.

(6) The component is rinsed in a Booth, Cleaning, Water Base Solvent Spray after ultrasonic cleaning. If contaminants remain, the component is returned to presoak and the process is repeated as required.

g. Track No. 7

(1) This track removes grease, oil, and hydraulic fluid contamination. The solvent degreasing operation is performed by the Solvent Ultrasonic Cleaner (Appendix C, Item 2). The ultrasonic tanks use cleaning compound Appendix A, Item 12.

(2) The component is placed in the ultrasonic solvent tank 6 inches above the bottom of the tank to complete the cleaning cycle.

(3) The selection of time cycle for ultrasonic mode depends on the amount of contamination present and the type of circuitry involved.

(4) If required, the component is cleaned and rinsed in the Booth, Cleaning, Water Base Solvent Spray, (Appendix B, Item 26).

h. Track No. 8 (see Appendix D).

4-4.5. Cleaning Track Selection Criteria. Always select the mildest form of cleaning that will accomplish the task. The selection of the cleaning track to be used is based on the following criteria:

a. Type and extent of the contamination or corrosion.

b. Accessibility to the contamination or corrosion.

c. Type of avionic equipment.

4-4.6. Type and Extent of the Contamination. Table 4-2 describes the various forms of contamination and the cleaning track best suited for each. There is more than one track available for cleaning, with the exception of oil, grease, and hydraulic fluid. Use hand-cleaning procedures as alternatives to unavailable or invalid cleaning tracks.

4-4.7. Cleaning Track Preselection Requirements. The avionic cleaning facility supervisor or equipment operator shall identify the type of contamination and extent of the damage to select the correct cleaning track. Experience has shown that most avionic equipment has dirt, dust, or some form of corrosion present, and requires cleaning. If contamination or corrosion is not evident, confirmation via inspection is required by an experienced avionic technician.

4-4.8. Accessibility to Contamination and Corrosion. Visual inspection of avionic components usually indicates the extent of contamination and corrosion damage. Visual inspection also determines the cleaning method required to remove contaminants or corrosion from tight areas. The aqueous ultrasonic and solvent ultrasonic cleaners provide the most efficient means of cleaning hard to reach areas. Consideration must also be given to drying that follows the cleaning cycle. In some cases, the most efficient means of cleaning may require extensive drying. This makes the whole process less efficient.

4-4.9. Type of Avionic Equipment. The criteria for selection of a cleaning track are also based on type of avionic component to be cleaned. A thorough inspection of the item to be cleaned is important to determine the type of circuitry and components involved. Table 4-3 is a guide for determining the cleaning track to use on various electronic and electrical components.

4-4.10. Cleaning Restrictions.

a. Selection of the cleaning track is a decision to be made by the avionic cleaning facility supervisor. Certain circuit components can be damaged by support equipment.

b. The use of support equipment on certain avionic equipment and components is restricted (paragraphs 4-5.2.2 to 4-5.2.5).

4-5. ALTERNATE CLEANING MATERIALS, EQUIPMENT, AND TECHNIQUES.

4-5.1. Avionic Cleaning Materials. The following paragraphs provide information to ensure the proper selection and application of avionic cleaning materials.

4-5.1.1. Availability of Materials. Only materials, equipment, and techniques approved by the applicable parent service organization shall be used on military aircraft and avionic systems. Appendix A (Consumable Supplies and Materials), Appendix B (Tools and Support Equipment), and Appendix C (Special Support Equipment) are provided to ensure the availability of approved materials and equipment.

TABLE 4-2. Types of Contamination Versus Cleaning Tracks

Type of contamination	Cleaning Track Numbers							
	1	2	3	4	5	6	7	8
Light dirt/dust	X				X			X
Heavy dirt/dust		X				X		
Salt Spray	X	X			X	X		X
Light corrosion		X		X	X			X
Heavy corrosion			X	X		X		X
Oil						X	X	
Grease						X	X	
Hydraulic fluid						X	X	

4.5.1.2. Materials Used for Cleaning. Table 4-4 contains a list and description of the authorized cleaning materials for avionic equipment. Cleaning can be accomplished as follows:

CAUTION

Some of the materials identified in Table 4-4 can create hazardous conditions or damage equipment unless used strictly in the applications and manner described. Authorized alternative materials are included in this manual, where applicable, to allow for potential supply shortages.

a. Solvent cleaning - solvents are effective in dissolving grease and oil. Solvents can be applied by wiping, brushing, soaking, or spraying.

b. Detergent/water cleaning - varying concentrations of detergent and water mixtures are used to remove dust, dirt, salt, grease, and oil. Detergent/water mixtures can be applied by wiping, brushing, soaking, and spraying.

TABLE 4-3. Recommended Cleaning Process Versus Type of Avionic Equipment

Type of equipment	Acqueous ultrasonics	Solvent ultrasonics	Water base spray booth	Abrasive tool	Mini-abrasive	Hand clean
Housing/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
Waveguides	X	X	X	X(1)	X	X
Wire harnesses			X		X	X
Servos/synchros					X(1)	X
Antennas, blade	X	X	X		X	X
Antennas, dome	X(1)	X(1)	X	X(1)	X	X
Antennas, radar			X	X(1)	X	X
Antennas, ECM					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 and connectors			X		X	X
High density connectors					X	X
Edge connectors			X		X	X
Coaxial Connectors					X	X
Printed circuit boards			X			X

Note: (1) External use only.

TABLE 4-4. Avionic 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 and covers, and antenna assemblies.	Mix one part cleaner in 10 parts distilled water and apply with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23). Rinse with fresh water and wipe dry.	Do not use around oxygen, oxygen fittings, or oxygen regulators fires or explosion may result.
	Heavy concentration of surface grime, oil, exhaust smudge and fire extinguishing chemicals in equipment bays and on external cases and covers.	Mix one part cleaner in six parts distilled water and apply with Cleaning Cloth CCC-C-46, Class 7 (Appendix A, Item 23). Rinse with fresh water and wipe dry.	Never use full strength, Do not allow to dry on surface. Refer to Chapter 10 for emergency cleaning procedures after immersion or exposure to excessive amounts of salt water, fire extinguishing chemicals, soot, smoke, or vaporous gases.
Detergent, Liquid, Nonionic MIL-D-16791, Type I	Cleans transparent and acrylic plastics and cockpit indicator glass covers. Also used in the Water-based Solvent Spray Cleaning Booth and the Aqueous Ultrasonic Cleaner for removing contaminants.	For hand cleaning, apply with Flannel Cloth, CCC-C-458, Type II (Appendix A, Item 26). Let dry; then remove with dry flannel cloth.	Mix 1 fluid oz per gallon water.
Cleaning and Cleaning-lubricating Compounds Electrical Contact, Low Ozone Depletion Potential MIL-PRF-29608, Type I, Class L	A cleaner-lubricant compatible with potting compounds, rubbers, and insulations. 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 (Appendix B, Item 5) .	Avoid Application to areas requiring solder or coating.
Type I Class C	May be used for cleaning electrical contacts.		

TABLE 4-4. Avionic Cleaning Materials - (Cont)

Description	Characteristics	Application	Restrictions
Dry Cleaning Solvent, MIL-PRF-680, Type III	General purpose cleaner for medium to 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, CCC-C-46, Class 7. (Appendix A, Item 23); Cheesecloth, CCC-C-440 (Appendix A, Item 25); or Brush, Typewriter A-A-3077 (Appendix B, Item 4) as appropriate. Wipe clean with Cleaning Cloth.	Do not use around oxygen, oxygen fittings, or oxygen regulator as fire or explosion may result.
	Cleaner for smoke damage removal on internal chassis components.	Apply by scrubbing affected area with Cleaning, Cloth CCC-C-46, Class 7 (Appendix A, Item 23). Toothbrush, or Brush, Typewriter A-A-3077 (Appendix B, Item 4) as appropriate. Wipe clean with Cleaning Cloth.	When used for smoke damage removal, always follow up with solution of one part deionized water and one part Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15).
	Cleaner for smoke damage removal on circuit components and laminated circuit boards.	Apply by wiping or scrubbing affected area with Cleaning Cloth CCC-C-46, Class 7 (Appendix A, Item 23), or Toothbrush. Wipe clean with Cleaning Cloth.	May cause swelling of silicone. rubber seals in equipment exposed to emersion for long periods.
	Cleaner for removal of Water-Displacing Corrosion Preventive Compounds, MIL-C-81309, Type III, Corrosion Preventive Compound, MIL-PRF-16173, Grade 4.	Apply with Brush, A-A-289 style opt. (Appendix B, Item 1) or Toothbrush, as appropriate. Wipe clean with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23).	May soften some plastics, wire harness tubing, or plastic coating on wiring. Test affected area for adverse reactions prior to general application.

TABLE 4-4. Avionic Cleaning Materials - (Cont)

Description	Characteristics	Application	Restrictions
Isopropyl Alcohol, TT-I-735	General purpose cleaner and solvent for removal of salt residue and contaminants common to internal avionic equipment. General cleaner for internal chassis components.	Apply a solution of one part deionized or dia-tilled water and one part Isopropyl Alcohol, TT-I-735, to affected area with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23) or Toothbrush.	Isopropyl Alcohol, TT-I-735, is highly flammable. All application of Isopropyl Alcohol, TT-I-735, and water may be air dried or dried by portable air blower or ovens.
	Solvent cleaner for solder flux residue in all applications of electronics, electrical equipment, and micro-miniature circuits.	Apply a solution of one part deionized or distilled water to three parts Isopropyl Alcohol, TT-I-735, and scrub the solder joint and adjacent area with Acid Brush, A-A-289 Style opt. (Appendix B, Item 1) or Toothbrush, Wipe Clean with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23).	
	Cleaner for fingerprint removal on metals and nonmetals.	Apply a solution of one part deionized or distilled water and one part Isopropyl Alcohol, TT-I-735, to affected area with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23). Wipe clean.	
	Cleaner for bacteria and fungi attack on all metals and nonmetals.	Apply Isopropyl Alcohol, TT-I-735, to affected area with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23). Wipe clean and air dry.	

TABLE 4-4. Avionic Cleaning Materials - (Cont)

Description	Characteristics	Application	Restrictions
Isopropyl Alcohol, TT-I-735 (cont)	Cleaner for salt-water immersion and fire extinguishing agents on all internal circuit components and laminated circuit boards.	Apply Isopropyl Alcohol, TT-I-735 to affected area with Cleaning Cloth, CCC-C-46 (Appendix A, Item 23) or Acid Brush,A-A-289 style opt. (Appendix B, Item 1), or Toothbrush, as appropriate.	
	Cleaner for electrical contact surfaces.	Apply a solution of one part deionized or distilled water and one part Isopropyl Alcohol, TT-I-735, to affected area with Acid Brush, A-A-289 style opt. (Appendix B, Item 1) or Pipe Cleaner (Appendix B, Item 5). Wipe clean and air dry.	
Water, Distilled	Cleaner for solder flux residue in all applications of electronics, electrical equipment, and micro-miniature circuits.	Apply a solution of one part deionized or distilled water to three parts Isopropyl Alcohol, TT-I-735, and scrub joint and adjacent area with Acid Brush, A-A-289 style opt. (Appendix B, Item 1) or Toothbrush, Wipe clean with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23).	Deionized water, obtainable from commercially available processing units that is pumped into some shore activity shops, is an authorized substitute.
Fluid, VV-D-1078	Dimethyl polysiloxane silicone. A lubricant compatible with potting compounds, rubbers and insulations. May be used to lubricate electrical contacts	Apply sparingly using Disposable Applicator or Pipe Cleaner (Appendix B, Item 5) or syringe.	Avoid application to areas requiring soldering or coating.

c. Distilled or fresh water is used to dilute isopropyl alcohol or detergents for use in cleaning. It may also be used to rinse or remove dust, dirt, salt, and cleaning solutions. Application can be by wiping, brushing, soaking or spraying.

4-5.1.3. Hazardous Chemical or Materials Identification Label. Many materials outlined in this manual are potentially hazardous to personnel and potentially damaging to aircraft, especially with improper use. When using any chemicals, such as paint strippers, detergents, conversion coatings, and solvents, follow the correct procedures with appropriate protective gear. Read the appropriate hazardous material identification label prior to use of any hazardous materials. Figure 4-3 shows the standard symbol format using numerals and symbols to describe the degree of hazard. These labels include descriptions of health, fire, reactivity, and specific hazards of the packaged product. Hazardous chemicals used in corrosion control and their specific hazards are listed in Appendix A. Refer to TM-3-250 (Army only) for proper storage, shipment, handling and disposal of hazardous chemicals.

4-5.2. Avionic Cleaning Equipment. The following paragraphs provide information to ensure the proper selection and application of avionic cleaning equipment.

4-5.2.1. General. Experimentation with cleaning support equipment is not an authorized practice. Damage to circuit components may result from reactions to chemical solutions used in cleaning equipment. Avionic technicians should understand the functions, capabilities, and

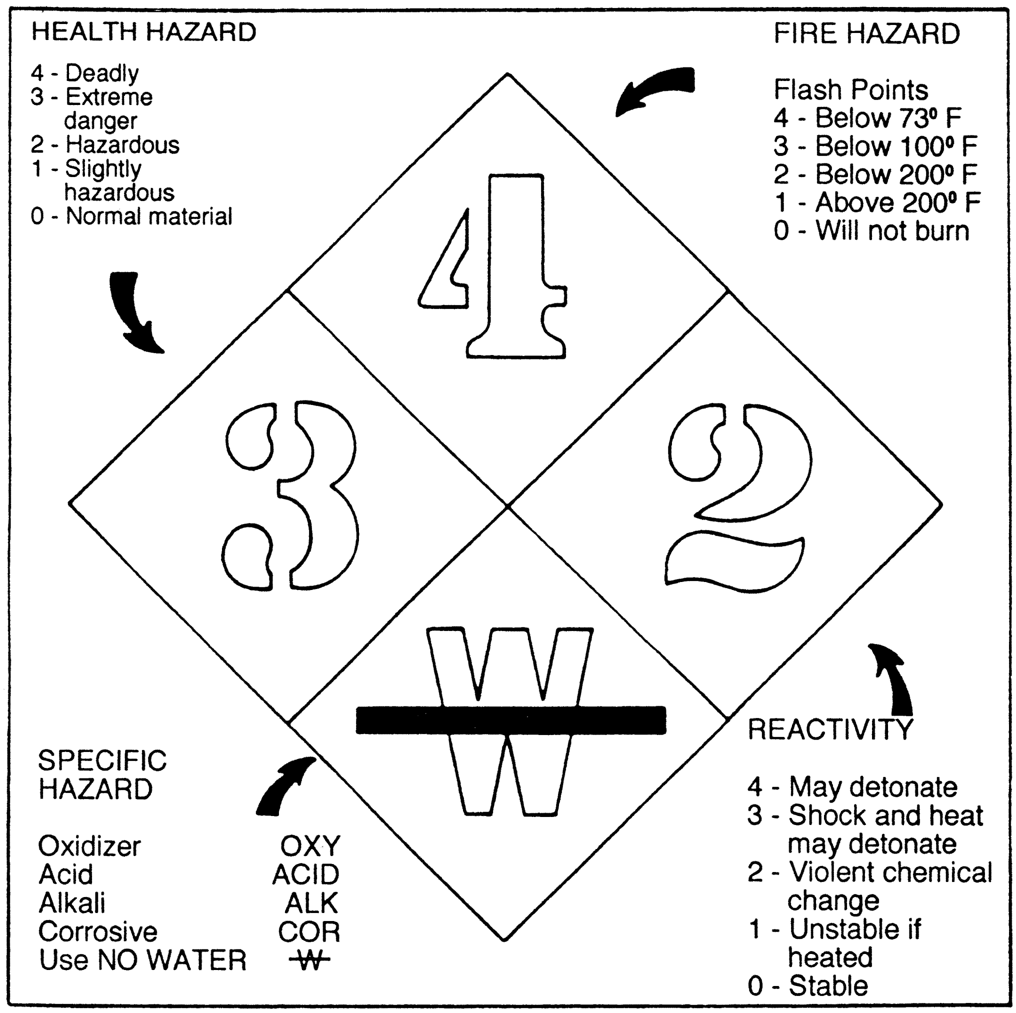


Figure 4-3. Hazardous Chemical or Material Identification Label

restrictions that apply to each piece of cleaning equipment. This will prevent damage to avionic equipment and circuit components that could result from improper use. Each piece of cleaning equipment has been selected to perform specific functions. The following paragraphs identify these intended functions and include general limitations as applicable to each type of support equipment.

NOTE

Maintenance personnel should refer to appropriate cleaning equipment service manuals for specific operating instructions.

4-5.2.2. Aqueous Ultrasonic Cleaner. The following is a list of the specific restrictions that apply to the use of Aqueous Ultrasonic Cleaner (Appendix C, Item 1):

CAUTION

Miniature and microminiature printed circuit boards (PCBs) may be susceptible to damage due to ultrasonic frequency, power level, or both. Due to the difficulty of determining which components may be damaged, ultrasonic cleaning of PCBs is not authorized unless specified. For additional information, refer to NAVAIR 01-1A-23 (Navy) or TO 00-25-234 (Air Force).

a. The Aqueous Ultrasonic Cleaner (Appendix C, Item 1) is used for the removal of dirt, dust, salt spray deposits, and corrosion products. This is achieved by ultrasonic scrubbing action in detergent and water solution.

(1) The maximum operating temperature shall be 130°F (54°C). The operating frequency used shall be 20 kHz.

(2) An additional function of the equipment is that of "presoaking" avionic equipment and components prior to the ultrasonic function.

(3) Detergent, MIL-D-16791 (Appendix A, Item 10) is the specified detergent. This detergent solution shall be mixed 1 ounce detergent to 1 gallon of water.

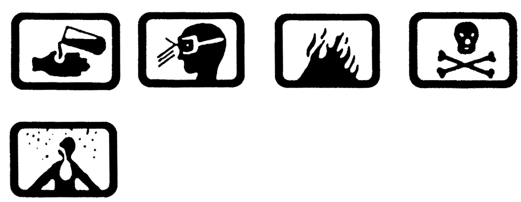
b. Paper capacitors and paper-bound components disintegrate in Detergent, MIL-D-16791 (Appendix A, Item 10) solution.

c. Sealed bearings, synchro and servo bearings, instrument bearings, and similar devices with permanently lubricated bearings can experience lubricant removal. These devices would be rendered useless unless there are procedures specified in the applicable service directives for relubrication. When practical, avionic equipment containing such bearings can be cleaned by aqueous ultrasonics if the bearings are sealed in a plastic bag.

d. Sealed components (other than hermetically sealed) can trap detergents and water. This may cause drying problems. In each case, the sealed component shall be opened to eliminate detergent traps.

e. Thin metal foil types of gummed labels can loosen and separate.

4-5.2.3. Solvent Ultrasonic Cleaner. The following is a list of the specific restrictions that apply to the use of Solvent Ultrasonic Cleaner (Appendix C, Item 2):



Alcohol, Isopropyl 6

a. Solvent Ultrasonic Cleaner (Appendix C, Item 2) is used to remove light to heavy oil, grease, and hydraulic fluid contamination by ultrasonic scrubbing in a solvent solution.

(1) The maximum operating temperature shall be the solvent's boiling point. The maximum operating frequency used shall be 40 kHz.

(2) Solvent, Cleaning (Appendix A, Item 12) may be used in solvent ultrasonic cleaner applications.

MIL-PRF-680, Type III may be used in solvent ultrasonic if used at room temperature.

b. Coaxial connector gaskets and other neoprene rubber components are susceptible to damage by solvents. Also, cleaning solvents can wick up the coaxial leads causing condensation and drying problems. Where solvent ultrasonic cleaning is desired, equipment containing these devices can be cleaned only if the coaxial connector can be sealed in a plastic bag.

c. Sealed bearings, synchro and servo bearings, instrument bearings and similar devices with permanently lubricated bearings shall be treated as specified in paragraph 4-5.2.2c.

d. Sealed components (components other than hermetically sealed) shall be treated as specified in paragraph 4-5.2.2d.

e. Solvent Ultrasonic Cleaner (Appendix C, Item 2) can be used as a solvent degreaser. The restrictions as specified in this paragraph apply to solvent degreaser functions. The solvent vapor rinse and solvent vapor drying functions do not use the ultrasonic frequency function. Therefore, they may be used to rinse and dry PCBs.

4-5.2.4. Water Base Solvent Spray Booth. The following is a list of the specific restrictions that apply to the use of Water Base Solvent Spray Booth (Appendix B, Item 26).

a. The Water Base Solvent Spray Booth (Appendix B, Item 26) is used to remove dirt, dust, salt spray deposits, and light corrosion products. This is achieved by a detergent and water spray system.

(1) The spray equipment provides an air pressure powered spray of detergent solution through a hand-held gun, using either filtered or tap water. It also can deliver a water rinse or drying jet of air through the gun.

(2) A turntable is included, allowing 360 degree rotation of the avionic equipment being cleaned or rinsed.

(3) The unit may be used as a “precleaner” prior to placing the component in a detergent cleaning tank.

(4) The unit also is used to rinse components after the application of detergent cleaning, abrasive corrosion removal, or hand cleaning operations.

NOTE

Increasing the proportion of detergent in the solution does not necessarily increase cleaning power. This can, in some cases, reduce cleaning effectiveness.

(5) Detergent, MIL-D-16791 (Appendix A, Item 10) is the specified detergent. The detergent solution shall be mixed 1 ounce detergent to 1 gallon of water.

b. Sealed bearings, synchro and servo bearings, instrument bearings, and similar devices with permanently lubricated bearings shall be treated as specified in paragraph 4-5.2.2c.

c. Sealed components (other than hermetically sealed) shall be treated as specified in paragraph 4-5.2.2d.

4-5.2.5. Abrasive Tools. The following is a list of the specific restrictions that apply to the use of abrasive tools.

a. Mono-basic Sodium Phosphate, AWWA-B504 (Appendix A, Item 44) or Glass Beads, SAE AMS 2431 (Appendix A, Item 73) used in abrasive tools are easily trapped in miniature and microminiature female edge connectors. When use of a Blast Cleaning Cabinet on internal chassis components is necessary, the connectors shall be sealed with Pressure Sensitive Tape, SAE-AMS-T-21595, Type I (Appendix A, Item 32). Ensure that the tape is removed following cleaning.

b. Delicate metal surfaces are susceptible to damage if abrasive tools are not used with care. Only experienced operators are authorized to use abrasive tools on avionic equipment.

c. Some miniature/microminiature PCBs contain devices sensitive to electrostatic discharge (ESD) that may be destroyed by the static charge created by abrasive agents used in abrasive tools. In no case is a Blast Cleaning Cabinet or Portable Mini-Abrasive Unit (Appendix C, Item 3) authorized for cleaning or corrosion removal of components where ESD devices are installed.

4-5.3. Avionic Cleaning Procedures. The following paragraphs provide information to ensure the proper cleaning of avionic equipment.

4-5.3.1. General. Contamination is responsible for corrosion problems in avionic equipment. Cleaning can prevent many of these problems and is the first logical step following inspection. Cleanliness is very important in maintaining the functional integrity and reliability of avionic systems. Dirt may be either conductive or insulating. As a conductor, it may provide undesired electrical paths, while as an insulator it may interfere with proper operation.

4-5.3.2. Cleaning Methods Selection Criteria. Always select the mildest method of cleaning that will accomplish the task. The selection of the cleaning method is a decision to be made by the work center supervisor or equipment operator. Certain circuit components can be damaged by support equipment. This paragraph is intended to emphasize the limitations involved in using support equipment on certain avionic equipment and components. The method used shall be based on:

a. Type and extent of the contamination and/or corrosion.

b. Accessibility to the contamination and/or corrosion.

c. Type of avionic equipment.

NOTE

- Deionized or distilled water is required in cleaning operations involving soldering and some conformal coating applications. If deionized or distilled water is not available locally, distilled water may be procured under the stock number listed in Appendix A, Item 70.

- Acid cleaners shall not be used on avionic equipment.

4-5.3.3. Hazards of Cleaning. It is a good maintenance practice to use the mildest cleaning method that will ensure proper decontamination. It is also important that the correct cleaning solution and cleaning materials are used to avoid damaging avionic equipment and components. The following emphasizes some of the hazards of cleaning:

a. Cleaning solvents or materials can be trapped in crevices or seams. This may interfere with later applications of preventive coatings as well as causing corrosion.

b. Vigorous or prolonged scrubbing of laminated circuit boards can cause damage to the boards.

c. Certain cleaning solvents soften conformal coatings, wire coverings, acrylic panels, and some circuit components.

4-5.3.4. When to Clean. The immediate removal of corrosion on the avionic equipment and surrounding structure is always a high priority in corrosion control. Therefore, immediate cleaning shall be accomplished after avionic equipment has been exposed to any of the following conditions:

a. Adverse weather conditions or salt-water spray (open canopy, equipment door, or panel).

b Fire-extinguishing agents.

c. Spilled electrolyte or corrosion deposits around battery terminals and the general vicinity of the battery area.

d. Corrosion removal or component repair.

4-5.3.5. Precleaning Treatment.

a. Disconnect power supply.

b. Ensure drain holes are open.

c. Remove covers, etc.

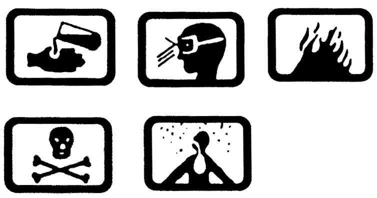
d. Disassemble where practical.

e. Use only authorized materials.

f. Ensure compatibility of materials prior to use.

g. Mask and protect accessories or components to prevent entrance of water, solvents or cleaning components.

4-5.3.6. Cleaning and Drying Restrictions. Certain circuit components create potential problems during cleaning and drying. In most cases, the problems can be overcome prior to cleaning the equipment. The greatest potential for problems is the circuit component that traps water or solvents because of its construction. Table 4-5 lists the components and shows the techniques to use to avoid problems. In some cases, mechanical cleaning and drying equipment may create a problem due to shock, vibration, or high temperature. These problems are listed in Table 4-5 and are discussed in paragraph 4-4.10. The procedures that shall be used to avoid water and solvent traps are as follows:



Alcohol, Isopropyl 6

a. Seal small components with Tape, Pressure Sensitive, SAE-AMS-T-21595 (Appendix A, Item 32). Ensure tape and tape residue are removed using Solvent Cleaning (Appendix A, Item 12) followed with Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15) prior to drying the equipment.

b. Seal large components in Plastic Bags (Appendix A, Item 64) or seal with Barrier Material, Water Vapor Proof, MIL-PRF-131 (Appendix A, Item 65). Place the bag or barrier material around the component and seal with Tape, Pressure Sensitive, SAE-AMS-T-21595 (Appendix A, Item 32). Ensure tape, tape residue, and bag or barrier material are removed using Solvent Cleaning (Appendix A, Item 14) followed with Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15) prior to drying the component.

NOTE

Repair conducted by Organizational/Unit or Intermediate Maintenance Activities shall not include disassembly of avionic equipment beyond authorized limits established by the parent service organization. Cleaning, corrosion repair, treatment and preservation of equipment shall include all cables, harnesses, and hardware furnished with each piece of equipment.

c. In some cases the component may be removed from the equipment without too much difficulty. When this is possible, the removed component shall be cleaned separately.

4-5.3.7. Hand Cleaning Methods. Hand methods shall be used for cleaning small, delicate, confined surfaces where parts cannot tolerate other means of cleaning. Also, hand methods that shall be used when accessories/facilities for other methods that are not available. Hand cleaning methods for avionics utilize the following (refer to Appendices A and B):

a. Cloth, CCC-C-46

b. Cheesecloth, CCC-C-440

c. Cotton tip applicator

d. Acid brush, A-A-289

e. Toothbrush

f. Brush

g. Lint-free cloth, A-A-59323

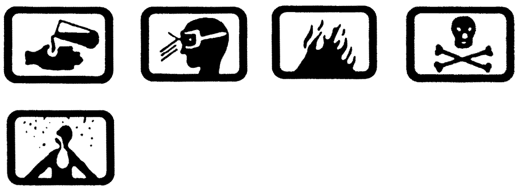
h. Cotton flannel, CCC-C-458

i. Plastic manual spray bottle

TABLE 4-5. Cleaning and Drying Restrictions.

Compound	Problem	Solution
APC connectors (mircowave)	Shock damage to center conductor	Seal and hand clean only
Crystal detectors	Heat damage from oven	Dry at 130°F (54°C) maximum
Delay lines (physical)	Trap solution in housing	Seal or remove
Fan Motors	Trap solution in housing	Seal or remove
Gyroscopes	Trap solution in housing	Seal
Klystron cavity	Trap solution in sockets	Remove tube and seal socket
Meters and instrument gauges	Trap solution through open back	Seal
Paper capacitors	Disintegrate	Seal
Potentiometers	Trap solution through open housing	Seal
Printed circuit board	Trap solution (when installed)	Remove (clean separately)
Rotary switches	Trap solution through open housing	Seal
Sliding attenuators (RF)	Trap solution in slide housing	Seal or remove
Sliding cam switches	Shock damage to cam	Remove or hand clean only
Synchros and servos	Removes lubricant from bearing	Seal or remove
Transformers	Trap solution in housing	Seal
Tunable cavities	Trap solution in cavity area	Seal or remove
Vacuum tubes	Shock damage	Remove
Variable attenuators (microwave)	Trap solution is housing	Seal or remove
Waveguide (microwave)	Trap solution in guide housing (when installed)	Seal or remove
Wires wrap connections	Shock damage	Hand clean only

4-5.3.8. Fingerprint Removal. The fats and oils caused by fingerprints are highly corrosive.



Alcohol, Isopropyl 6

WARNING

- Do not use synthetic fiber wiping cloths with Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15) due to its low flash point. Dry fiber wiping cloths will cause a static charge buildup and can result in a fire.

a. Apply a mixture of one part Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15) and one part distilled water to affected areas with Cleaning Cloth, CCC-C-46 (Appendix A, Item 23);Acid Brush A-A-289, style opt. (Appendix B, Item 1); Toothbrush or brush as appropriate.

b. Wipe or scrub affected area until contaminants have been dislodged.

c. Remove residue by blotting or wiping with Cleaning Cloth, CCC-C-46 (Appendix A, Item 23). Inspect affected areas for signs of residues and contaminants.

d. Discard contaminated cloths and solvents in approved disposal containers after cleaning operation to avoid contamination of other components.

e. Repeat process until all contaminants are removed.

CAUTION

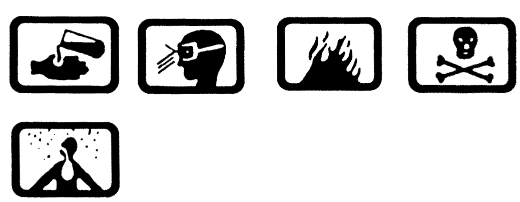
Prior to ultraviolet (UV) light inspection, avionic equipment must be examined for Erasable Programmable Read Only Memory (EPROM) components. EPROMs have windows that are usually covered with an aluminum foil mask or black tape. Visually examine EPROMs to ensure the tape or foil has not lifted from the windows. Do not place EPROMs near a UV light source for long periods of time.

f. Natural sunlight includes ultraviolet light, although at a much lower intensity than the light from the ultraviolet lamp. Extended exposure of EPROM and ESD devices to sunlight can degrade these devices.

WARNING

Ultraviolet Light, (Appendix B, Item 24) is harmful to eyes when used without the filter. Do not use a cracked or damaged filter.

4-5.3.9. Cleaning and Removal of Solder Flux Residue. Solder flux residue is present in all solder operations. This residue will cause corrosion if an electrolyte is present. Use of cleaning solvents that do not damage associated wiring circuit components, or laminated circuit board coatings is required. The presence of solder flux can be detected by using Ultraviolet Light. Under ultraviolet light, traces of solder flux resin appear as a fluorescent yellow to brownish residue.



Alcohol, Isopropyl 6

WARNING

Lead contained in solder can rub off onto a person's hands from a soldered joint. Lead oxide is a poison that is not eliminated by the body and can accumulate over years of exposure. Touching solder followed by smoking or eating is a potential means of ingesting trace amounts of lead oxide. Wash hands thoroughly following any soldering/desoldering operation.

a. Solder flux residues shall be removed from circuit boards and circuit components in accordance with paragraph 4-4.4a. Use a solution of one part distilled water to three parts of Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15) to clean the affected area. Refer to ANSI/J-STD-001 for additional information on solder fluxes and soldering techniques.

b. Store critical circuit components not installed in equipment as specified in paragraph 4-9.4. Ensure EPROM devices have windows covered. Refer to Chapter 9 for packaging information on ESD devices.

4-5.3.10. Cleaning and Removal of Silicone Lubricant. Remove silicone residue from surfaces as follows:

a. Wipe contaminated surface with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23); Acid Brush, A-A-289, (Appendix B, Item 1); Disposable Applicator (Appendix B, Item 6); or Pipe Cleaner (Appendix B, Item 5) dampened with MIL-PRF-85570 or Cleaning Solvent (Appendix A, Item 14) until clean.

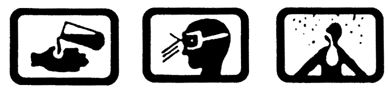
b. Dry surface with Cleaning Cloth, CCC-C-46, Class 7; Disposable Applicator; or Pipe Cleaner.

4-5.3.11. Cleaning and Removal of Bacteria and Fungi. Dirt, dust, and other airborne contaminants are leading contributors to bacteria and fungus (microbial) attack. The best defense against this form of attack is to maintain cleanliness and, where possible, low humidity. Fungus and bacteria shall be removed from affected areas as follows:

a. Mask air capacitors, relay contacts, open switches, and tunable coils with Pressure Sensitive Tape, SAE-AMS-T-21595, Type I (Appendix A, Item 32).

b. Treat affected areas in accordance with paragraph 4-5.3.8.

4-5-3.12. Cleaning and Removal of Dust, Dirt, Grease, and Oil. Dust and dirt shall be removed by wetting surface with fresh water as follows:



Compound, Aircraft Cleaning 4

a. Apply a solution of one part Aircraft Cleaning Compound, Class I, MIL-PRF-85570, Type II (Appendix A, Item 11) to ten parts distilled water.

b. Scrub affected areas of parts with Cleaning and Polishing Pad, Non-Abrasive (Appendix A, Item 3); Cleaning Cloth, CCC-C-46 (Appendix A, Item 23); Cloth, Cheese-Cloth, CCC-C-440 (Appendix A, Item 25); Brush, Acid Swabbing A-A-289 (Appendix B, Item 1); Toothbrush; or Applicator, Cotton Tipped (Appendix B, Item 6).

c. Wipe area with Cleaning Cloth, CCC-C-46 (Appendix A, Item 23).

d. Rinse with clean, fresh water and by area with Cleaning Cloth, CCC-C-46.

e. Remove grease and oil as specified in paragraph 4-5.3.12a. Use a solution of one part Aircraft Cleaning Compound, MIL-PRF-85570 to ten parts of distilled water.

4-5.3.13. Surface Preparation. The true cleanliness of bare metal surfaces after a cleaning process is very critical to adhesion of any subsequent coating material. For example, a chemical conversion coating, paint dry film lubricant, adhesive, etc. One method used to identify when a surface is clean enough for good adhesion is the Water

Break Test. The procedure is described in NAVAIR 01-1-509 (Navy), TO 1-1-691 (Air Force), and TM 55-1500-344-23 (Army). This test is appropriate for use at the time of the final clear water rinse. This usually follows cleaning of any bare metal surface for adhesion.

4-5.3.14. Special Considerations. Dust, fingerprints, surface oxides, contaminants, or other foreign material on a surface, can undo preservation provided by protective coatings. Specific avionic subsystems, equipment, and components shall be cleaned as specified in Chapter 5.

4-5.3.15. Post-Cleaning Procedures.

CAUTION

When aerosol spray, compressed air, or air from dryers is used on ESD devices, precautions in NAVAIR 01-1A-23 (Navy) or TO 00-25-234 (Air Force) shall be followed.

a. After completion of the cleaning steps, reinspect the affected area for signs of residue, surface film, or water.

b. If the affected area is not clean, repeat the cleaning procedures. Water-displacement, preservation, and lubrication should follow the cleaning and drying steps in preventive maintenance.

4-6. DRYING EQUIPMENT AND PROCEDURES.

4-6.1. 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 ambient air, the longer the drying time.

4-6.2. 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 have been removed.

CAUTION

The motion of air against other materials can generate static charges that degrade or destroy ESD devices. Care must be exercised during handling/repair of these items. Use the recommended shop practices outlined in Chapter 9.

4-6.3. 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.

CAUTION

Portable air blowers, hot air blowers, hair dryers, and similar drying devices may cause fires when used in or around aircraft. Hot Air Gun, Raychem, HT-900 (Appendix B, Item 17), or an equivalent spark-proof subsitute, is the only authorized hot air gun to be used in and around aircraft. Hot Air Gun, A-A-59435 (Appendix B, Item 16), is authorized only for shop use.

4-6.4. Drying with Hot Air Blower. Procedures for the use of hot air blowers are as follows:

CAUTION

Compressed air used for drying can create airborne particles that may enter the eyes. Pressure shall not exceed 10 psi. Eye protection is required.

a. 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 jet.

b. Dry the equipment with a Hot Air Gun, A-A-59435 (Appendix B, Item 16) or Hot Air Gun, Raychem, HT-900 (Appendix B, Item 17) as appropriate. Surfaces should not be heated with the hot air gun above 130°F when drying equipment.

4-6.5. Drying with Circulating Air Drying Oven. The Circulating Air Drying Oven, (Appendix B, Item 27) is used to dry small electrical and electronic components, such as unpressurized instruments, control boxes, PCBs, and similar devices. The circulating air drying oven shall never be operated above 130°F (54°C) when drying avionic equipment or components. Damage may result from overheating of discrete electronic circuit components. Procedures for the operation of the circulating air drying oven are as follows:

a. Blow off excess water with dry air or dry nitrogen at no more than 10 psi pressure. Deflect air off interior back and sides of enclosure to diffuse jet.

CAUTION

Older circulating air drying ovens may have uncalibrated dials or controls for setting the oven temperature. These ovens shall be calibrated so that the 130°F (54°C) temperature setting is “red lined” on the dial or control.

b. Set the temperature control at a maximum of 130°F (54°C).

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

NOTE

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

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

4-6.6. Drying with Forced Air Oven. The Forced Air Drying Oven (Appendix B, Item 28) 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 a follows:

CAUTION

The motion of air against other materials can generate static charges that degrade or destroy ESD devices. Care must be exercised during handling/repair of these items. Use the recommended shop practices outlined in Chapter 9.

a. Blow off excess water with dry air or dry nitrogen at no more than 10 psi pressure. Deflect air off interior back and sides of enclosure to diffuse jet.

CAUTION

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

b. Set the temperature control at a maximum of 130°F (54°C).

c. Place the component(s) in the oven and close the door. If a timer is available, set it for approximately 1 to 2 hours. Opening and closing the oven door during drying 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.

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

4-6.7. Drying with Vented Oven (Bulb Type). Vented drying oven procedures are as follows:

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

b. Dry the equipment at approximately 130°F (54°C) for 3 to 4 hours.

4-6.8. Drying with Vacuum Oven. Vacuum oven drying procedures are as follows:

CAUTION

The motion of air against other materials can generate static charges that degrade or destroy ESD devices. Care must be exercised during handling/repair of these items. Use the recommended shop practices outlined in Chapter 9.

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

b. Dry the equipment at approximately 130°F (54°C) and 26 inches of mercury (Hg) for 1 to 2 hours.

4-7. PRESERVATIVES.

4-7.1. General. Surfaces and components not normally conformal coated or painted need preservation. Cleanliness and elimination of moisture are keys to avoiding corrosion. Since it is impossible to guarantee a dry, moisture-free environment, preservation of equipment is essential. In today's avionic systems, miniaturization has resulted in microminiature circuits no longer than a pencil eraser. The slightest amount of corrosion can cause a whole system to fail. Preservation has become an essential part of the repair and maintenance of avionic systems.

4-7.2. Why Preserve.

a. To protect nonmoving parts by filling air spaces, displacing water, and providing coatings.

b. To protect such components as hinges, control cables, gears, linkages, bearings, etc., from wear by providing lubrication.

c. To protect nonoperating or idle equipment.

4-7.3. When to Preserve. Preservatives should always be used:

a. After avionic cleaning.

b. On avionic equipment prior to shipment.

c. On equipment or components that are nonoperating or idle (including those awaiting parts).

d. Whenever access is achieved to parts normally inaccessible for inspection without disassembly and inspection.

e. Whenever paint films in difficult-to-protect areas require additional preservation.

f. After immersion or exposure to fresh water, salt water, fire extinguishing agents, etc.

g. Whenever the corrosion protection system has failed in service.

4-7.4. What to Preserve. Preservatives should be used only where their application and maintenance will not hamper circuit or component operation. Components that do not require preservation are listed in paragraph 4-7.5. Most preservatives form a nonconductive film that acts to insulate two mating surfaces. For example, preservative on a relay's mating contacts will degrade operation of the relay. Each piece of avionic equipment should be inspected. With the assistance of the applicable service directives, areas requiring preservation should be noted and preserved on a scheduled basis.

The following items may require preservation on a scheduled basis:

a. Hinges and door latches.

b. Electrical connectors and receptacles.

c. Shock mounts, rigid mounts, and associated brackets.

d. Any dissimilar metals not otherwise preserved.

e. Antenna mounts, brackets, hardware, and housings.

f. Fasteners, screws, nuts, and bolts.

g. Terminal boards, bus bars, and junction boxes.

h. Equipment lids on the interior or exterior of equipment that are susceptible to moisture.

i. Solder joints not otherwise conformal coated.

j. Unpainted mounting brackets, equipment racks, and shelving.

k. Unpainted equipment covers, lids, and chassis.

l. External and internal surfaces of coaxial connectors.

m. External surfaces of cooling system joints.

n. Grounding straps and wires.

4-7.5. What Not to Preserve. The following items shall not be preserved or come in contact with preservatives:

a. Laminated circuit boards that are conformal coated.

b. Nonmetallic surfaces such as control box faceplates (acrylic).

c. Tunable capacitors and inductors.

d. Internal surfaces of waveguides.

e. Internal surfaces of tuned tanks.

f. Relay and circuit breaker contacts.

g. Fuses.

NOTE

Only preservative materials approved by the parent service organization shall be used on military aircraft and avionic systems. Appendix A (Consumable Materials List) and Appendix B (Tools and Support Equipment) are provided to ensure the availability of approved materials and equipment.

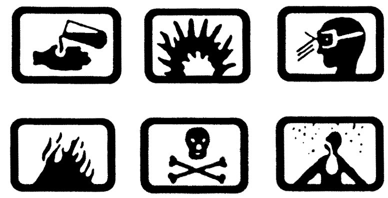
4-7.6. Preservative Materials. Preservatives may also act as water-displacing materials (refer to paragraph 4-7.7a) and lubricants. Table 4-6 contains a list of authorized preservative compounds for avionic equipment.

4-7.7. How to Preserve. The various specific applications of preservatives are covered in Chapter 5. The following are general application procedures that apply in most cases.

a. Water-displacing corrosion preventive compounds, MIL-C-81309, Type II (Appendix A, Item 16), shall be applied as follows:

(1) Clean surface of dirt, soil, contaminants, and corrosion products as specified in Chapter 5.

(2) When necessary, apply pressure sensitive tape, SAE-AMS-T-21595, Type I (Appendix A, Item 32), to all components not to be preserved. (Refer to paragraph 4-7.5 for list of items).



Compound, Corrosion Preventive, 3
Water-Displacing

(3) Apply an even, thin film to the surface. Ensure thorough coverage of dissimilar metal surface contact areas, crevices, and water entrapment areas. Avoid excessive application. When MIL-C-85054 is used, apply second coat after 30 minutes.

(4) Remove pressure sensitive tape, as applicable.

b. Corrosion preventive compound, MIL-PRF-16173, Grade 4 (Appendix A, Item 17), shall be applied as follows:

(1) Clean surface of dirt, soil, and corrosion products as specified in Chapter 5.

(2) Apply water-displacing compound, MIL-C-81309, Type III (Appendix A, Item 16) as specified in paragraph 4-7.7a prior to applying MIL-PRF-16173.

(3) When necessary, thin corrosion preventive compound, MIL-PRF-16173, Grade 4 (Appendix A, Item 17) with dry cleaning solvent, MIL-PRF-680, Type III (Appendix A, Item 14) to working viscosity.

(4) Apply, with brush, (Appendix B, Item 2), or spray an even, thin film to non-moving external areas.

Table 4-6. Preservative Compounds for Avionic Equipment

Description	Characteristics	Application	Restrictions
Corrosion preventive compound, water-displacing, ultra-thin film, avionics grade, MIL-C-81309, Type II and III	General preservative for internal areas of avionic equipment; internal areas of electrical connectors, receptacles, and solder joints. Contains water-displacing properties.	Apply by spraying an even, thin film to the surface. Can be removed with cleaning solvent.	Not intended for use on exterior surfaces of avionic equipment. Deposits a thin film which must be must be removed for proper function of contact 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, solvent cutback, cold-application MIL-PRF-16173 Grade 4	General preservative for external surface 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 cleaning solvent.	Do not use on interior surfaces or avionic equipment. 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. Must be applied over water-displacing corrosion preventive compound, MIL-C-81309, Type III, to accomplish a complete water-displacing and preservative on all areas exposed to elements and moisture.
Corrosion Preventative Compound (Amlguard) MIL-C-85054 (non-ODS)	Temporary repair of paint damage to exterior surfaces such as cracks and scratches preservative for non-moving metal parts not requiring a lubricated surface	Apply by brush or spraying an even thin film to surface	Do not use on interior surfaces or avionic equipment. 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.

(5) Dip screws or fasteners in preservative and install. Where disassembly is frequent, use MIL-L-63460, or MIL-C-81309, Type II. When infrequent, use MIL-C-16173, Grade 4 for long term protection.

4-8. LUBRICANTS.

4-8.1. General. Lubrication of equipment performs several important functions. It not only prevents wear between moving parts but provides a corrosion barrier and chemically inhibits corrosion. Particular attention should be given to lubrication points, hinges, latches, etc, for signs of lubricant breakdown. For example, caking of grease, loss of oil or dry film lubricant, or evidence of contamination.

4-8.2. Requirements. Maintenance personnel should refer to the applicable service directives for specific lubrication requirements.

4-9. PACKAGING, HANDLING, AND STORAGE.

4-9.1. General. An avionic corrosion control program must include procedures for packaging, handling, and storage of avionic equipment and components. Preventive maintenance techniques are rendered useless if these procedures are not followed. Materials used to package, handle, or store avionic equipment must be compatible to the equipment and environment. Refer to MIL-STD-2073/1, MIL-E-17555, NAVSUP 484 (NAVY), TO 00-85-3 (Air Force), and AR 746-1 (Army) for additional information on packaging and preservation.

NOTE

Some avionic equipment contains ESDS modules or components. Maintenance personnel should come with ESD device handling procedures established by the applicable service directives. Failure to do so will jeopardize ESD device/mission integrity. Refer to Chapter 9 to avoid conflict with recommended practices for ESD equipment, modules, and components.

4-9.2. Maintenance Activities Compliance. Organizational/Unit and Intermediate Maintenance Activities shall comply with the following:

a. Use only metal or preserved wooden shelves for storing avionic equipment and components.

b. Provide polyethylene foam, A-A-59135 or A-A-59136 (Appendix A, Item 60), 1/2-inch thick, as cushioning for equipment on shelves, pallets, etc. Do not use horse hair, sponge-rubber, or similar materials.

NOTE

Refer to NAVAIR 01-1A-505 (Navy), TO 1-1A-14 (Air Force), or TM 55-1500-323-24 (Army) for information on electrical connector caps.

c. Plastic or metal caps shall be used for electrical connector protection, as specified in paragraphs 4-9.4 and 4-9.5.

CAUTION

Use only special handling/shipping containers for protection of avionics from shock.

d. Use cushioning material, cellular plastic film (bubble wrap), PPP-C-795, Class 1 (Appendix A, Item 62), for short term protection of equipment from handling and shock.

e. Use plastic bags (Appendix A, Item 64), for short term protection of uninstalled small components and microminiature PCBs against moisture and contamination.

f. Use unicellular polypropylene packaging foam, PPP-C-1797 (Appendix A, Item 63), and water vapor proof packaging material, MIL-PRF-131 (Appendix A, Item 65), for long-term protection of miniature/microminiature circuit components, laminated circuit boards, and critical avionic components against moisture and contamination.

g. Comply with the requirements of MIL-STD-2073/1, MIL-E-17555, NAVSUP 484 (Navy), TO 00-85-3 (Air Force), or AR 746-1(Army) when shipping avionic equipment by air/surface.

h. For equipment requiring ESD protection, refer to Chapter 9.

4-9.3. Handling. Damage has occurred to avionic equipment because of incorrect/rough handling between repair shops and incorrect packaging methods. The best method of avoiding handling damage when transporting equipment is through the use of cushioning material (bubble wrap), PPP-C-795, Class 1 (Appendix A, Item 62). Bubble wrap is primarily used to absorb shock and is not intended as a preservation material. Packaging materials may absorb moisture through "breathing" as pressure changes occur. Bubble wrap should be placed around the component in both directions leaving the corners open to avoid condensation. Use masking tape, SAE-AMS-T-21595 (Appendix A, Item 32) for securing bubble wrap. Use preservation and sealing tape, SAE-AMS-T-22085 (Appendix A, Item 31) or masking tape, SAE-AMS-T-23397 (Appendix A, Item 33) as alternates.

4-9.4. Packaging and Storage. Although packaging is a function of the Supply Department, many times avionic equipment is packaged by maintenance personnel. This is for shipping between shops, operating activities, or ships prior to/during deployments. Packaging methods are an important consideration because the time equipment is in transit could be lengthy.

a. Proper packaging should include provisions for the length of time equipment will be in storage. Equipment should be packaged for long-term protection if the length of storage time is uncertain.

b. Local packaging of avionic equipment and components shall apply the following procedures:

(1) Plastic bags (Appendix A, Item 64), provide adequate protection against moisture and contamination for short-term, temporary storage. These bags shall be used during maintenance or repair operations of laminated circuit boards and small electrical/electronic components.

(2) Barrier Material, Water Vapor Proof, MIL-PRF-131 (Appendix A, Item 65), provides excellent protection against moisture and contamination. It is used during equipment transportation and long-term storage under all weather conditions. This material shall be used for long-term packaging of miniature/microminiature circuit components, laminated circuit boards, and other critical avionic components. Barrier Material, Water Vapor Proof, MIL-PRF-131 (Appendix A, Item 65), shall be sealed with sealing machine, electric jaw (Appendix B, Item 25).

(3) Unicellular polypropylene packaging foam, PPP-C-1797 (Appendix A, Item 63), is used for protection against shock and moisture. If protection against shock and handling is required in conjunction with Plastic Bags, (Appendix A, Item 64), or Barrier Material, Water Vapor Proof, MIL-PRF-131 (Appendix A, Item 65), use the unicellular polypropylene packaging foam held in place by pressure sensitive tape, SAE-AMS-T-22085 (Appendix A, Item 31).

c. For equipment requiring ESD protection refer to Chapter 9.

4-9.5. Electrical Connector and Waveguide Caps. The use of plastic caps hinders contamination of equipment from airborne particles present in repair shops/supply spaces.

CAUTION

No tape other than pressure sensitive tape, SAE-AMS-T-22085, Type II, is authorized for use on wave guides or electrical connectors. Air Force only refer to TO 00-25-234 for taping of connectors of wave guides.

a. During Organizational/Unit level maintenance, the plastic cap can become foreign object debris (FOD) in an aircraft. In aircraft with engine or equipment removed for inspection or maintenance, many electrical connectors are exposed. Military standard metal covers shall be used in lieu of plastic covers in these cases.

b. If military standard metal covers are not available, cap-off electrical connectors or waveguides with pressure sensitive tape, SAE-AMS-T-22085, (Appendix A, Item 31). In no case will any other tape be used to seal or cap-off electrical connectors.

4-9.6. Desiccants. Desiccants are normally packaged in equipment crated for shipment or storage. In some cases, the desiccants are placed in systems aboard aircraft. Desiccant, MIL-D-3464, Grade A (Appendix A, Item 68) is used to absorb moisture and lower the relative humidity when placed in a sealed container.

a. Desiccants may be ineffective for the following reasons:

(1) Moisture may condense as water if the desiccant becomes saturated.

(2) Desiccant is not in the right location.

(3) Rapid change in temperature may produce precipitation before the desiccant can react.

(4) Not enough desiccant is present.

CAUTION

Do not use loose desiccant in packaging of avionic equipment. The use of loose desiccant may cause damage to equipment.

b. The following considerations apply to desiccants:

(1) Desiccants shall be in unruptured bags of sturdy construction.

(2) Bags will be secured to prevent movement.

(3) Desiccant bags shall not be placed on, nor permitted to come in contact with, unprotected surfaces.

(4) Desiccants should be reactivated prior to reuse.

(5) Do not remove desiccant from wrap unless ready for use.

c. If a desiccant bag should break open during transit, clean the avionic equipment immediately. Do not turn moving parts any more than absolutely necessary until all desiccant particles have been removed. Work out the desiccant particles with a brush and not more than 10 psi dry air pressure. Use Acid Brush, A-A-289 style opt. (Appendix B, Item 1), or Brush, (Appendix B, Item 2) for this purpose. An alternate method is the use of a brush and vacuum cleaner (Appendix B, Item 13).

CAUTION

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

4-9.7. Humidity Indicators. Humidity indicators, MIL-I-8835 (Appendix A, Item 69), shall be placed in containers with desiccants. A humidity indicator is used to determine if a desiccant is sufficiently active to maintain an acceptable relative humidity.

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

5-1. GENERAL.

5-1.1. Maintenance Functions. This chapter outlines the materials, equipment, and techniques involved in corrosion control. In each case, some discretion on the part of the Organizational/Unit and Intermediate Maintenance personnel is warranted. It is important that personnel analyze the problem and select the correct corrosion removal and preservation materials. In addition, each case should be followed up where possible to see if the corrosion has been arrested. It is also extremely important that personnel identify whether the base material of connectors and accessories is metal or composite. Avionic corrosion control is an important function in maintaining miliary aircraft. This requires knowledge of the science and technology of avionic corrosion control. Preventive maintenance must occur as part of all maintenance functions performed on avionic systems. This is in conjunction with any corrosion control team effort.

5-1.2. Item Inspection. Whenever equipment is removed from aircraft for bench check or repair, covers and housings should be inspected and treated for corrosion. Avionic technicians must ensure that corrosion repair, treatment, and preventive maintenance become part of normal maintenance and repair procedures.

5-2. CORROSION REMOVAL MATERIALS AND EQUIPMENT.

5-2.1. General. Organizational/Unit and Intermediate Maintenance Activities should review Appendix A of this manual for corrosion repair materials/equipment. In addition, Appendix B of both this manual and NAVAIR 01-1A-509 (Navy), TO 1-1-691 (Air Force), or TM 55-1500-344-23 (Army) should also be reviewed. Where facilities and space permit, the additional materials/equipment described in Chapter 4 can be added to the Avionic Corrosion Work Center. This will achieve more efficient production of cleaning and treatment.

5-2.2. Corrosion Removal. When corrosion is detected, corrective action is required. If the corrosion is within repairable limits specified in the applicable service directives, corrective action shall be initiated. This shall consist of cleaning, corrosion removal, treatment and preservation, where required. The mildest method shall always be used to remove corrosion. The following methods are approved for use on avionics:

a. Hand rubbing/abrasion. The nature of some surfaces such as chrome, nickel, gold and silver plated contacts, cadmium and tin plated connectors and accessories, limit the use of highly abrasive methods. Tarnish and light corrosion can be removed from such surfaces by rubbing with:

(1) Eraser (Appendix A, Items 5, 6, 7, and 8).

(2) Brushes, A-A-3077 and A-A-2074, (Appendix B, Items 4 and 31).

(3) Non-Abrasive Pad (Appendix A, Item 3).

Other surfaces such as antenna mounts, equipment racks, chassis, etc., can have light to heavy corrosion removed by hand rubbing with:

(4) Abrasive Mat, A-A-58054 (Appendix A, Item 1).

(5) Abrasive Cloth, ANSI-B74.18 (Appendix A, Item 4).

b. Portable Mini-Abrasive Unit. The Portable Mini-Abrasive Unit (Appendix C, Item 3) is a hand-held miniature abrasive tool used to remove light corrosion products from small avionic components. For example, printed circuit board (PCB) edge connector pins, small avionic structural components. This abrasive unit should not be used on plated surfaces.

(1) Mono-basic Sodium Phosphate, AWWA-B504 (Appendix A, Item 44), is the specified abrasive material for use in the Mini-Abrasive Unit.

(2) The Portable Mini-Abrasive Unit shall be operated only in a Blast cleaning Cabinet. The monobasic

sodium phosphate abrasive may contaminate other equipment and components if allowed to blow freely into the surrounding shop.

c. Hand-Held Abrasive Tool. This unit is used with a Blast Cleaning Cabinet to remove corrosion products from avionic equipment structures and housings.

CAUTION

The Blast Cleaning Cabinet, Hand-Held Abrasive Tool, and Portable Mini-Abrasive Unit (Appendix C, Item 3) shall not be used to clean electrostatic discharge sensitive (ESD) devices. This includes, but is not limited to, microminiature and similar microelectronic components, separate or installed in equipment. Refer to paragraph 4-5.2.5. for further restrictions.

(1) Glass Beads, SAE-AMS-2431 (Appendix A, Item 73), are the specified abrasive material for use in the hand-held abrasive tool.

(2) The Hand-Held Abrasive Tool shall be operated only in a Blast Cleaning Cabinet. The glass beads may contaminate other equipment and components if allowed to blow freely into the surrounding shop.

WARNING

- Prolonged breathing of vapors from organic solvents or materials containing organic solvents is dangerous. Refer to DOD Instruction 6050.5LR. When in doubt, contact the local Safety Officer.

- Chemical paint removers are toxic to skin, eyes, and respiratory tract. Avoid skin and eye contact. Use only with adequate ventilation. Emergency eye wash unit required.

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, A-A-59298.

d. Chemical Paint Removers. Epoxy Paint Remover, MIL-R-81294 (Appendix A, Item 50), shall be used to chemically remove paint and may be applied by brush. When used, care should be exercised in handling to avoid contact with the skin. The directions on the container should be followed to ensure safe handling and best results. Air Force personnel should refer to TO 1-1-8 for authorized chemical paint removers. Whenever a chemical paint remover has been used, the surface should be thoroughly washed with fresh water and detergent prior to any paint application.

5-3. SURFACE TREATMENT.

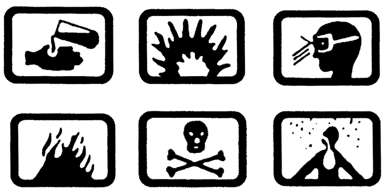
5-3.1. Chemical Conversion Material Procedures. Chemical conversion treatment is an extremely important part of the corrosion control process. Properly applied chemical treatments impart considerable corrosion resistance to the basic metal and greatly improve the adhesion of subsequently applied paints.

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.

a. Treatment Application Particulars. The procedures for treatment of aluminum alloys (MIL-C-5541) use Chemical Conversion Material, MIL-C-81706 (Appendix A, Item 45). Class 1A provides superior corrosion protection. Class 3, however, should be used where low electrical resistance is required, such as mounting of antennas. Alodine Sempen may be used for repair of small areas, (Appendix A, Item 45). Magnesium alloys are treated with Chemical Conversion Material, SAE-AMS-M-3171, Type VI (Appendix A, Item 46). The materials both for aluminum and magnesium are premixed and require no further adjustment prior to use.

b. Distinguishing Between Magnesium and Aluminum. The method to distinguish between magnesium and aluminum is as follows:



Silver Nitrate 9

WARNING

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

(1) Magnesium may be distinguished from aluminum by a spot test with silver nitrate solution. Dissolve a few crystals (approximately 1/4 teaspoon) of Silver Nitrate, A-A-59282 (Appendix A, Item 74) in approximately one (1) ounce of distilled water.

(2) Select or make a clean bare metal spot and place a drop of solution on it. If the area turns black, the material is magnesium. Aluminum shows no reaction.

(3) In the event Silver Nitrate, A-A-59282 (Appendix A, Item 74), is not available, use Silver Nitrate Solution (Appendix A, Item 75).

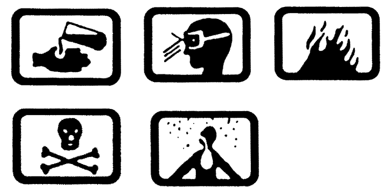
(4) Place one (1) drop of the solution on the bare metal. If the area turns black, the metal is magnesium.

5-3.1.1. Aluminum Surface Treatment. When required to treat aluminum alloys, clean to obtain a water break-free surface.

NOTE

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

(1) Wet the surface with water.



Coating, Chemical Conversion 10

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, MIL-C-81706, is the only chemical conversion treatment for aluminum used in avionics. Touch-n-prep pen may be used for repair of small areas, (Appendix A, Item 45).

(2) While the surface is still wet, apply the Chemical Conversion Material, MIL-C-81706 (Appendix A, Item 45), by Artist's Brush (Appendix B, Item 2A), until an iridescent golden color is obtained (this usually takes 2 to 4 minutes), or use Sempen to apply material, (Appendix A, Item 45).

(3) Immediately rinse the chemical from the surface with fresh water when the proper color conversion is obtained. Thorough rinsing is important to stop the chemical action and minimize solution entrapment. Failure to rinse adequately may accelerate corrosion and reduce paint adhesion.

(4) All excess conversion coating solution that collects into pools within the aircraft or components must be removed.

(5) After rinsing allow the coated surface to air dry (usually 30 minutes). 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.

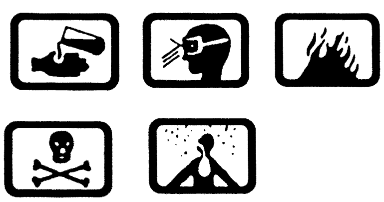
NOTE

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

(6) Any difficulty in properly applying chemical conversion materials may be attributed to insufficiently cleaned metal surfaces, or depleted or contaminated solution. Contaminated or overage material (MIL-C-81706 has a shelf life of at least one year) may not form good films. Overage chemical conversion compounds may be used if an iridescent gold color is obtained on aluminum is under 4 minutes.

5-3.1.2. Magnesium Surface Treatment. When required to treat magnesium alloys, clean to obtain a water break-free surface.

(1) Wet the surface with water



Chemical Conversion Material 11

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 polyproplene containers should be used. Discard all contaminated solutions.

NOTE

Chemical Conversion Material, SAE-AMS-M-3171, is the only chemical conversion treatment for magnesium used in avionics.

(2) While the surface is still wet, apply the Chemical Conversion Material, SAE-AMS-M-3171, Type VI (Appendix A, Item 46), by Artist's Brush (Appendix B, Item 2A), until a greenish-brown or brass-yellow color is obtained. This usually takes one to five minutes.

(3) Immediately rinse the chemical from the surface with fresh water when the proper color conversion is obtained. Thorough rinsing is important to stop the chemical action and minimize solution entrapment. Failure to rinse adequately may accelerate corrosion and reduce paint adhesion.

(4) All excess conversion coating solution that collects into pools within the aircraft or components must be removed.

(5) After rinsing allow the coated surface to air dry (usually 30 minutes). 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 temperatures below 50°F, more time may be required to form good films. This is indicated by the proper greenish-brown or brass-yellow color.

(6) Any difficulty in properly applying chemical conversion materials maybe attributed to insufficiently cleaned metal surfaces, or depleted or contaminated solution. Contaminated or overage material may not form good films. Overage chemical conversion compounds may be used if a greenish-brown or brass-yellow color is obtained on magnesium in under 30 minutes.

5-3.1.3. Treatment of Other Metals. Treatment of other metals is limited to corrosion removal and cleaning.

5-3.1.4. Post Treatment of Conversion Coated Surfaces. Before painting or applying sealant, allow chemical conversion coating to dry (usually 1 hour). Until dry, the coating is soft. Do not wipe the area with a cloth (until dry) or brush (until dry), since wiping will remove the coating.

5-4. PROTECTIVE COATINGS.

NOTE

For information on procedures and equipment to be utilized for paint stripping, conversion coating, pre-paint preparation, paint mixing, and paint application techniques, refer to NAVAIR 01-1A-509 (Navy), TO 1-1-8 (Air Force), and TM 55-1500-345-23/TB 43-0118 (Army).

5-4.1. General. Protective coating are susceptible to damage by handling, accidental scratching, and corrosion. The functions of boxes, chassis, housings, and frames are to enclose, protect and secure the vital internal components of any avionic unit. Therefore, it is important that this structural integrity be maintained at the Intermediate Maintenance Activity (IMA) by the proper application of protective coatings.

a. Painted Surfaces. Painted surfaces on avionic equipment will withstand a normal amount of abrasion from handling and hand tools. However, chipped, scrapped, scratched, and scuffed surfaces of protective paint will cause the base metal of the structure to become corrosion prone. The avionic technician in the Organizational/Unit Maintenance Activity shall pay particular attention to the mishandling of hand tools and avionic equipment. A few minutes of extra time spent in the careful use of tools will save hours of paint touchup and corrosion removal work. When properly applied, these coatings will prolong the useful life of the base material protecting it from corrosion and harmful agents. Any painting operation involves three basic steps:

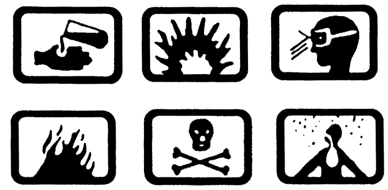
(1) Surface preparation.

(2) Application of primer and/or undercoat.

(3) Application of one or more finish/topcoats.

NOTE

All paint color numbers specified in this manual are in accordance with color coding contained in FED-STD-595.



Compound, Corrosion Preventive, 3
Water-Displacing

b. Minor Paint Damage. Minor paint film damage occurs via chipping, scratching, abrasion, etc. Use Water-Displacing Corrosion Prevention Compound, MIL-C-81309 (Appendix A, Item 16), for temporary protection from corrosion. Long-term repair of the damaged area is achieved by touch-up painting.

c. Extensive Paint Damage. Extensive paint damage requires stripping of old paint, cleaning, conversion coating (if necessary), priming and/or undercoating and applying topcoat(s) as specified in paragraphs 5-4.2 through 5-4.6. Personnel should refer to NAVAIR 01-1A-509 (Navy), TO 1-1-8 (Air Force), or TM 55-1500-344-23 (Army) for paint stripping procedures.

5-4.2. Cleaning and Surface Preparation. It is essential that only thoroughly cleaned surfaces (free from any contaminants) be painted. Paint and other protective coatings will not adhere properly over foreign matter. For example, oil, grease, dirt, moisture, or old paint that is loose or badly cracked. Corrosion and contaminants shall be removed from metal surfaces as specified in paragraph 5-2. Old paint should be removed by paint strippers as specified in paragraph 5-2.2d. The surface shall be cleaned as specified in paragraph 4-5.3.12. If necessary, aluminum and magnesium surfaces shall be treated in accordance with paragraphs 5-3.1.1. and 5-3.1.2. Mask all openings and areas not to be painted with Tape, Pressure Sensitive, SAE-AMS-T-21595, Type I (Appendix A, Item 32).

5-4.3. Painting Equipment and Materials. The painting equipment and accessory materials available for use on avionic equipment are as follows:

a. Paint Equipment.

(1) Spot Touch-Up Spray Gun (Appendix B, Item 32).

(2) Air Brush, Artist Model 200 (Appendix B, Item 33).

(3) Brush, Paint, (Appendix B, Item 2).

(4) Brush, Artist's (Appendix B, Item 2A).

(5) Valve, Metering (Appendix B, Item 34).

(6) Air Regulator Assembly (Appendix B, Item 35).

(7) Paint Spray Booth, (Appendix B, Item 30).

b. Paint Materials.

NOTE

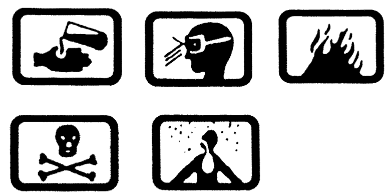
Epoxy Primers, MIL-PRF-85582 and MIL-PRF-23377, are issued as two-part kit. Mix only the materials from the same kit (i.e. the brand and batch number of both cans should be the same). Follow mixing instructions printed on the cans.

(1) Water Reducible Epoxy Primer, MIL-PRF-85582 (Appendix A, Item 48), is used to improve topcoat adhesion and provide a corrosion inhibited undercoating. This two-part material should be mixed and applied over properly prepared surfaces in accordance with procedures contained in NAVAIR 01-1A-509 (Navy), TO 1-1-8 (Air Force), or TM 55-1500-345-23 (Army).

(2) Primer Coating, Epoxy Polyamide, MIL-PRF-23377 (Appendix A, Item 52), is used to improve topcoat adhesion and provide a corrosion inhibited undercoating. This two-part material should be mixed and applied over properly prepared surfaces in accordance with procedures contained in NAVAIR 01-1A-509 (Navy), TO 1-1-8 (Air Force), or TM 55-1500-345-23 (Army).

NOTE

Coating Epoxy-Polyamide, MIL-PRF-22750 (Appendix A, Item 53), is issued as a two-part kit, which includes a can of pigmented compound and a can of converter. Mix only materials from the same kit (i.e. the brand and batch number of the pigmented compound must be the same as those on the converter can). Follow mixing instructions printed on the cans.

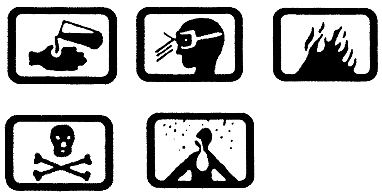


Aliphatic Polyurethane Coating	12
Primer Coatings, Epoxy Waterborne	13
Coating, Epoxy, High Solids	14
Primer Coatings, Epoxy, Chemical and Solvent Resistant	15
Coating Aircraft Touchup	16
Coating Aircraft Touchup	17

(3) The topcoat is the final or finish coat applied over the primer. For Navy applications, the topcoat shall be Coating, Epoxy-Polyamide, MIL-PRF-22750 (Appendix A, Item 53). For Army applications, the topcoat shall be Coating, Aliphatic Polyurethane, Chemical Agent Resistant, MIL-C-46168 (Appendix A, Item 57). Selection of topcoat color, when equipment is refinished, shall be based on the equipment normal location. For Navy application, cockpit equipment shall be coated with Epoxy-Polyamide, Lusterless Black MIL-PRF-22750, Color Number 37038 (Appendix A, Item 53). Alternate use of Lusterless Gray, MIL-PRF-22750 Color Number 36231 (Appendix A, Item 53) is acceptable as appropriate. Unless otherwise specified, equipment shall be coated with Epoxy-Polyamide Dark-Gull Gray, MIL-PRF-22750, Color Number 36231 (Appendix A, Item 53). Equipment markings shall be replaced with Stencil Marking Set (Appendix B, Item 21), and Coating Aircraft Touchup, MIL-PRF-81352 (Appendix A, Item 49), in appropriate color. These topcoat materials are authorized

and approved for Navy use. Air Force personnel should refer to TO 1-1-8 for proper color and paint systems. MIL-PRF-85285 is the preferred topcoat for Air Force avionic equipment.

(4) Thinners are volatile solutions used to thin or reduce paint the the desire consistency. The type of thinner that may be used and the recommended quantity are usually stated on the paint container.



Thinner, Aircraft Coating 18

WARNING

Prolonged breathing of vapors from organic solvents or materials containing organic solvents is dangerous. Refer to DOD Instruction 6050.5-LR, OPNAVINST 5100.23, TB MED 502/DLAM 1000.2, or AFOSH STD 48. When in doubt, contact the local Safety Officer.

(5) Local air pollution regulations may restrict the use of many coatings and thinners in some areas. Thinner Aliphatic Polyurethane, MIL-T-81772 (Appendix A, Item 59), may be used to thin MIL-PRF-23377, MIL-PRF-22750, MIL-C-46168, and MIL-PRF-81352 coatings. MIL-PRF-85582 shall be thinned as specified by the manufacturer.

c. Paint Problems. Certain discrepancies may appear on finish coatings due to faulty application methods or the condition of the surface to which it is applied. The most common defects, probable causes, and preventives are listed in Table 5-1.

5-4.4. Application of Coating. The method used to paint, touch-up, or apply preservatives depends on the extent of the job, materials, 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 or unsuitable.

a. Paint Spray Booth. The Paint Spray Booth (Appendix B, Item 30), is used to provide an enclosure for paint spray operations.

b. The unit shall be equipped with an exhaust fan and filter capable of evacuating paint fumes and entrapping spray particles.

5-4.5. Application of Primer. Primers MIL-PRF-23377 (Appendix A, Item 52) and MIL-PRF-85582 (Appendix A, Item 48) are to be utilized on avionic equipment as specified in paragraph 5-4.3.

a. The surface to be painted should be cleaned and pretreated thoroughly.

b. Mask all openings and areas not be painted with Pressure Sensitive Tape, SAE-AMS-T-21595, Type I (Appendix A, Item 32), and Paper, Kraft, A-A-203 (Appendix A, Item 36) or MIL-PRF-131 (Appendix A, Item 65).

c. Primer coat can be sprayed or brushed on.

d. When possible, the item or material painted should be kept in a dry, dust-free place until the primer dries and hardens.

5-4.6. Application of Topcoat. The only topcoats to be utilized on Navy avionic equipment are Coating, Epoxy-Polyamide, MIL-PRF-22750 (Appendix A, Item 53) and MIL-PRF-81352 (Appendix A, Item 49), as specified in paragraph 5-4.3. The color should be selected also in accordance with paragraph 5-4.3. MIL-PRF-85285 is preferred for use on Air Force avionics. The only topcoat to be utilized on Army avionic equipment is Coating, Aliphatic Polyurethane, Chemical Agent Resistant, MIL-PRF-85285 (Appendix A, Item 55).

a. When a single coat does not adequately cover the undercoat, and protection against extreme exposure is required, two or more coats may be required.

b. After the undercoat or primer has dried, the finish coats shall be applied by spray or brush. Application

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 selective areas • Application of the first coat too thin especially in hot weather • Poorly cleaned surface • Wrong thinning mixture	• Ensure sufficient mixing and thinning • Ensure proper preparation of the surface
Orange Peel - orange skin appearance	• Spray 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 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 hot humid days during or shortly after application • Caused by condensation of moisture onto the freshly painted surface 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 areas 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 thinner MIL-T-81772 (Appendix A, Item 59). Blot dry using clean absorbent cloth. Repeat as necessary and repaint.

Table 5-1. Cause and Prevention of Paint Defects (Continued)

Paint application defects	Cause	Prevention
Grit	• Gritty surface coatings are caused by the settling of particulate debris onto freshly painted surfaces, usually within two hours of the paint application	• Clean surface prior to application • Filter paint before mixing
Alligatoring - characterized by irregular separations and wide cracks in the paint film	• Softened undercoat • Uncured layer	• Remove affected paint and refinish
Bleeding - discoloration of 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 due to oxidation of the topcoat	• Polishing or light sanding of area. If persistent, refinish affected area
Checking - thin lines criss-crossing each other	• Softened undercoat • Uncured layer • Condition increases with aging	• Remove affect paint and refinish
Cracking - irregular lines in paint film	• Inadequate curing of paint • Inadequate mixing • Change in temperature during applications	• Remove affected paints and refinish
Crow footing - line branching in all directions and crossing each other	• Application before undercoat has dried • Too rapid evaporation of thinner • Coating too thick	• Sanding topcoat and refinishing • Remove affected paint and refinish
Peeling - separation and lifting of paint film	• Separation of topcoat from primer or primer from metal surface due to: • Lack of or improper chemical conversion coating applications • Contaminated (dirty) surface • Wet surface	• Remove paint film and refinish affected area
Runs and sags	• Application of too much paint • Paint contains too much solvents	• Sand surface and refinish • If affected area is extensive, remove paint from affected area and refinish
Scratches and chips	• Gouging with sharp tools • Sharp blows by tools or stones	• Touch-up affected area

method depends on the type of finish required, materials used, and surface to be finished. Care should always be taken to keep the area free of dust and other foreign matter when applying the topcoat.

c. Remove all masking materials as soon as possible.

5-5. ENCAPSULANTS.

5-5.1. General. Encapsulants are materials used to cover a component or assembly in continuous organic resin. Encapsulants provide electrical insulation, resistance to corrosion, moisture, fungus, and mechanically support the components. In miliary avionic equipment, encapsulants are classified as follows:

a. Potting compounds used to seal electrical connectors, plugs, and receptacles.

b. Conformal coatings used to encapsulate PCBs and modules. Refer to NAVAIR 01-1A-23 (Navy) or TO 00-25-234 (Air Force).

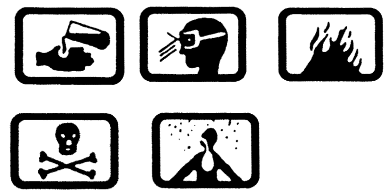
c. Fungus proof coatings, usually varnish, used to encapsulate certain avionic circuit components in a thin protective film that is impervious to fungus attack. Usually used in older macroelectronic and electrical components.

NOTE

Refer to NAVAIR 01-1A-5605 (Navy), TO 00-25-234 (Air Force), or TM 55-1500-323-24 (Army) for additional information and application procedures on potting compounds.

5-5.2. 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 the exclusion of moisture, stray particles, and aircraft liquids (hydraulic fluid, fuel, and oil).

a. Materials. The following materials shall be used for "potting" electrical connectors.



Sealing Compound, 19

Adhesive/Sealant, Silicone RTV, Non-Corrosive 1

NOTE

Potting compounds shall comply with the requirements of specifications MIL-PRF-8516 and MIL-A-46146, except where substitutes are specifically authorized by the cognizant engineering authority.

(1) Sealing Compound, Synthetic Rubber, Accelerated, MIL-PRF-8516 (Appendix A, Item 30), is a two-part synthetic rubber compound. It consists of a base and an accelerator (curing agent) packaged together. It is used for sealing low voltage electrical connectors, wiring, and other electrical apparatus, where temperature does not exceed 200°F (93°C). MIL-PRF-8516 is not authorized for use in engine bays, keel areas, or areas adjacent to bleed air ducts.

(2) RTV, MIL-A-46146 (Appendix A, Item 40), is used for sealing electrical connectors electronic components where a more flowable, one-part material is required. This material is described in detail in paragraph 5-5.4.

(3) Sealing Compound, MIL-PRF-81733 (Appendix A, Item 29), is used to prevent entry of corrosive environments. These materials are described in detail in paragraph 5-5.4.

(4) Sealing Compound, MIL-M-24041 is a two-component polyether polyurethane system consisting of a prepolymer and a curing agent before mixing. These compounds are flexible cold-flow and cold-resistant materials with excellent electrical properties and are

intended for use in a seawater environment. This compound will adhere to metal, rubber, or polyvinyl-chloride, and may be used for the sealing and reinforcement of electrical connectors, wiring and other electrical apparatus. This compound is used to seal connectors located in areas where the temperature range is -80°F to +300°F.

NOTE

Refer to NAVAIR 01-1A-505 (Navy), TO 00-25-234 (Air Force), or TM 55-1500-323-24 (Army).

b. Reverted Potting Compounds. Depending on the environment, potting compounds, such as Pro-Seal 777 (green) and EC-2273 (black), are known to revert to a liquid after a year, or two. Compounds that revert exhibit a sticky, oozing consistency that flows out of the connector. In some cases, the reverted potting compounds flow around through the pins and receptacles, insulating the connections where continuity is required.

NOTE

Electrical connectors should be examined for evidence of potting compound deterioration (reversion). If soft, spongy, doughy, viscous, or flowing conditions exist, the connector shall be replaced in accordance with NAVAIR 01-1A-505 (Navy), TO 00-25-234 (Air Force), or TM 55-1500-323-24 (Army).

c. Precautions. When using potting compounds the following precautions shall be followed:

(1) Apply potting compounds only to thoroughly clean surfaces.

(2) Follow instructions carefully when mixing the base compound and accelerator. Substitution, partial mixing, or incorrect proportions of base compound and accelerator may produce a sealant with inferior properties.

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

(4) Potting compounds may contain small quantities of flammable solvents, and/or release by-products on curing. Adequate ventilation and fire precautions are required during mixing, curing, and/or storage of potting compounds.

(5) Potting compounds that have exceeded normal shelf life are not to be used unless retested and certified.

(6) Avoid the use of masking tape and fiberboard molds. If potting molds are not furnished with connector or are not available, a plastic sleeve should be constructed. This will aid in forming the potting compound around the connector shell.

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

NOTE

Refer to NAVAIR 01-1A-505 (Navy), TO 00-25-234 (Air Force), or TM 55-1500-323-24 (Army).

(8) Frozen, premixed, potting compounds should be used as soon as possible after the removal from the deep freeze or a significant (approximately 50 percent) reduction in work life can be experienced.

(9) Remove reverted potting compounds as soon as possible.

5-5.3. Fungus-Proof Coatings. Fungus-proof coatings should not be applied indiscriminately to all electronic components. Treat only those components that have been treated or are specified in the applicable service directives. Fungus-proof coatings can, in some instances, be detrimental to the function/maintenance of equipment. For example, it deteriorates wire insulation and its removal is labor intensive. The IMA will retreat the entire surface only when touch-up procedures will not provide protection to the item. Considering the difficulties of applying a fungus-proof coating, it is important to recognize that if the coating is not maintained properly, many hours of additional repair time will be required.

5-5.3.1. Fungus-Proof Varnish. The authorized fungus-proof coating is Varnish, ASTM D3955 (Appendix A, Item 42). If it is found necessary, the varnish may be thinned with Thinner, ASTM D263 (Appendix A, Item 58).

5-5.3.2. Items to be Protected Against Varnish Application. Varnish shall not be applied to any surface where it interferes with the operation/performance of the equipment. Such surfaces shall be protected against varnish application by masking with Pressure Sensitive Tape, SAE-AMS-T-22085, Type II (Appendix A, Item 31). the following items shall be protected.

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 values. These values are specified in the applicable service directives.

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

(4) High wattage and wirewound resistors.

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

(6) Painted, lacquered, or varnished surfaces, unless otherwise specified.

(7) Rotating parts such as dynamotors, generators, motors, etc. However, electronic components associated with these parts shall be treated in accordance with procedures outlined in this manual.

(8) Waveguides (working 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-fiber-glass, fluorocarbon, vinyl, and alkyd.

(18) Materials used for their specific arc-resistant 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. For example, bearings, contact fingers, potentiometers, shafts, shields, and variable auto-transformers.

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

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

5-5.3.3. Methods of Application. The varnish coating shall be applied by spraying, brushing, dipping, or any combination. The dried film shall have a clear, smooth finish (free from bubbles, wrinkles, filaments, or spray dust). The running, lumping, or gathering of the film into drops shall be avoided. Where practical, the dry film thickness shall be at least 0.002 inch.

CAUTION

Varnish, ASTM D3955 (Appendix A, Item 42), shall be applied only on clean, dry surfaces with the temperature less than 100°F (38°C).

NOTE

All surfaces to be coated shall be free of dirt, grease, and other foreign matter. Components that cannot be cleaned satisfactorily or that show evidence of corrosion should be replaced by acceptable components. Clean as specified in paragraph 4-5.3.12.

a. Spraying. For larger equipment, a pressure pot spray gun with a 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 shall be applied in a wet coat over all parts to prevent the formation of fuzz or filaments. A dry spray which forms spray dust shall not be used. The equipment or individual assembly shall be sprayed from as many angles as necessary to assure complete coverage with a wet coat. If more than one coat of varnish is applied, sufficient drying time should be allowed between each coat.

b. Brushing. All parts which cannot be reached by spray shall be coated as completely as practicable with a brush. A brush may also be used to cover small areas not covered during the spraying process. On those components requiring extensive masking, brush application of the coating material may prove more efficient than spray application.

c. Dipping. Subassemblies or components may be coated by dipping, provided all requirements are met.

5-5.3.4. Drying of Coated Equipment. Equipment coated with varnish shall be dried by heating to 130°F (54°C). Heating shall 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 not longer than 3 hours. Drying may be done in a vented oven, vacuum oven, or with Hot Air Gun, A-A-59435 (Appendix B, Item 16 (shop use only)).

WARNING

Components that are to be enclosed in airtight cases should be allowed to air-dry at least 24 hours after varnish dries. Fumes may accumulate to dangerous levels in the containers and be ignited by sparks.

5-5.3.5. Special Precautions. When varnish is to be applied on certain types of equipment, special precautions are required to be followed. The following is an equipment and parts list 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 the damage is great, proper alignment is impossible. Extreme care must be exercised in removing and replacing coil shields.

c. Trimmer Capacitors. Avoid spraying or brushing varnish on the plates of trimmer capacitors. To minimize damage, all trimmer capacitors should be completely covered during coating. If these capacitors fail to operate satisfactorily after treatment, make a thorough inspection for deposits of varnish.

d. Tuning Slugs. Extreme care must be taken in removing and replacing tuning slugs. If varnish is accidentally applied to a slug, remove it before replacing the slug.

e. Discriminator Circuits. Careful adjustment of discriminator circuits after treatment is essential, especially in the case of frequency-modulated receivers. Discriminator circuits are more susceptible to change in circuit constants caused by varnish than other part.

f. Tuned Circuits. Be especially careful during masking to ensure that wires associated with tuned circuits are not moved. Movement of such wires may cause changes in circuit values.

g. Relays. Deposits of varnish on the armature, pivots, or similar components will cause the relays to bind. The whole relay should be carefully masked until after spraying has been completed. A brush should be used to coat the coils and leads after the masking has been removed. Relays with palladium-tipped contacts should be removed before application of varnish.

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

5-5.4. Sealants. Sealants are another type of protective film used in avionic equipment. Sealants are usually liquid or paste, which solidify after application. They form a flexible seal, preventing moisture intrusion at mechanical joints, spot-welds, and threaded closures. In addition, sealants prevent entry of corrosive environments to faying surfaces, fastener areas, exposed landing gears switches, and other metal-encased avionic equipment. They function principally as waterproof barriers. It is therefore very important that damaged sealants be repaired as soon as possible.

NOTE

For application procedures of Sealing Compound, MIL-PRF-81733, refer to NAVAIR 01-1A-509 (Navy), TO 1-1-691 (Air Force), and TM 55-1500-344-23 (Army).

a. Types of Sealants. The following sealants shall be used on avionic equipment:

(1) Sealing Compound, Low Temperature Curing, MIL-S-83318 (Appendix A, Item 28), is a quick cure sealant used for sealing gaps and depressions on areas during extreme cold activities. Apply with Brush, Typewriter, A-A-3077, Style T (Appendix B, Item 4).

(2) Adhesive-Sealant, Silicone, RTV, Non-corrosive, MIL-A-46146 (Appendix A, Item 27), is used for sealing avionic equipment in areas where temperatures are between 250°F (121°C) to 350°F (177°C).

(3) RTV Coating Flowable, Brush Application, MIL-A-46146 (Appendix A, Item 40), is used for encapsulating and sealing of electrical and electronic components. This material has good resistance for oxidation, weathering, and water.

(4) Sealing Compound, MIL-PRF-81733 (Appendix A, Item 29), can be used to seal gaps, seams, and faying surfaces with temperatures up to 250°F (121°C). This material is applied by brush.

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 circuit. They may be identified in most cases by a vinegar odor while in a liquid or curing state.

(5) Conformal Coating. For information on procedures and equipment to be used to apply conformal coatings, refer to NAVAIR 01-1A-23 (Navy) and TO 00-25-234 (Air Force).

b. Sealant Containing Acetic Acids. Table 5-2 lists some of the RTV silicone sealants considered corrosive and should not be used in avionic equipment.

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 101
RTV 158	RTV 786	* RTV 92-024	
RTV 159	* RTV 891	* RTV 92-048	

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

*Products discontinued by manufacturer but may still obtained in the supply store.

CHAPTER 6
TREATMENT OF SPECIFIC AVIONIC EQUIPMENT

6-1. GENERAL. All aircraft electrical/electronic units must be opened and inspected for evidence of internal moisture and corrosion. When corrosion is detected, prompt corrective action is required. This action shall consist of cleaning, corrosion removal, treatment, and preservation, where required. Maintenance personnel should always use the mildest method available to remove corrosion. The procedures and techniques of corrosion removal outlined in the following paragraphs are intended to assist avionic technicians in equipment repair. In each case, some discretion on the part of maintenance personnel is warranted. It is important that personnel analyze the problem, select the appropriate corrective action, and confirm corrosion control effectiveness. It is recommended that Chapter 2 be reviewed for basic information on what avionic corrosion is, why it occurs, and the various forms it can take.

6-2. REPAIR OF AVIONIC EQUIPMENT HOUSING, MOUNTING, AND STORAGE HARDWARE.

6-2.1. Bilge Areas. A common trouble spot on all aircraft is the bilge area, especially in helicopters. These areas contain all types of avionic equipment and present a natural sump or collection point. Accumulation of waste, hydraulic fluids, water, dirt, loose fasteners, drill shavings and other debris is typical. Liquids shall be pumped or drained from bilge areas. Bilge areas should be cleaned before equipment replacement. All efforts should be made to ensure that avionic equipment is cleaned and preserved before being returned to these areas. Bilge areas shall be cleaned and preserved as specified in NAVAIR 01-lA-509 (Navy), TO 1-1-691 (Air Force), or TM 55-1500-344-23 (Army).

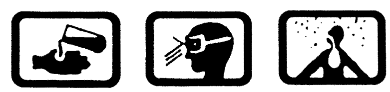
6-2.2. Equipment Bays. Avionic equipment bays and installed equipment are highly susceptible to corrosion. This is especially true in helicopters and aircraft using external ram air cooling. The avionics technician should routinely survey the inside of equipment bays whenever he is working in these areas. Report evidence of any corrosion. The inspection and treatment process are outlined in the following paragraphs.

NOTE

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

a. Clean and inspect hardware, fixed mountings, and points of metal bonds for signs of galvanic corrosion. Pay particular attention to areas of dissimilar metal.

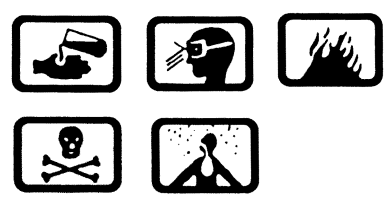
b. Remove corrosion with Abrasive Cloth, ANSI-B 74.18, 320 Grit, Type I, Class 1 (Appendix A, Item 4), or Abrasive Mat, A-A-58054, Type I (Appendix A, Item 1).



Compound, Aircraft Cleaning 4

c. Clean affected areas with a solution of nine parts fresh water to one part Aircraft Cleaning Compound, MIL-PRF-85570, Type II (Appendix A, Item 11). Apply with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23).

d. Rinse with fresh water and wipe dry with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23).

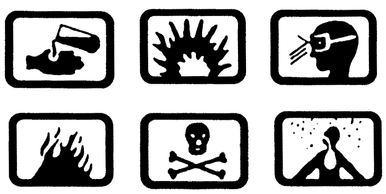


Coating, Chemical Conversion 10

CAUTION

Exercise care when using Chemical Conversion Material, MIL-C-81706, or Sempen near electronic hardware. It can cause corrosion of the delicate electronic devices if not suitably protected.

e. After corrosion is removed, aluminum surfaces shall be treated with Chemical Conversion Material, MIL-C-81706. (Appendix A, Item 45), and painted as specified in NAVAIR 01-1A-509 (Navy only) and paragraphs 5-4.1 through 5-4.6. Air Force personnel should refer to equipment specific manuals for proper color and paint systems.



Compound, Corrosion Preventive, Water-Displacing 3

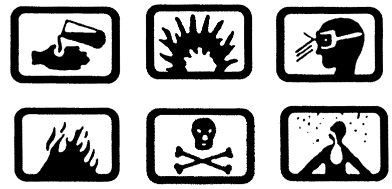
f. When environmental conditions or time do not permit, preserve with a thin film of Water-Displacing Corrosion Preventive Compound, MIL-C-81309 (Appendix A, Item 16) or MIL-C-85054 (Appendix A, Item 16A).

6-2.3. Engine Compartments. Remove corrosion and preserve as follows:

a. Inspect the compartment, hardware, electrical connectors, terminal boards, junction boxes, and ram air turbine for signs of salt spray contamination and corrosion.

b. Treat as specified in paragraph 6-2.2 with the following exceptions.

(1) Treat electrical connectors as specified in paragraphs 6-3.11.1. through 6-3.11.4.



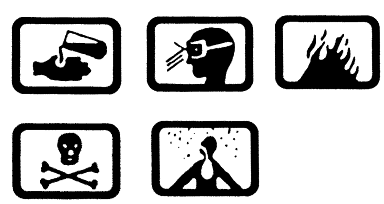
Compound, Corrosion Preventive, Water-Displacing 3

(2) Treat terminal boards as specified in paragraph 6-2.8. Preserve internal surfaces and terminals with a thin film of Water-Displacing Corrosion Preventive Compound, MIL-C-81309, Type III (Appendix A, Item 16).

(3) Treat ram air turbine as specified in the applicable service directives.

6-2.4. Battery Compartments, Boxes, and Adjacent Areas. The battery, battery cover, battery box, and adjacent areas (especially areas below the battery compartment) are subject to the corrosive action of the electrolyte. Two different types of batteries are encountered on avionic equipment, lead acid type (sulfuric acid electrolyte) and nickel-cadmium type (potassium hydroxide electrolyte).

6-2.4.1. Preparation of Solutions for Cleaning and Neutralizing Battery Electrolytes. Indicating solutions are required for cleaning areas subjected to electrolyte spills. These solutions determine the location of contaminated areas and indicate when these areas have been completely neutralized. Use a 10% sodium bicarbonate (ordinary baking soda in water) solution to neutralize sulfuric acid from lead acid batteries and a 3% boric acid (in water) solution to neutralize potassium hydroxide from nickel-cadmium batteries.



Alcohol, Isopropyl 6

WARNING

- Sulfuric acid and battery electrolytes are highly toxic to eyes, skin, and respiratory tract. Avoid all contact. Skin and eye protection is required. If any acid/ electrolyte contacts the skin or eyes, flood the affected area immediately with water and consult the Base Medical Service. Emergency shower and eye wash station are required. Use only with adequate ventilation. Assure this operation has been reviewed by local Bioenvironmental Engineer.

- When working around batteries, always wear eye protection (face shield), acid resistant rubber apron and gloves.

6-2.4.2. Litmus Indicating Solution. Litmus indicating solutions are used on lead acid battery electrolyte spills. Pour one pint of a mixture containing 70% Isopropyl Alcohol TT-I-735 (Appendix A, Item 15) and 30% distilled water, both by volume, into a plastic spray bottle with a hand squeeze pump, add one tablespoon of litmus powder into the liquid, and mix thoroughly until a deep blue color is observed. Or use litmus paper (Appendix A, Item 67A).

6-2.4.3. Bromothymol Blue Indicating Solution. Bromothymol blue indicating solutions (See 6-3.9a(1))are used on nickel-cadmium battery electrolyte spills. Pour one pint of bromothymol blue solution into a plastic spray bottle with a hand squeeze pump. Using an eye dropper, add one drop of phosphoric acid into the solution, A-A-59282, (Appendix A, Item 67), with subsequent mixing after each drop, until the color of the solution changes from blue to gold/amber.

6-2.4.4. Sodium Bicarbonate Neutralizing Solution. Pour one pint of fresh water into a 500-ml polyethylene wash bottle, add two ounces of Sodium Bicarbonate, ASTM D 928 (Appendix A, Item 43) and mix thoroughly.

6-2.4.5. Boric Acid Neutralizing Solution. Pour one pint of fresh water into a 500-ml polyethylene wash bottle, add one-half ounce of Boric Acid, A-A-59282 (Appendix A, Item 47) and mix thoroughly.

6-2.4.6. Cleaning and Neutralizing Procedures.

a. Remove any standing liquid or puddles with a squeeze bulb type syringe, absorbent cloth, or sponges. Place these items in a leak-proof container for removal to prevent the contamination of other areas.

b. Spray the entire suspected area with the proper indicator solution, using the minimum amount needed to wet the entire surface. For spills from lead acid batteries, use the litmus solution, which will change in color from deep blue to a bright red in areas contaminated by sulfuric acid. For spills from nickel-cadmium batteries, use the bromothymol blue solution, which will change in color from amber or gold to a deep blue in areas contaminated by potassium hydroxide.

c. Apply the correct neutralizing solution to the areas where the indicating solution has changed color. Ensure that the area is well saturated and that the stream is directed into all seams and crevices where 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. Corrosion Preventive Compound, MIL-C-81309, can be used for temporary protection of bare metal areas.

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

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

g. Repair and apply prepaint treatment, sealant, and coatings as required. Special acid and/or alkali resistant coatings are usually required for battery compartments, boxes, and areas. Refer to the applicable aircraft manuals.

NOTE

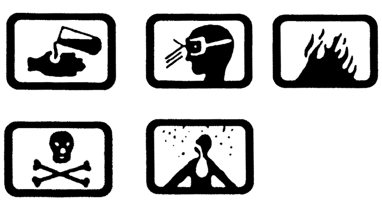
Refer to NAVAIR 17-15BAD-1 (Navy) or TM 11-614S203-14-2 (Army) for additional information on maintenance of aircraft batteries.

6-2.5. Frames, Mounting Racks, and Shock Mounts. Shock mounts and associated hardware on pod/airframe mounted equipment are usually the last items to be inspected for corrosion damage. This is usually because inspection requires the removal of the shock mount to facilitate examination. For this reason, shock mounts and associated metallic hardware must be preserved to ensure protection. This does not eliminate the requirement to inspect shock mounts. For frames, mounting racks, and shock mounts that are not normally painted, remove corrosion and preserve as follows:

NOTE

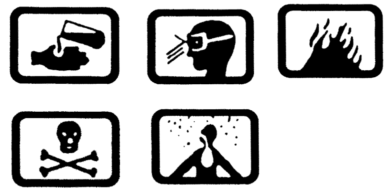
The use of dissimilar metals in the selection of screws, washers, and nuts should be eliminated, wherever possible. Refer to Chapter 7 for information on bonding and grounding hardware.

a. Remove corrosion with Abrasive Cloth, 320 Grit, ANSI-B74.18, Type I, Class I (Appendix A, Item 4), or Abrasive Mat, A-A-58054, Type I (Appendix A, Item 1). Pay particular attention to dissimilar metal couples.



Alcohol, Isopropyl 6

b. Clean affected area with one part Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15) mixed with one part fresh water. Apply with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23). Pay particular attention to shock mounts that contain rubber shock absorbers. These items may swell if immersed in Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15), for a long period of time. If rubber does swell, it will return to its normal size after a short period of time.



Compound, Corrosion Preventives Water-Displacing 3

c. Frames, mounting racks, and shock mount associated metallic hardware shall be preserved with a thin film of Water-Displacing Corrosion Preventive Compound, MIL-C-81309 (Appendix A, Item 16) or MIL-C-85054 (Appendix A, Item 16A).

d. For frames, mounting racks, and shock mounts that are normally painted, remove corrosion and clean as outlined in steps a through c. Paint these areas in accordance with NAVAIR 01-lA-509 (Navy only). Air Force personnel should refer to equipment specific manuals for proper color and paint systems. Army personnel shall refer to TM 55-1500-345-23 and TB 43-0118.

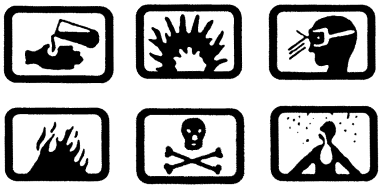
6-2.6. External Pod Mounted Equipment. External avionic pods are susceptible to the same corrosive environment as the airframe. Cleaning techniques are the same with the exception of electromagnetic gaskets, shields, electrical connectors, and mating surfaces. Treat as follows:

NOTE

- Refer to the applicable service directives for information on those areas of external pod mounted avionic equipment that may be preserved without degrading the electrical characteristics of the equipment. Do not preserve water seal gaskets.
- Refer to Chapter 8 and the applicable service directives for information on electromagnetic gasket plating where the plating surfaces have been removed.

a. Remove corrosion and clean as specified in paragraph 6-2.7.

b. Paint as required by equipment specific manuals.



Compound, Corrosion Preventive, Water-Displacing 3

c. If painting cannot be accomplished, preserve external surfaces with a thin film of Water-Displacing Corrosion Preventive compound, MIL-C-81309 (Appendix A, Item 16) or MIL-C-85054 (Appendix A, Item 16A).

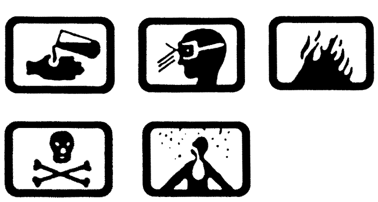
d. Clean and preserve electrical connectors and wire harnesses as specified in paragraphs 6-3.11.1 thru 6-3.11.4 and 6-3.13.

6-2.7. Cockpit and Control Boxes. Use Vacuum Cleaner, MIL-V-21987 (Appendix B. Item 13), vacuum the cockpit area clean. The following inspection and treatment procedures shall apply to cockpit avionic components.

a. Inspect control box units for corrosion and contaminants. Pay particular attention to switches, dials, knobs and electrical connectors.

b. Remove corrosion products from metal surfaces with Abrasive Mat, A-A-58054, Type I (Appendix A, Item 1), or Cleaning and Polishing Pad, Non-Abrasive (Appendix A, Item 3) as appropriate.

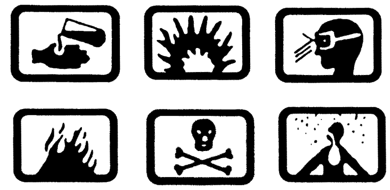
c. Clean affected area with Dry Cleaning Solvent, MIL-PRF-680, Type III (Appendix A, Item 14). Apply with Cleaning Cloth, CCC-C-46 Class 7 (Appendix A, Item 23).



Alcohol, Isopropyl 6

d. Follow with application of one part Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15), to one part deionized water. Wipe clean with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23).

e. Paint as required by equipment specific manuals.



Compound, Corrosion Preventive, Water-Displacing 3

Compound, Corrosion Preventive, 8

WARNING

Do not use Corrosion Preventive Compound MIL-C-81309 or MIL-PRF-16173, or MIL-C-85054 or Lubricating Oil, General Purpose Preservative, VV-L-800 (Appendix A, Item 18) around oxygen or oxygen fitting since fire/explosion may result.

f. Spray Water-Displacing Corrosion Preventive Compound, MIL-C-81309 (Appendix A, Item 16), on metal surfaces and wipe with cleaning cloth, CCC-C-46, Class 7(Appendix A, Item 23). Take steps not to get preservative on acrylic plastic faceplate.

g. Clean and preserve toggle, rotary, and pushbutton switches as specified in paragraph 6-3.7.

h. Clean control box faceplates with solution of one (1) ounce Detergent, Liquid, Nonionic, MIL-D-16791, Type I (Appendix A, Item 10), in one (1) gallon of fresh water. Apply and wipe with Flannel Cloth, CCC-C-458, Type II (Appendix A, Item 26). Polish glass with clean flannel cloth.

i. Clean and preserve cockpit and control box electrical connectors as specified in paragraphs 6-3.11.1 through 6-3.11.4.

6-2.8. Terminal Boards, Junction Boxes, Relay Boxes, and Circuit Breaker Panels. Remove covers and access panels. Treat as follows:

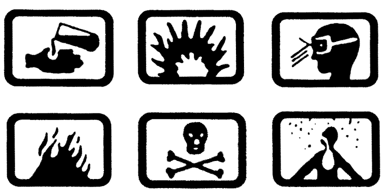
WARNING

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

a. External surfaces:

(1) Treat as specified in paragraph 6-2.2.

(2) Prepare surface and paint as specified in NAVAIR 01-1A-509 (Navy), TO 1-1-8 (Air Force),and TM 55-1500-345-23 and TB 43-0118 (Army).



Compound, Corrosive Preventive, Water-Displacing 3

(3) When environmental conditions or time do not permit, preserve with a thin film of Water-Displacing Corrosion Preventive Compound, MIL-C-81309 Type II (Appendix A, Item 16).

b. Internal components:

(1) Remove corrosion with Cleaning and Polishing Pad, Non-Abrasive (Appendix A, Item 3) or Abrasive Mat, A-A-58054 Type I (Appendix A, Item 1), as appropriate.

Alcohol, Isopropyl 6

(2) Clean affected area with one part Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15), mixed with one part deionized water. Apply with Cleaning Cloth, CCC-C-46 Class 7 (Appendix A, Item 23), Brush, Acid, A-A-289 (Appendix B, Item 1) or Brush, Typewriter, A-A-3077 (Appendix B, Item 4).

(3) Wipe clean and allow to air dry.

(4) Clean and preserve electrical connectors as specified in paragraphs 6-3.11.1 through 6-3.11.4.

(5) Coat internal surface by applying a thin film of Water-Displacing Corrosion Preventive Compound, Ultra-Thin Film, MIL-C-81309, Type III (Appendix A, Item 16), to all electrical connections, terminals, and internal surfaces. Avoid the application of preservatives on relay and circuit breaker contacts.

NOTE

For additional information on bonding and grounding straps, refer to Chapter 7 and the applicable service directives.

6-2.9. Metallic Equipment Covers and Housings. Avionic equipment cases, covers, housings, and associated hardware are usually exposed to harsher elements than internal circuit components. As a result, they require more frequent cleaning. Treat any corrosion as specified in paragraph 6-2.2.

a. Hardware associated with equipment housings and cases that are not normally painted should be preserved. Preserve as often as necessary, depending on the operating environment. Materials and procedures specified in the appropriate Maintenance Requirement Cards (MRCs) or Phased Maintenance Inspection Checklist may be used as alternatives.

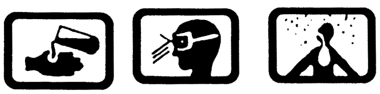
b. Hinges and latches on equipment covers shall be preserved as specified in paragraph 6-2.11.

6-2.10. Nonmetallic Covers and Housings. In some cases avionic equipment, support equipment, or general purpose test equipment use high impact plastic or fiberglass covers and housings. These should be cleaned as follows:

a. The primary cleaning method shall be cleaning track CSR2A or CSR3 (as applicable). Refer to Table 4-1.

b. The Secondary Cleaning Method.

(1) Inspect hardware, hinges and points of metal bonds for signs of galvanic corrosion. Pay particular attention to dissimilar metals. Remove any corrosion with Cloth Abrasive, ANSI-B74.18, Type 1, Class 1 (Appendix A, Item 4), or Abrasive Mat, A-A-58054, Type I (Appendix A, Item 1).



Compound, Aircraft Cleaning 4

(2) Clean cover and housing with a solution of nine parts fresh water to one part Aircraft Cleaning Compound, MIL-PRF-85570, Type II (Appendix A, Item 11). Apply with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23).

(3) Rinse with fresh water and wipe dry with Cleaning Cloth, CCC-C-46, Class 7.

(4) Allow to air dry, if necessary.

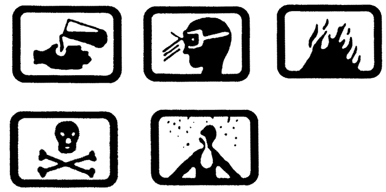
(5) Hardware associated with test equipment housings and covers that is not normally painted should be preserved as often as necessary, depending on the operating environment. Do not preserve water seal gaskets.

(6) Equipment hinges and latches shall be preserved as specified in paragraph 6-2.11.

6-2.11. Equipment Hinges and Latches. Inspect hinges and latches on black boxes, access doors, etc., for corrosion and condition of preservatives/ lubricants. Treat as follows:

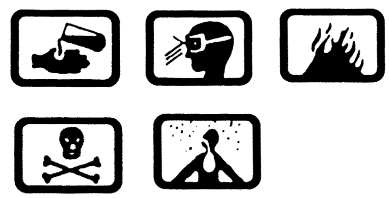
a. Clean affected areas with Cleaning Cloth, CCC-C-46. Class 7 (Appendix A, Item 23) dampened with Dry Cleaning Solvent, MIL-PRF-680 (Appendix A, Item 14).

b. Remove corrosion with Abrasive Mat, A-A-58054, Type I, Grade A or B (Appendix A, Item 1) or Abrasive Cloth, 320 Grit, (Appendix A, Item 4), as appropriate.



Alcohol, Isopropyl 6

c. Wipe residue with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23) dampened with Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15) and allow to dry.



Coating, Chemical Conversion 10

CAUTION

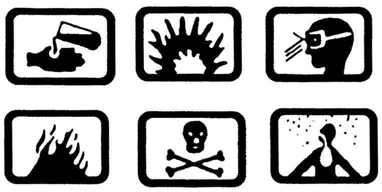
Exercise care when using Chemical Conversion Material, MIL-C-81706 near electronic hardware. It can cause corrosion of the delicate electronic devices if not suitably protected.

d. After corrosion is removed, aluminum surfaces shall be treated with Chemical Conversion Material MIL-C-81706, Class 1A (Appendix A, Item 45), as specified in NAVAIR 01-lA-509 (Navy), TO 1-1-691 (Air Force), and TM 55-1500-344-23 (Army) and paragraphs 5-3.1.1 and 5-3.1.2.

e. Prepare bare metal non-moving parts requiring no lubrication as specified in NAVAIR 01-lA-509 (Navy), TO 1-1-691 (Air Force), and TM 55-1500-344-23 (Army). When environmental conditions or time do not permit, preserve surfaces requiring no lubrication with a thin film of Water-Displacing Corrosion Preventive Compound, MIL-C-81309 (Appendix A, Item 16).

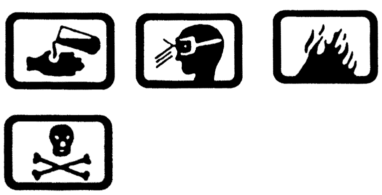
WARNING

Do not use corrosion preventive compounds, MIL-C-81309, MIL-C-85054, MIL-PRF-16173, or lubricating oil, General Purpose Preservative, VV-L-800, around oxygen or oxygen fittings since fire/explosion may result.



Compound, Corrosion Preventive 3
Water-Displacing

f. Spray hinges and latches with Water-Displacing Corrosion Preventive Compound, Ultra-Thin Film, MIL-C-81309, (Appendix A, Item 16).

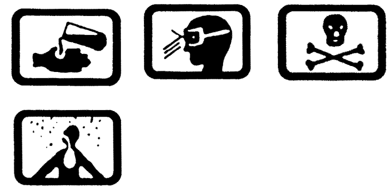


Oil, Lubricating, 24
General Purpose

g. Apply Lubricating Oil General Purpose Preservative, VV-L-800 (Appendix A, Item 18), on moving parts.

6-2.12. Shelves, Bulkheads, and Crevices. Inspect shelves, bulkheads, crevices and corners for signs of corrosion. Examine these areas for deteriorated paint that is cracked, chipped, peeled, etc. Treat as specified in paragraph 6-2.2.

6-2.13. Moisture Traps and Cavity Areas. Inspect for moisture traps and cavity areas at rear of equipment shelves. Treat as specified in paragraph 6-2.2.



Sealing Compound 2
Corrosion Inhibitive

a. If necessary, before painting fill depression areas and cavities with Sealing Compound, MIL-PRF-81733, (Appendix A, Item 29).

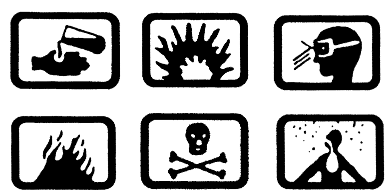
b. Apply sealing compound and finish as specified in NAVAIR 01-1A-509 (Navy), TO 1-1-691/TO 1-1-8 (Air Force), and TM 55-1500-344-23 (Army).

6-2.14. Cockpit Indicator and Mounting Hardware. Inspect cockpit indicator and mounting hardware for dirt, dust, and corrosion. Treat as follows:

a. Remove corrosion and clean as specified in paragraph 6-2.7.

b. Clean indicator faces as specified in paragraph 6-2.7f. Polish glass with clean flannel cloth.

c. Where required, replace decal as specified in the applicable service directives.



Compound, Corrosion Preventive, 3
Water-Displacing

d. Apply Water-Displacing Corrosion Preventive Compound, MIL-C-81309, (Appendix A, Item 16), or MIL-C-85054 (Appendix A, Item 16A) on mounting hardware.

e. Touch up all bare metal in the cockpit area with the appropriate coating system.

6-2.15. Electrical Bonding and Grounding Straps. The bonding and grounding straps used on aircraft and avionic equipment are a major source of galvanic corrosion. In most cases, the bonding or grounding strap is made of a metal that is dissimilar to the mating surface. This creates a galvanic couple that in the presence of moisture will corrode rapidly. Treat as specified in paragraphs 7-2 through 7-2.3.

6-3. REPAIR OF AVIONIC SYSTEMS, EQUIPMENT, AND COMPONENTS.

6-3.1. 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 skin to route the various lines to the antenna. The area around the antenna mounting is susceptible to moisture intrusion from rain, condensation, aircraft washing, and internal fluids (i.e., fuel, engine oil, etc.) Antennas mounted on the lower fuselage are particularly corrosion prone. The inspection and treatment process are outlined in the following paragraphs.

NOTE

Instructions on recognizing corrosion are outlined in Chapter 3. If corrosion is beyond the surface stage (i.e. pitting and cracking), refer to NAVAIR 01-lA-509 (Navy), TO 1-1-691 (Air Force), or TM 55-1500-344-23 (Army) for assessment/ treatment techniques.

6-3.1.1. Corrosion Visual Inspection. A visual check of the antenna mounting base metal surface can reveal signs of corrosion attack. Corrosion deposits are the most obvious indication that an attack has taken place. Since antennas are usually mounted on aluminum structural materials, corrosion (deposits of aluminum oxide) generally can be identified as a white or greyish-white powder.

NOTE

Antenna radomes and covers shall be repaired as specified in NAVAIR 01-lA-22 (Navy) or TO 1-1-24 (Air Force).

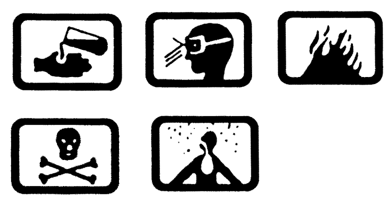
6-3.1.2. Antenna Mounting Area Preparation Procedures. When corrosion is visually apparent, corrective action is necessary to prevent any further deterioration. Corrosion treatment involves stripping finishes from the corroded area, removal of corrosion products, cleaning, and restoration of the surface protective finish. The procedures to be used on the antenna base and mating aircraft structure for corrosion removal, cleaning, and mounting preparations are as follows:

a. Remove dirt, oil, and grease from contact surfaces of the antenna and aircraft skin by wiping with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23), dampened with Cleaning Solvent, (Appendix A, Item 12), in order to evaluate the extent of corrosion damage.

NOTE

A nonmetallic tool for sealant removal may be made from plastic material as shown in Figure 6-1.

b. Remove any existing sealant with a nonmetallic tool.

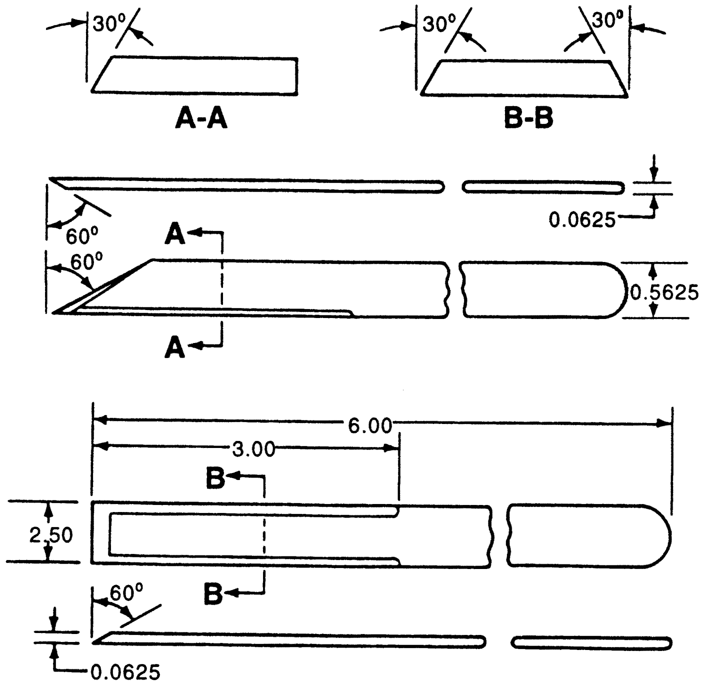


Remover, Paint 24

c. Remove paint, if necessary, from the planned contact surface of the aircraft skin with Epoxy Paint Remover, MIL-R-81294 (Appendix A, Item 50), as described in NAVAIR 01-lA-509 (Navy) or TM 55-1500-344-23 (Army), using Applicator, Cotton Tipped (Appendix B, Item 6). Air Force personnel shall refer to TO 1-1-8 for authorized paint removal methods.

d. Thoroughly clean area with water moistened Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23), to ensure removal of all stripper.

e. Remove surface corrosion with Abrasive Mat, A-A-58054, Type I (Appendix A, Item 1) or Abrasive Cloth, 320 Grit, ANSI-B74.18 (Appendix A, Item 4). Ensure corrosion is removed from both the antenna base and the airframe contact area.



NOTES:
1. ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED.
2. MATERIAL: MICARTA (SUGGESTED).

Figure 6-1. Nonmetallic Sealant Removal Tool

Alcohol, Isopropyl 6

f. Wipe off residue with a Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23), dampened with Isopropyl Alcohol TT-I-735 (Appendix A, Item 15).

g. Allow to air dry.

h. Where corrosion products were abrasively removed, the cleaned surface shall be treated with the appropriate chemical conversion material as described in paragraphs 5-3.1.1 and 5-3.1.2.

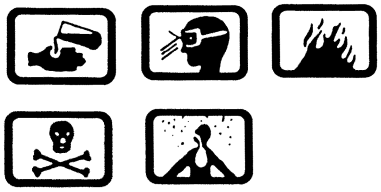
6-3.1.3. Rigid Antenna Mounting (without gasket). The mounting bases of rigid antennas, vary in shape and size. The following installation procedures are typical and may be used for mast-type antennas (blade, spike, whip base, or long wire mast base) not requiring a gasket. The procedures for application of corrosion prevention measures and attachment of the antenna to airframe structure are:

a. Clean and remove corrosion from the antenna mounting area as described in paragraph 6-3.1.2.

NOTE

Remove anodize coating from screw countersink areas on new antennas.

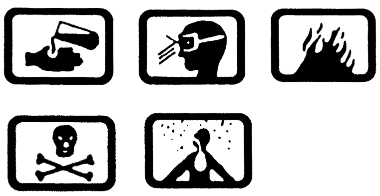
b. Remove corrosion from screw countersink areas on antenna base in order to provide good electrical conductivity from the base to the screws. Remove corrosion using Cloth, Abrasive, Aluminum Oxide, ANSI-B74.18, 320 Grit (Appendix A, Item 4).



Alcohol, Isopropyl 6

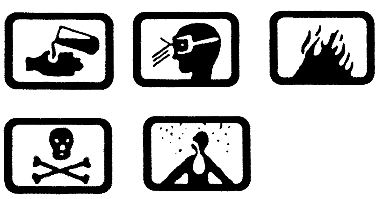
c. Clean bared areas by wiping with a Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23), dampened with Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15).

d. Allow to air dry.



Coating, Chemical Conversion 10

e. Apply Chemical Conversion Material, MIL-C-81706, Class 3 (Appendix A, Item 45), to bared counter sink areas in accordance with the procedure described in paragraphs 5-3.1.1 and 5-3.1.2.



Corrosion Preventive Compound, 8

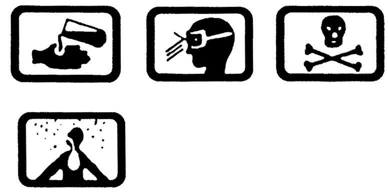
f. Apply an even coating of Corrosion Preventive Compound, MIL-PRF-16173, Grade 4 (Appendix A, Item 17), to both the aircraft skin surface and antenna/mast base. Avoid getting the material in the base countersink areas. Wipe any corrosion preventive compound from the bared countersink using a solvent dampened cloth as described in steps c and d above.

g. Position the antenna base. Ensure countersink area is clean under screw heads. Run-in mounting screws.

h. Conduct electrical resistance test as specified in paragraph 6-3.1.12.

i. Clean the outside edge of antenna attachment area and fastener heads with a Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23), dampened with Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15).

j. Allow to air dry.



Sealing Compound 2

k. Using Spatula, A-A-277 (Appendix B. Item 18) or Sealant Gun (Appendix B, Item 36) with Nozzle (Appendix B, Item 37), form a fillet of Sealing Compound, MIL-PRF-81733 (Appendix A, Item 29), around the outside edge of antenna/mast base to form a watertight seal.

l. Cover fastener heads with Corrosion Preventive Compound, MIL-PRF-16173, Grade 4 (Appendix A, Item 17).

m. Allow the sealant to cure for one-half hour, then remove excess sealant from the aircraft skin using a nonmetallic scraper as shown in Figure 6-1.

n. For maintenance on H-46 helicopters equipped with ARA-25 antenna the following maintenance procedures are recommended.

1. Intermediate Maintenance Activity.

(a) Use MIL-PRF-81733 sealant on dome to base.

(b) Apply MIL-PRF-81733 to coaxial connector base.

(c) Seal dome to base attaching screws with a thin film of MIL-PRF-81733 over the screw heads.

2. Organizational Maintenance Activities.

(a) Prior to installation; apply a thin film of MIL-PRF-16173 grade 4 to all unpainted antenna surfaces.

(b) Install fastners wet with MIL-PRF-16173 grade 4.

(c) Apply masking tape to both sides of the seam.

(d) Clean area to be sealed with TT-I-735A alcohol and dry with a clean lint-free rag.

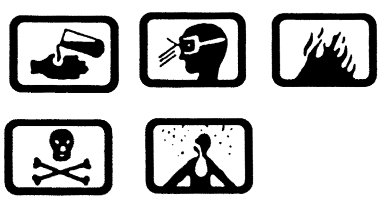
(e) Apply MIL-PRF-81733 and smooth with a spatula. (Remove tape).

(f) Apply a thin film of sealant over fastner heads.

(g) When sealant has cured, restore paint as per reference NAVAIR 01-1A-509 or TO 1-1-8.

6-3.1.4. Rigid Antenna Mounting (with gasket). These procedures are applicable to flush and blade/spike type antennas that require a conductive gasket between the antenna base and aircraft skin. The following procedures are for application of sealants, corrosion preventives, and attachment of antenna base.

a. Clean and remove corrosion from the aircraft skin and the antenna base mounting and apply chemical conversion coating in accordance with paragraphs 6-3.1.2a through 6-3.1.3e.



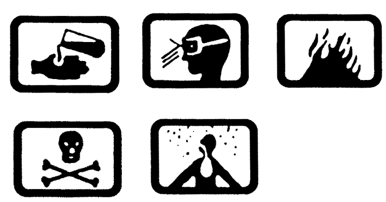
Compound, Corrosion Preventive 8

b. Place the gasket on the antenna base, and mate the antenna and coaxial cable connector halves. Apply a coating of MIL-C-16173, Grade 4 Corrosion Preventive Compound (CPC) (Appendix A, Item 17) with a Paint Brush (Appendix B, Item 2) to the exterior of the mated coaxial connectors, the antenna base within the gasket cutout for the connector, and the exterior aircraft skin that matches the gasket connector cutout when the antenna is mounteed on the aircraft.

NOTE

- (Air Force) With aircraft SPD and/or Equipment IM approval, the CPC on the exterior of the mated coaxial connectors may be replaced with a wrap of HiTak Sealing Tape and the CPC on the antennaq base around the bottom of the attached coaxial connector may be replaced by filling the bottom of the attached coaxial connector may be replaced by fillinhg gasket cut-out area around the attached coaxial connector up to flush with the top of the gasket with HT 3326-5 Self-Leveling Green two component polyurethane sealant mixed and applied per the manufacturer's instructions (Av-DEC Inc.; 1810 Mony St.; Ft. Worth, TX 76102). Apply sealant before mating the coaqxial connector halves, and allow it to cure a minimum of 30 minutes at 75°F before continuing with the installation of the antenna.

- (Air Force) With aircraft SPD and/or Equipment IM approval, the gasket supplied with the antenna may be replaced with a conductive HiTak gasket fabricated fromn aluminum mesh embedded in a modified polurethane gel by Av-DEC, Inc.; 1810 Mony St.; Ft. Worth, TX 76102 or a conductive gasket fabricated frokj aluminum mesh embedded in fluorosilicone gel by TA MFG.; 2806 W. Franklin Pkwy.; Valencia, CA 91355.



Alcohol, Isopropyl 6

c. Clean any corrosion preventive compound from the screw countersink areas using a Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23), dampened with Isopropyl Alcohol TT-I-735 (Appendix A, Item 15).

d. Allow to air dry.

e. Position the antenna base. Ensure countersink area is clean under the screw heads. Run-in mounting screws.

f. Conduct electrical resistance test as outlined in paragraph 6-3.1.12.

g. Clean and seal the antenna base attachment area and fastener heads in accordance with the step-by-step procedures of paragraphs 6-3.1.3i through 6-3.1.3m.

NOTE

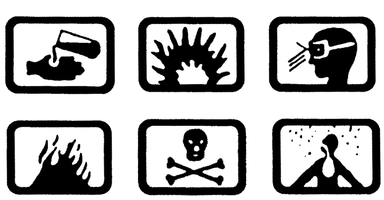
(Air Force) If one of the alternate antenna gaskets is used, the perphery of the antenna base does not require fillet sealing unless a contour mismatch betwen the antenna base and the aircraft skin is severe enough to leave a gap for fluid entry.

6-3.1.5. Flush or Dome Antenna Mounting. These installation procedures are applicable to flush or dome covered antennas. These antennas usually are installed on aircraft as part of the primary structure. The radiating elements of the antenna and fiberglass cover are normally individual units. The procedures for applying corrosion preventives to these antennas are:

NOTE

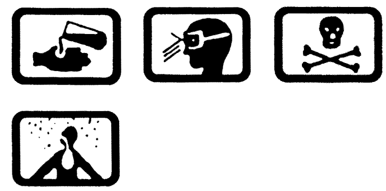
Antenna cover damage shall be repaired as specified in NAVAIR 01-lA-22 (Navy) and TO 1-1-24 (Air Force).

a. Clean and remove corrosion from the antenna installation areas as described in paragraph 6-3.1.2.



Compound, Corrosion Preventive, Water-Displacing 3

b. Install antenna in accordance with the applicable service directives. Prior to attaching dome or cover, spray a coating of Water-Displacing Corrosion Preventive Compound, MIL-C-81309, (Appendix A, Item 16) on the internal areas of the connector. Mate the connector and apply Water-Displacing, Corrosion Preventive Compound, MIL-C-81309 (Appendix A, Item 16), over the antenna mounts, the outside of the mated antenna connectors, and all other exposed metallic hardware, including anchor nuts, nut plates, etc.



Sealing Compound 2

c. Install dome or cover. With Spatula, A-A-277 (Appendix B, Item 18), apply a uniform coating of Sealing Compound, MIL-PRF-81733 (Appendix A, Item 29), over the junction of fiberglass cover and aircraft skin. Ensure sealant also covers fastener heads to form a watertight seal.

NOTE

For antennas with EMI gaskets, place sealant around the outer edge (periphery) of the gasket to prevent the entry of moisture. Ensure no sealant gets between the conductive EMI gasket and the contacting skin, since the sealant is an insulator.

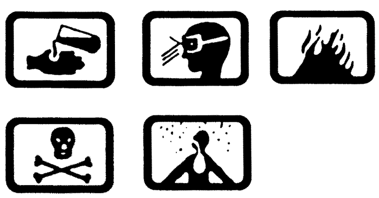
d. Allow the sealant to cure for one-half hour, then remove excess sealant from the aircraft skin area around the antenna using a nonmetallic scraper as shown in Figure 6-1.

6-3.1.6. Radar Dish Antenna Corrosion Preventive Procedure. One of the primary problems related to dish antenna is that the protective finish on the dish is subject to scratching and chipping. This usually occurs in the process of normal handling and maintenance. The antenna metal is usually aluminum or magnesium. Since both metals are anodic to the attaching hardware, the dish is potentially subject to galvanic corrosion around the hardware. In addition, the antenna is subject to surface corrosion wherever the finish is damaged. Depending upon facilities, deployment, and other factors, either refinishing or a temporary protection procedure is appropriate. Refer to

NAVAIR 01-lA-509 (Navy), TO 1-1-691/TO 1-1-8 (Air Force), or TM 55-1500-344-23 (Army) for procedures for stripping, cleaning, and refinishing. Refinishing is normally justified only in the case of general finish damage (at least 20% of the antenna area).

6-3.1.7. Temporary Dish Protection. This procedure is appropriate for repair of limited damage to the finish of a dish antenna. It is also appropriate for touch-up type use. Organizational/Unit or Intermediate level activities shall perform the following procedure:

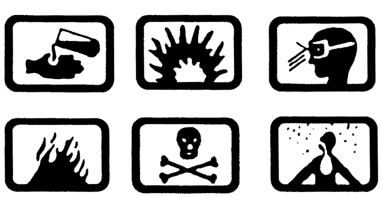
a. Remove surface corrosion with Abrasive Mat, A-A-58054, Type I (Appendix A, Item 1).



Alcohol, Isopropyl 6

b. After completion of corrosion removal, clean the area with Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15). Apply by wiping area with solvent dampened Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23), or spray application.

c. Allow to air dry.



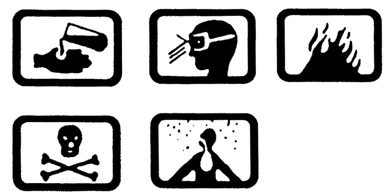
Compound, Corrosive Preventive 3
Water-Displacing

d. Spray a coating of Water-Displacing, Corrosion Preventive Compound, MIL-C-81309 (Appendix A, Item 16), over the affected areas. Unless the repaired area is subject to significant abrasion or erosion, this coating will provide relatively long term corrosion protection (at least one year).

NOTE

There are some radar antennas that have a protective finish or covering, such as mylar, placed over the aluminum/ magnesium base metal. Refer to the applicable service directives for further information and repair procedures on these antennas.

6-3.1.8. Radar Antenna Associated Hardware. For protection of the radar antenna associated hardware, such as nuts, bolts, screws and washers, utilize the following procedure:



Alcohol, Isopropyl 6

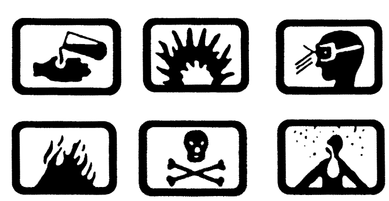
NOTE

Replace nuts, bolts, screws and washers which have the protective coating (normally cadmium) worn off. Refer to the applicable service directives for information on replacement parts.

a. Clean hardware with Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15), using a Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23).

b. Allow to air dry.

c. If corrosion is present but replacement is not practical, surface corrosion on hardware may be removed with an Abrasive Mat, A-A-58054, Type I (Appendix A, Item 1). Repeat step a and b following corrosion removal.



Compound, Corrosion Preventive, 3
Water-Displacing

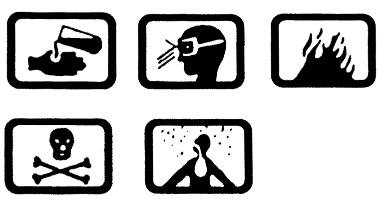
d. Spray a coating of Water-Displacing, Corrosion Preventive Compound, MIL-C-81309 (Appendix A, Item 16), over cleaned hardware after installation.

6-3.1.9. 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. Cleaning and preserving antenna connectors, both multi-pin and coaxial, are as specified in paragraphs 6-3.11.1 through 6-3.11.4.

6-3.1.10. UHF/VHF/ADF Antenna Sealing. The location of UHF/VHF/ADF antennas is normally on the lower fuselage. This results in a particularly bad corrosion problem due to fluids in the bilge area. This has been the principal cause of maintenance requirements on these antennas. The following preventive procedures shall be utilized to minimize this problem.

a. With antenna removed, clean grease, oil, and dirt from aircraft mounting areas with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23), dampened with Cleaning Solvent, (Appendix A, Item 12).

b. Remove any surface corrosion present with Abrasive Mat, A-A-58054 (Appendix A, Item 1) or Abrasive Cloth, 320 Grit, ANSI-B74.18 (Appendix A, Item 4).



Alcohol, Isopropyl 6

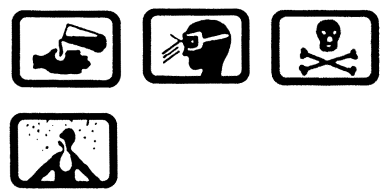
NOTE

For corrosion beyond the surface stage, refer to NAVAIR 01-lA-509 (Navy), TO 1-1-691 (Air Force), or TM 55-1500-344-423 (Army).

c. Wipe clean the corrosion removal, antenna, and aircraft mounting areas with a Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23), dampened with Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15).

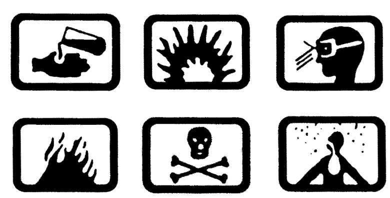
d. Allow to air dry.

e. Normally the antenna is assembled with the dust cover mated to the bottom of the antenna casting. The antenna cavity is installed inside the casting. A plate, called an antenna element, mates to the antenna cavity flange and under a plastic plate. During assembly of the antenna components, discard the extruded rubber dust cover channel which fits between the dust cover edge and the antenna casting. Clean the circumference of the mated dust cover and antenna casting by wiping with a Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23) dampened with Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15). Similarly, clean around the circumference of the plastic plate which mates to the antenna cavity, and top of the fasteners on the dust cover.



Sealing Compound 2

f. Seal the junction of dust cover, antenna cavity and casting outer edge with Sealing Compound, MIL-PRF-81733 (Appendix A, Item 29), applied with Spatula, A-A-277 (Appendix B, Item 18), or Sealant Gun (Appendix B, Item 36) with Nozzle (Appendix B, Item 37). Include sealing around circumference of the plastic plate, antenna cavity, and top of the fasteners on the dust cover.



Compound, Corrosion Preventive, 3
Water-Displacing

g. After sealant has cured for one-half hour, install antenna and spray a coating of Water-Displacing Corrosion Preventive Compound, MIL-C-81309 (Appendix A, Item 16), over the antenna mounts.

h. Clean and preserve electrical connectors in accordance with paragraphs 6-3.11.1 through 6-3.11.4.

i. Seal the circumference of the antenna and aircraft mating surface with Sealing Compound, MIL-PRF-81733 (Appendix A, Item 29), applied with brush, spatula or sealant gun as specified in paragraph 6-3.1.3.

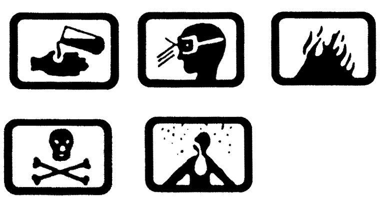
6-3.1.11. Long Wire/Direction Finder (DF) Sense Antenna Corrosion Prevention Procedures. The cleaning and presentation procedures for this type of antenna are as follows:

a. The corrosion removal and cleaning procedures prior to mounting the antenna mast are described in paragraph 6-3.1.2, with mast mounting procedures in paragraph 6-3.1.3.

NOTE

If more than surface corrosion is present (for example, pitting), the part should be replaced.

b. Preparation of individual parts involves removal of surface corrosion on the antenna mast, cable shackle, clevis bolts, etc., using an Abrasive Mat, A-A-58054, Type I (Appendix A, Item 1).

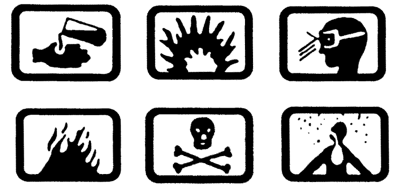


Alcohol, Isopropyl 6

c. Clean dirt, oil, grease, and any residue by wiping the parts with a Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23) damped with Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15).

d. Allow to air dry.

e. Assemble parts and install long wire/DF antenna by referring to the applicable service directives for attachment and tensioning instructions.



Compound, Corrosion Preventive, 3
Water-Displacing

NOTE

It is preferable to apply Water-Displacing, Corrosion Preventive Compound, MIL-C-81309, to new bare wire after the antenna is installed/tensioned. If access to the wire after installation makes this impractical, wet wiping the wire with MIL-C-81309 can be performed prior to installation. In such a case, attempt to minimize flexing, coiling or abrasion of the wire after the MIL-C-81309 is applied and before the wire is installed/tensioned.

f. With the antenna installed, spray a coating of Water-Displacing, Corrosion Preventive Compound, MIL-C-81309 (Appendix A, Item 16) over the attaching hardware. If a new bare wire (no nylon sleeving) has been installed, wipe wire with a Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23), soaked with the Water-Displacing, Corrosion Preventive Compound, MIL-C-81309, so the fluid can penetrate around the individual strands.

g. To prevent moisture from entering the insulator, fill the space around the wire where it enters the insulator with Room Temperature Vulcanizing, Adhesive Sealant, RTV 3140, Clear, MIL-A-46146 (Appendix A, Item 40). Seal both ends of the insulator in this manner.

NOTE

- Select a scale on the milliohmmeter such that the maximum allowable reading (2.5 millohms) is near mid-range. This will to ensure maximum instrument accuracy.
- Proper torquing of connections, good resistance readings, and complete sealing are all essential to ensure a connection will function reliably in field service.

6-3.1.12. Antenna Bonding/Grounding Connection Electrical Resistance Test. The electrical resistance test is performed after an antenna base is mounted or ground installation is assembled. The test shall take place prior to applying sealant. It consists of a milliohmmeter reading (resistance) between antenna base/grounded equipment and the aircraft structure. It is essential that the probe be placed against bare metal when taking the reading. The resistance between the antenna base/equipment to be grounded and aircraft structure should not exceed 2.5 milliohms.

6-3.2. Avionic Test Equipment. Precision measurement/ test equipment is required for testing, troubleshooting, and repairing modern avionic systems. This makes the reliability of these test systems in any environment critical for aircraft flight and mission essential functions. Aircraft operational requirements often result in short turnaround repair times for damaged/malfunctioning avionic equipment. This provides the avionic technician little time to troubleshoot, test, and repair an avionic system. Valuable maintenance time is lost if test equipment is not functioning properly. A major source of equipment malfunction is due to corrosion. The corrosion sources that are particularly detrimental to avionic test equipment include:

a. Moisture and fluid intrusion (rain, condensation fuel, hydraulic fluid, etc).

b. Corrosive elements in the surrounding atmosphere.

c. Malfunctioning or inadequate shop environmental control systems.

d. Malfunctioning or inadequate built-in filter systems.

NOTE

In this section, use of the term “avionic 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), or any equipment used to perform measurements, test, or troubleshoot avionic systems.

6-3.2.1. Cleaning Versus Calibration. A problem common to all automatic/manual test equipment is the effects dirt, dust, lint, etc. have on equipment calibration. Large numbers of test equipment, particularly older units, have not been cleaned periodically. This allows contaminants to collect on components and become an integral part of the circuit, altering circuit parameters. For example, a small amount of dust around a vacuum tube socket can affect circuit parameters. These contaminant-induced changes are compensated for during each recalibration process and can limit the equipment’s peak operating efficiency over time. Also, it is easy for calibration of equipment to shift in service when some of the contaminants are dislodged. Because of the effect that contaminants can have on electrical characteristics, it is common for cleaning to significantly affect the electrical performance. Cleaning (and preservation) is mandatory immediately after equipment exposure to any of the following conditions:

a. External exposure to wet weather conditions.

b. Internal exposure to water or any other fluid.

c. Internal or external exposure to fire extinguishing agents.

d. Internal exposure to electrolyte or corrosive deposits from batteries.

6-3.2.2. Support Equipment/General Purpose Test Equipment Covers and Housings. The cleaning, corrosion removal, and preservation of support equipment/general purpose test equipment housings and covers shall be as follows:

NOTE

Prior to cleaning the covers and housings, remove the operator’s panel, electrical/ electronic components, harnesses, and connectors.

a. The Primary Method.

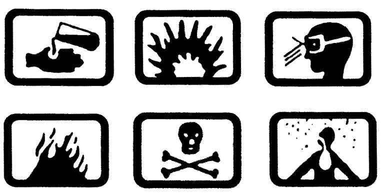
(1) Remove corrosion and clean as specified in cleaning track BCSR2A5 or BCSR35, as applicable. Refer to Table 4-1.

(2) Remove oil, grease and hydraulic fluid as specified in cleaning track DBSR2A5 or DBSR35, as applicable. Refer to Table 4-1.

(3) If no corrosion products, oil, grease, or hydraulic fluid exists, clean as specified in cleaning track CSR2A5 or CSR35, as applicable. Refer to Table 4-1.

b. The secondary method shall be as specified in paragraph 6-2.2

c. Prepare surfaces and paint as specified in paragraphs 5-4.1 through 5-4.6.



Compound, Corrosion Preventive, 3
Water-Displacing

d. If painting is not practical, (temporarily) preserve unpainted surfaces with a thin coating of Water-Displacing Corrosion Preventive Compound, MIL-C-81309 (Appendix A, Item 16).

e. Hardware associated with test equipment housings and covers that are not normally painted should be preserved as often as necessary, depending on the operating environment.

f. Equipment cover hinges and latches shall be preserved as specified in paragraph 6-2.11.

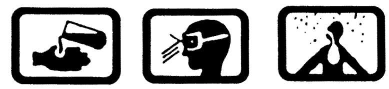
6-3.2.3. ATE Cabinets, Doors and Panels. Cleaning, corrosion removal, and preservation of ATE cabinets, doors, and panels shall be as follows:

NOTE

The use of dissimilar metals in the selection of screws, washers and nuts should be eliminated wherever possible. Refer to Chapter 7 and NAVAIR 01-lA-505, NAVAIR 01-lA-1 (Navy); TO 1-lA-14, TO 1-lA-8 (Air Force); or TM 55-1500-323-24 (Army) for information on bonding/grounding hardware.

a. Inspect hardware and points of metal bonds for signs of galvanic corrosion. Pay particular attention to dissimilar metals.

b. Remove any corrosion with Cloth Abrasive, ANSI-B74.18, Type I, Class 1 (Appendix A, Item 4), or Abrasive Mat, A-A-58054, Type I (Appendix A, Item 1).



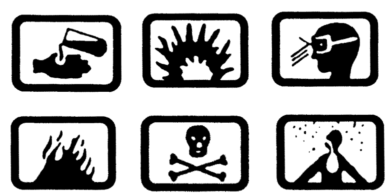
Compound, Aircraft Cleaning 4

c. Clean affected areas with a solution of nine (9) parts fresh water to one (1) part Aircraft Cleaning Compound, MIL-PRF-85570, Type II (Appendix A, Item 11). Apply with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23).

d. Rinse with fresh water and wipe dry with Cleaning Cloth, CCC-C-46.

e. If required, aluminum surfaces shall be treated with chemical conversion material as specified in paragraphs 5-3.1.1 and 5-3.1.2.

f. Prepare surface and paint as specified in paragraphs 5-4.1 through 5-4.6.



Compound, Corrosion Preventive, 3
Water-Displacing

g. If painting is not practical, (temporarily) preserve unpainted surfaces with a thin coating of Compound, MIL-C-81309 (Appendix A, Item 16).

h. Hardware associated with test equipment housing and covers that are not normally painted should be preserved as often as necessary, depending on the operating environment. Do not preserve water seal gaskets.

i. Equipment covers, hinges and latches shall be preserved as specified in paragraph 6-2.11.

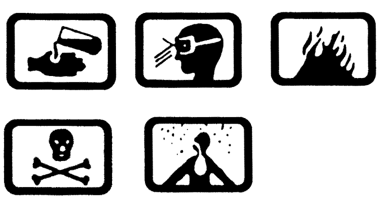
6-3.2.4. Battery Compartments. Some support equipment and general purpose test equipment contain internal batteries. Clean, neutralize, and preserve the battery compartment as follows:

a. Clean and neutralize electrolyte spills as specified in paragraphs 6-2.4.1 through 6-2.4.6 as applicable.

b. Prepare surface and paint as specified in paragraphs 5-4.1 through 5-4.6.

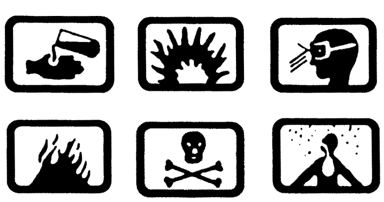
c. As an interim measure, preserve the cleaned battery compartment with a thin coating of Water-Displacing Corrosion Preventive Compound, MIL-C-81309 (Appendix A, Item 16).

6-3.2.5. Meters. Voltmeters, ammeters, and multimeters are usually constructed of high impact plastic or acrylic. Normally these meters are not disassembled for cleaning. Clean as follows:



Alcohol Isopropyl 6

a. Clean metal hardware and metal surfaces with an application of one part Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15) to one part fresh water. Wipe clean with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23).



Compound, Corrosion Preventive, 3
Water-Displacing

b. Apply Water-Displacing Corrosion Preventive Compound, MIL-C-81309 (Appendix A, Item 16), on metal hardware. Take steps not to get preservative on acrylic plastic faceplates.

c. Clean toggle, rotary and push button switches as specified in paragraph 6-3.7.

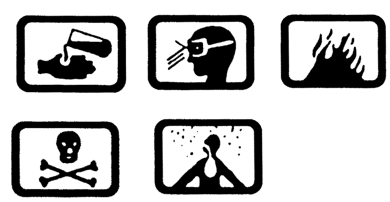
d. Clean meter faceplates as specified in paragraph 6-2.7h.

e. Clean high impact plastic or acrylic housings with solution of one (1) ounce Detergent, Liquid Nonionic, MIL-D-16791, Type I (Appendix A, Item 10) in one (1) gallon of fresh water. Apply and rub surface clean using Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23), that is wet with cleaning solution. When surfaces are clean, remove cleaner residue by wiping with a clean Cleaning Cloth, CCC-C-46, Class 7, that has been frequently rinsed and kept damp with clean water.

6-3.2.6. Operator and Instrument Panels. General purpose test equipment, support equipment, and ATE operator/instrument panels shall be cleaned externally and preserved as follows:

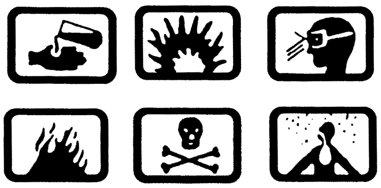
a. Inspect operator and instrument panels for corrosion and contaminants. Pay particular attention to switches, dials, knobs, and hardware.

b. Remove any corrosion from metal surfaces with Abrasive Mat, A-A-58054, Type I (Appendix A, Item 1), or Cleaning and Polishing Pad, Non-Abrasive (Appendix A, Item 3).



Alcohol, Isopropyl 6

c. Clean metal surfaces with one part Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15) to one part fresh water. Apply with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23).



Compound, Corrosion Preventive 3
Water-Displacing

d. Apply Water-Displacing Corrosion Preventive Compound, MIL-C-81309 (Appendix A, Item 16) on metal hardware. Take steps not to get preservative on acrylic plastic faceplates.

e. If required, aluminum surfaces shall be treated with Chemical Conversion Material, as specified in paragraph 5-3.1.1.

f. Prepare surface and paint as specified in paragraphs 5-4.1 through 5-4.6.

g. Clean and preserve toggle, rotary and pushbutton switches as specified in paragraph 6-3.7.

h. Clean operator/instrument faceplate as specified in paragraph 6-2.7h.

i. Clean and treat light bulb assemblies as specified in paragraph 6-3.5.

CAUTION

The method for internal cleaning of general purpose test equipment, support equipment, and ATE depends on the types of circuit components involved. This includes components like tunable cavities, open transformer housings, variable attenuators, rotary switches, trim potentiometers, etc. that can act as water/solvent traps making drying difficult. Prior to the internal cleaning of manual or automatic test equipment, inspect for components that can act as water or solvent traps.

6-3.2.7. Internal Cleaning of Support Equipment. With the exception of emergency procedures assigned to Organizational/Unit Maintenance (refer to Chapter 10), the internal cleaning of support equipment is normally an Intermediate Maintenance Activity function. This cleaning and preservation of support equipment shall be as follows:

a. Remove the cover and housing.

b. Inspect for components that can act as water and solvent traps. Refer to Table 4-5 for a list of such components.

c. Seal, bag or remove potential water and solvent traps as described in paragraph 4-5.3.6.

d. Remove oil, grease and hydraulic fluid as specified in cleaning track DBR2A or DB35. Refer to Table 4-1.

e. If components will fit inside Blast Cleaning Cabinet, remove corrosion and clean as specified in cleaning track WSR2C5 or WSR35, as applicable. Refer to Table 4-1.

f. If no corrosion products, oil, grease, or hydraulic fluid exists, clean as specified in cleaning track SR2C5 or SR3C5, as applicable. Refer to Table 4-1.

6-3.2.8. Internal Cleaning of General Purpose Test Equipment. Oscilloscopes, signal generators, frequency counters, etc., usually accumulate more dust and dirt than other contaminants. The internal cleaning and preservation of general purpose test equipment shall be as follows:

a. Remove the cover and housing.

b. Inspect for components that can act as water and solvent traps. Refer to Table 4-5 for a list of these components.

c. Seal, bag, or remove potential water/solvent traps as described in paragraph 4-5.3.6.

d. Use Vacuum Cleaner (Appendix B, Item 13), to vacuum loose dust, dirt, and lint from the internal chassis/circuit components.

e. If components will fit inside Blast Cleaning Cabinet remove corrosion as clean as specified in cleaning track WSR2C5 or WSR35, as applicable. Refer to Table 4-1.

f. If no corrosion products exist, clean as specified in cleaning track SR2C5 or SR3C5, as applicable. Refer to Table 4-1.

g. Preserve in accordance with paragraph 4-7.

6-3.2.9. Internal Cleaning of ATE. ATE is usually constructed so that circuits are installed in drawers or cabinet-type racks. In most of these installations cleaning the whole drawer or cabinet is difficult because of the weight and size of the assemblies. In such cases, internal cleaning is done by hand. Where the assemblies can be removed and mechanically cleaned, they shall be cleaned and preserved as specified in paragraph 6-3.2.8. Those assemblies that cannot be removed and mechanically cleaned shall be cleaned and preserved as follows:

a. Open cabinet doors, remove cover, and slide drawers to full extended position.

b. Inspect for components that can act as water and solvent traps. Refer to Table 4-5 for a list of these components.

c. Seal, bag, or remove potential water/solvent traps as described in paragraph 4-5.3.6.

CAUTION

If wire wrap circuit board construction is used in ATE, do not apply water 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.

d. Use the Vacuum Cleaner, MIL-V-21987 (Appendix B, Item 13), to vacuum loose dirt, dust, and lint from the internal chassis/circuit components. Avoid direct contact between the vacuum cleaner hose wand and delicate circuit components.

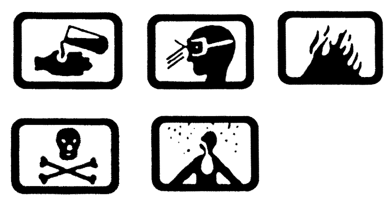
e. Hand clean as described in paragraph 4-4 or 4-5.

f. Preserve in accordance with paragraph 4-7.

6-3.2.10. Internal Cleaning of Microwave Test Equipment. Microwave equipment contains many potential water/solvent traps. In addition, microwave equipment makes use of many acrylic vanes and lenses in waveguides/cavities, variable attenuators, etc. Generally, these components can be sealed or removed from the chassis prior to cleaning and drying. The internal cleaning and preserving of microwave test equipment shall be as follows:

a. Clean external surface of waveguides as specified in paragraph 6-3.3.

b. Clean internal surface of waveguides as specified in paragraph 6-3.3.



Alcohol, Isopropyl 6

c. If the waveguide is not going to be reinstalled immediately, seal ends of waveguide sections with appropriate protective caps identified in the applicable service directives or with Pressure Sensitive Tape, SAE-AMS-T-22085 (Appendix A, Item 31). It is important that all tape residues are removed from all connecting surfaces prior to reassembly of the waveguide. Wipe residue with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23), dampened with Cleaning Solvent, (Appendix A, Item 12). Wipe with a Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23) dampened with Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15).

d. Clean connectors as follows:

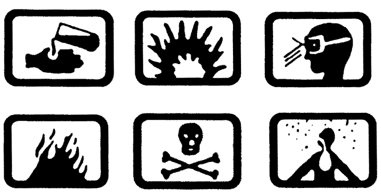
(1) Disconnect the connector sections.

(2) Remove corrosion from external surfaces with Abrasive Mat, A-A-58054 Type I, Grade A (Appendix A, Item 1). Wipe residue with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23).

(3) Clean connector sections by spraying internal/ external connector areas with Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15). Do not disturb the center conductor with a cleaning tool or brush.

(4) Wipe excess solvent with Cleaning Cloth, CCC-C-46, Class 7.

(5) Allow to air dry.



Compound, Corrosion Preventive, Water-Displacing 3

CAUTION

Do not apply preservation materials to internal surfaces/areas of waveguides or APC connectors.

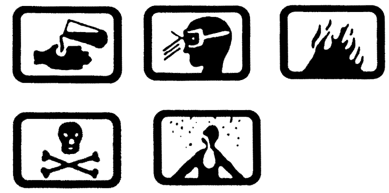
(6) Assemble connector sections and preserve the external areas with a thin coating of Water-Displacing Corrosion Preventive Compound, MIL-C-81309, (Appendix A, Item 16).

6-3.2.11. Special Cleaning Procedures. The following microwave circuit components shall be cleaned and preserved as follows:

a. Preserve electrical bonding and grounding straps as specified in Chapter 7.

b. Preserve relays and circuit breakers as specified in paragraph 6-3.6.

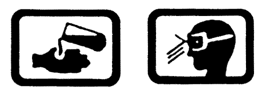
c. Clean rotary switches, trim potentiometers, and sliding cam switches as specified in paragraph 6-3.7.



Cleaning-Lubricating Compound 21

(1) Clean switch using Cleaning-Lubricating Compound, MIL-PRF-29608 (Appendix A, Item 13A).

(2) Wipe sliding contacts, cams, and contact points with Disposable Applicator or Pipe Cleaner (Appendix B, Item 5), as applicable, to remove residue.



Damping Fluid 23

(3) Reclean area with MIL-PRF-29608 Cleaning-Lubricating Compound, or lubricate with fluid VV-D-1078 (Appendix A, Item 76).

d. Microminiature printed circuit boards are cleaned as specified in NAVAIR 01-lA-23 (Navy) or TO 12-1-31 (Air Force).

e. Treat multi-pin electrical connectors and PCB edge connectors as specified in paragraphs 6-3.11.1 through 6-3.11.4 and 6-3.8.

f. External surfaces of sliding attenuators, variable attenuators, and tunable cavities are cleaned as follows:

CAUTION

Sliding/variable attenuators and tunable cavities are natural water/solvent traps. Never leave these components exposed during internal equipment cleaning. Sliding/variable attenuators and tunable cavities shall always be hand cleaned externally. Only hand clean internally where drying of the water/solvents can be accomplished.

(1) Remove corrosion and tarnish by rubbing affected area with Eraser (Appendix A, Item 5), or Eraser,

Wood Encased, (Appendix A, Item 7). Care should be taken not to remove any thin plating on surfaces.

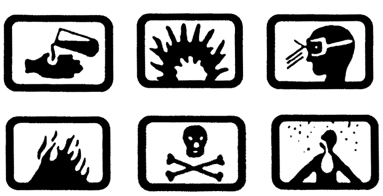
Alcohol, Isopropyl 6

(2) Apply Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15), with Acid Brush, A-A-289 style opt. (Appendix B, Item 1). Rinse affected area with Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15), and wipe with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23).

(3) Allow components to air dry.

Cleaning Compound, Lubricating 21

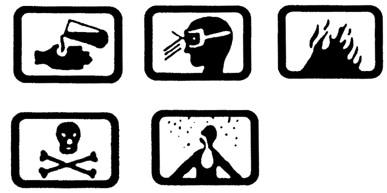
(4) Lubricate sliding components with an application of Spray Cleaning-Lubricating Compound, MIL-PRF-29608, Type I (Appendix A, Item 13A) or Fluid VV-D-1078 (Appendix A, Item 76). Mask any nearby areas where the presence of the silicone lubricant is not desired. The deposited silicone is very difficult to remove and prevents proper adhesion of any material applied to the sprayed area. Refer to paragraph 4-5.3.10 for method of removal.



Compound, Corrosion Preventive, Water-Displacing 3

(5) Spray a thin coating of Water-Displacing Corrosion Preventive Compound, MIL-C-81309, Type III, Class 2 (Appendix A, Item 16), on external metal surfaces. Avoid placing preservation material on sliding components.

g. Clean internal surfaces of sliding/variable attenuators and tunable cavities as follows:



Alcohol, Isopropyl 6

(1) Apply Isopropyl Alcohol, TT-I-735, with Acid Brush, A-A-289 style opt.

(2) Rinse affected area with Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15) and wipe with Cleaning Cloth, CCC-C-46, Class 7, (Appendix A, Item 23) or Disposable Applicator, GG-A-616 (Appendix B, Item 6).

(3) Allow components to air dry.

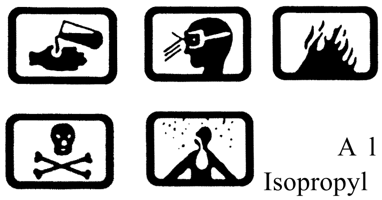
(4) Do not apply preservative material.

6-3.2.12. Paint Systems. It is important that the metallic housings of avionic test equipment be protected from the environment. A properly applied paint system provides effective, long term protection. However, a paint coating is subject to abrasion, chipping, scratching, and other forms of damage in service. When damage to the paint on test equipment occurs, positive action shall be taken to provide continuous protection to the base metal. The following specific actions are appropriate.

NOTE

All paint color numbers specified in this manual are in accordance with the color coding contained in FED-STD-595.

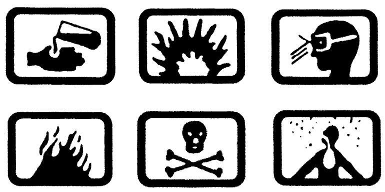
a. If painting is impractical due to environmental conditions, treat damaged paint film as follows:



Alcohol, Isopropyl 6

(1) Clean the bare area with a Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23), dampened with Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15).

(2) Allow to air dry.



Compound, Corrosion Preventive, 3
Water-Displacing

(3) As an interim measure, preserve with a thin film of Water-Displacing Corrosion Preventive Compound, MIL-C-81309 (Appendix A, Item 16).

b. Where conditions permit, process test equipment utilizing the cleaning, corrosion repair, and conversion coating, priming, and painting procedures described in Chapters 4 and 5 for avionic equipment with the following exceptions:

(1) The color requirements specified in paragraph 5-4.3 do not apply to test equipment. The color of a replacement topcoat shall be selected to match the original.

(2) While use of Coating, Epoxy-Polyamide, MIL-PRF-22750 (Appendix A, Item 53), as a topcoat, is a requirement on portable test equipment, Coating, MIL-PRF-81352 (Appendix A, Item 49) in the appropriate color, may be used on stationary indoor test equipment. These topcoat materials are authorized and approved for Navy use. Air Force personnel should refer to equipment specific manuals for proper color and paint systems. Apply in accordance with NAVAIR 01-lA-509 (Navy), TO 1-1-8 (Air Force), or TM 55-1500-344-23 (Army).

6-3.2.13 Packaging, Handling and Storage. The packaging, handling and storage procedures contained in paragraphs 4-9.1 through 4-9.4 shall apply to test equipment, where applicable. Organizational/Unit and Intermediate Maintenance Activities shall comply with the following additional requirements:

a. Regular external wipe-down cleaning shall be accomplished on all test equipment in the custody of the user activity. Use a clean, dry, soft cloth, Cotton Flannel, CCC-C-458, Type II (Appendix A, Item 26). This serves two purposes:

(1) Prevents accumulation of soils and potentially corrosive materials on equipment.

(2) Clean test equipment has a positive effect on the mental attitude of the individual using it. Such equipment generally receives better treatment.

b. Appropriate caps shall be installed on all equipment cavities and connectors at the Intermediate Maintenance Activities. If the test equipment is shipped to any Organizational/Unit Maintenance Activity with caps installed, it shall be returned to the Intermediate Maintenance Activity with the same type of caps installed.

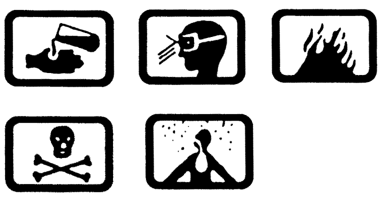
c. All decals shall be maintained. This is especially important during cleaning.

d. Test equipment being stored/shipped shall be preserved and placed in the appropriate carrying case or packaged as specified in paragraphs 4-9.3 and 4-9.4. This includes equipment listed as “excess equipment”.

6-3.3. Waveguides. Waveguides are only effective if the internal surfaces are completely clean, undented and not pitted by corrosion. The method of protecting the internal finish on a waveguide is to prevent moisture entry. It is essential that the waveguide seals integrity be maintained, because there is, currently, no known method of preserving the internal surfaces of a waveguide without adversely affecting the electrical characteristics, except by plating the surfaces with another metal, such as gold or silver, in production. This process is very expensive and seldom applied by waveguide sections used in aircraft. The integrity of a waveguide system is degraded every time a waveguide seal is broken for maintenance. Waveguides that must be opened for maintenance shall be sealed at the ends (flanges) with the appropriate protective cap or with Pressure Sensitive Tape, SAE AMS-T-22085 (Appendix A, Item 31). It is important that all residues from the pressure sensitive tape are removed from all mating flange surfaces prior to reassembly of the waveguide. Remove corrosion, clean, and preserve external surfaces of waveguides as follows:

a. Ensure ends of waveguides are sealed as described above.

b. Remove external corrosion with Abrasive Mat, A-A-58054, Type I (Appendix A, Item 1). Scrub affected areas until all corrosion and contaminants are loosened.



Alcohol, Isopropyl 6

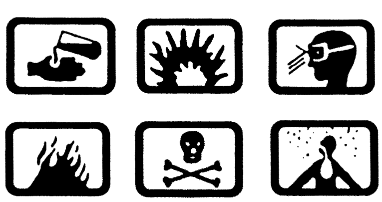
c. Using a Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23), dampened with Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15), wipe the affected areas clean.

d. Remove seals that had been applied to ends of waveguides.

e. With a clean Cleaning Cloth, CCC-C-46, Class 7, dampened with Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15), clean the mating flange surfaces, being especially careful to ensure all tape residue is removed.

f. Allow to air dry.

g. Reconnect all waveguides and plumbing.



Compound, Corrosion Preventive, Water-Displacing 3

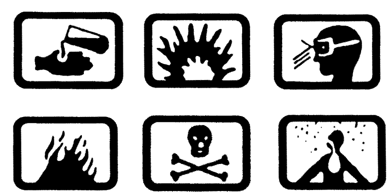
h. Preserve all exposed areas and hardware with a spray coating of Water-Displacing Corrosion Preventive Compound, MIL-C-81309 (Appendix A, Item16). Connecting surfaces shall be coated with Water-Displacing, Corrosion Preventive Compound, MIL-C-81309, (Appendix A, Item 16).

6-3.4. Waveguide Feed Horns. Waveguide feed horns, attached to some antenna dishes, are subject to attack at the open end of the waveguide. To protect this open-end area from corrosion, perform the following

Alcohol, Isopropyl 6

a. Clean with Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15).

b. Allow to air dry.



Compound, Corrosion Preventive, Water-Displacing 3

c. Spray the outer throat area of waveguide opening with an ultra-thin coat of Water-Displacing, Corrosion Preventive Compound, MIL-C-81309, (Appendix A, Item 16). Direct the spray across the throat so that it hits the opposite side and does not enter the waveguide past the flared throat area.

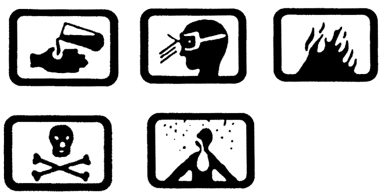
6-3.5. Lighting Systems and Assemblies. External formation lights, wing tip lights, rotating beacons, and lower fuselage anti-collision lights are highly susceptible to corrosion. This can be due to poor seals, exposure to the elements in flight, water intrusion, etc. In most cases corrosion is heaviest at the base of the bulb because of dissimilar metal contact between the bulb and socket. Treat corrosion as follows:

WARNING

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

a. Remove the light cover assembly and bulb from the socket.

b. Remove corrosion with Abrasive Mat, A-A-58054, Type I (Appendix A, Item 1), or Cleaning and Polishing Pad, Non-Abrasive (Appendix A, Item 3). Scrub affected area to loosen corrosion and contaminants.



Alcohol, Isopropyl 6

c. Clean affected area with one part Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15) mixed with one part fresh water. Use Acid Brush, A-A-289 style opt. (Appendix B, Item 1), with the bristle trimmed back, to assist in cleaning the base of the light socket.

d. After cleaning, re-apply Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15) solution, on affected area to flush out remaining residue.

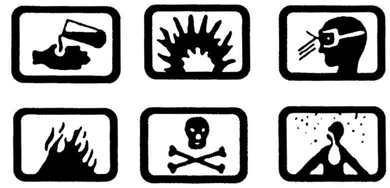
e. Wipe with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23).

f. Allow to air dry.

NOTE

The following procedures are applicable only to bulbs that are installed into their socket with a turning, twisting, or scraping motion (e.g. 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 the Water-Displacing Corrosion Preventive Compound, MIL-C-81309, (Appendix A, Item 16).

g. Preserve light assemblies as follows:

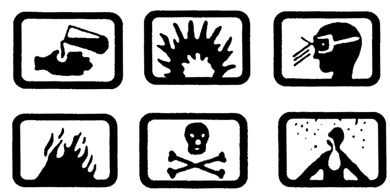


Compound, Corrosion Preventive, Water-Displacing 3

(1) Apply a thin film of Water-Displacing Corrosion Preventive Compound, MIL-C-81309, (Appendix A, Item 16) to metal base of bulb and bulb socket.

(2) Wipe metal base of bulb to remove excess material with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23).

(3) Install bulb in bulb socket.



Compound, Corrosion Preventive, Water-Displacing 3

(4) Preserve the outside area of the socket, light assembly bare metal, and hardware by applying a thin film of Water-Displacing Corrosion Preventive Compound, MIL-C-81309 (Appendix A, Item 16).

(5) Allow to dry.

(6) Reassemble light assembly lens cover. Touch up bare metal where light assembly mates to airframe as specified in paragraphs 5-4.1 through 5-4.6.

h. Small equipment mounted bulbs should be treated as specified in paragraphs 6-3.5a through g with the following exceptions:

(1) Preserve the outside area of the socket, light assembly, bare metal and hardware, by applying a thin film of Water-Displacing Corrosion Preventive Compound, Ultra-Thin Film MIL-C-81309, (Appendix A, Item 16).

(2) Allow to dry.

i. On lower fuselage light assemblies, where water intrusion is a problem during aircraft washdown, cleaning and applying preservatives shall take place after each aircraft wash down.

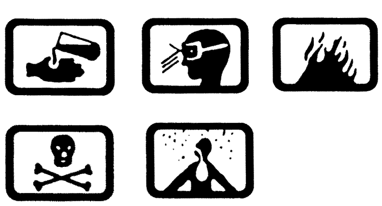
6-3.6. Relay and Circuit Breakers. Remove corrosion and preserve as follows:

NOTE

Corrosion (tarnish) removal is required on most types of contacts. Tarnish acts as an insulator on contacts. The sliding-type contact has 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 not to remove this plating surface. If the plating is removed, exposure of the base metal will cause corrosion and the relay/circuit breaker should be replaced.

a. Heavy corrosion and tarnish shall be removed by rubbing contact surfaces with Typewriter Eraser. Large contact areas may be cleaned using Eraser, Ruby Red (Appendix A, Item 6).

b. Medium to light corrosion and tarnish shall be removed by rubbing contact surfaces with Eraser, Wood Encased (Appendix A, Item 7). Large contact areas may be cleaned using Eraser.

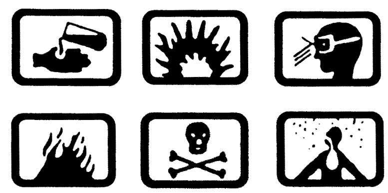


Alcohol, Isopropyl 6

c. Rinse contacts with Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15), and Applicator, Cotton Tipped (Appendix B, Item 6). Clean relay or circuit breaker assembly with Acid Brush, A-A-289 style opt. (Appendix B, Item 1). Pipe Cleaners (Appendix B, Item 5), may be used in hard-to-reach areas to assist in swabbing residue.

d. Wipe relay or circuit breaker assembly with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23), and allow to air dry.

e. Relays and contacts shall be preserved as follows:



Compound, Corrosion Preventive, 3
Water-Displacing

(1) Apply a thin film of Water-Displacing Corrosion Preventive Compound, Ultra-Thin Film, Avionics Grade, MIL-C-81309, (Appendix A, Item 16), to all areas of the relay or circuit breaker, avoiding contact and mating areas.

NOTE

After application of preservative to relays and circuit breakers, it is necessary to ensure removal of the preservative material from the contact points and mating surfaces.

(2) Wipe the contact points and mating surfaces with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23), Applicator, Cotton Tipped (Appendix B, Item 6), or Pipe Cleaner (Appendix B, Item 5), as applicable, dampened with Cleaning Solvent, (Appendix A, Item 12) to remove Water-Displacing Corrosion Preventive Compound, Ultra-Thin Film, Avionics Grade, MIL-C-81309, (Appendix A, Item 16). Wipe with Isopropyl Alcohol, TT-I-735. This is necessary or contacts will not function electrically.

6-3.7. Switches. Switches shall include all cam-operated toggle, rotary, interlock, and pushbutton types. Remove corrosion and treat as follows:

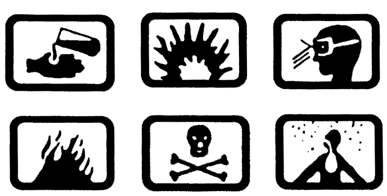
a. Apply Isopopyl Alcohol, TT-I-735 (Appendix A, Item 15) or Dry Cleaning Solvent, (Appendix A, Item 12), with Acid Brush, A-A-289 style opt. (Appendix B, Item 1), or Toothbrush (Appendix B, Item 3). Scrub the switch to remove corrosion and contaminants.

b. Wipe with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23). Allow to air dry.

CAUTION

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

c. Switches shall be preserved as follows:

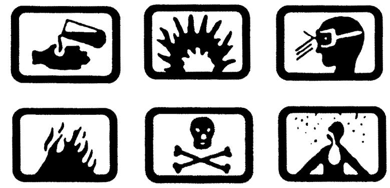


Compound, Corrosion Preventive, Water-Displacing 3

NOTE

After application of preservative to open switch assemblies, it is necessary to remove the preservative from the sliding contacts, cams, and contact points.

(1) Apply a thin film of Water-Displacing Corrosion Preventive Compound, Ultra-Thin Film, Avionics Grade, MIL-C-81309, (Appendix A, Item 16), to switch assembly. Cockpit and control box mounted switches shall 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.



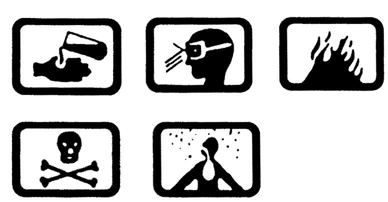
Compound, Corrosion Preventive Water Displacing 3

Alcohol, Isopropyl 6

(2) Wipe the sliding contacts, cams, and contact points of open switches with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23), Applicator, Cotton Tipped (Appendix B, Item 6), or Pipe Cleaner (Appendix B, Item 5), as applicable, dampened with Cleaning Solvent, (Appendix A, Item 12) to remove Water-Displacing Corrosion Preventive Compound, Ultra-Thin Film, Avionics Grade, MIL-C-81309, (Appendix A, Item 16). Wipe with Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15). This is necessary or contacts will not function electrically.

6-3.8. Edge Connectors and Mating Plugs. Edge connectors on printed circuit boards (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:

a. Remove corrosion and tarnish by rubbing affected area with Eraser, Magic Rub Plastic (Appendix A, Item 5). Care should be taken not to remove thinly plated surfaces.

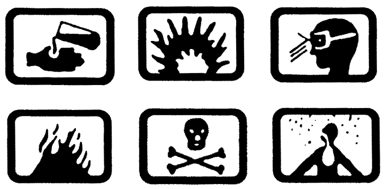


Alcohol, Isopropl 6

b. Apply Cleaning Solvent, (Appendix A, Item 12) with Acid Brush, A-A-289 (Appendix B, Item 1). Rinse affected area with Isopropyl Alcohol, TT-I-753 (Appendix A, Item 15), and wipe with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23).

c. Allow components to air dry.

d. Edge connectors shall be preserved as follows:



Compound, Corrosion Preventive, Water-Displacing 3

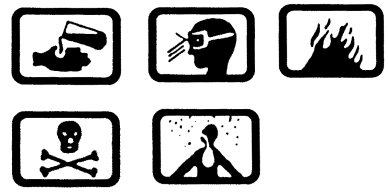
(1) Spray a thin film of Water-Displacing Corrosion Preventive Compound, Ultra-Thin Film, Avionics Grade, MIL-C-81309, (Appendix A, Item 16), to both male and female sections of connectors.

(2) Wipe excess preservative with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23).

6-3.9. Wet-Slug Tantalum Capacitors. Wet-slug tantalum capacitors can be internally damaged by the application of a reverse voltage. Such damage will often result in leakage of an acid which may cause corrosion in areas adjacent to the damaged capacitor. Capacitors having evidence of leakage must be replaced and all adjacent areas cleaned to prevent further corrosion. The following procedures shall apply for the inspection of wet-slug tantalum capacitors for damage:

a. During normal equipment maintenance at the Intermediate Maintenance Activity, the seam between the slug and case of each tantalum capacitor should be examined for a small deposit of silver (the color may be black or gray). If such color is present, place one drop of the following solution on the capacitor to ensure contact with the deposit and the seam between the slug and capacitor case.

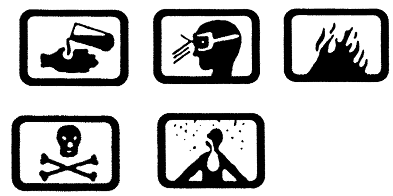
(1) Dissolve 1/4 teaspoon of Indicator, Thymol Blue Reagent, A-A-59282 (Appendix A, Item 67), in three (8-ounce) cups of deionized or distilled water.



Ammonium Hydroxide 22

(2) Add eight drops of Ammonium Hydroxide, A-A-59370 (Appendix A, Item 71), to assist in dissolving Indicator, Thymol Blue Reagent, A-A-59282 (Appendix A, Item 67).

b. If acid leakage has occurred, the solution will change from an amber or blue color to a reddish-purple color.



Alcohol, Isopropyl 6

NOTE

Unused Indicator, Thymol Blue Reagent A-A-59282 that displays a reddish-purple color is contaminated and shall not be used. Verify color by placing a small amount of Thymol Blue Reagent Indicator on white paper.

c. If no color change is observed, remove the indicator residue with Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15) and Acid Brush, A-A-289 style opt. (Appendix B, Item 1), or Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23).

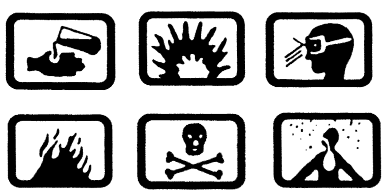
d. If color change is observed, remove damaged capacitor, neutralize the contaminated area by applying drops of the following solution:

(1) Dissolve one (8-ounce) cup of Sodium Bicarbonate, ASTM D928 (Appendix A, Item 43) in one gallon of fresh water.

(2) Thoroughly rinse the affected area with distilled or deionized water. Do not allow rinse water to contaminate other areas. Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23), may be used to trap rinse water runoff.

e. Clean affected area with Non-Abrasive Pad (Appendix A, Item 3) by scrubbing. Rinse with Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15). Wipe clean with Cleaning Cloth CCC-C-46, Class 7 (Appendix A, Item 23).

f. Retest per 6-3.9a. If test is negative, air dry, oven dry, or dry with hot air gun as specified in paragraphs 4-6.2 through 4-6.8.



Compound, Corrosion Preventive, 3
Water-Displacing

g. Preserve by applying a thin film of Water-Displacing Corrosive Preventive Compound Ultra-Thin Film, Avionics Grade, MIL-C-81309, (Appendix A, Item 16).

h. The replacement of conformal coatings shall be as specified in NAVAIR 01-lA-23 (Navy) or TO 00-25-234 (Air Force).

6-3.10. Aluminum Electrolytic Capacitors. Aluminum Electrolytic Capacitors, MIL-C-62, that utilize synthetic rubber seals (some rubber/plastic combination seals) are susceptible to damage during cleaning. Inspect Aluminum Electrolytic Capacitor, MIL-C-62 for end seal deterioration. If seals look bulged or uneven, the capacitor must be replaced and all adjacent areas cleaned to prevent further corrosion.

a. Clean as specified in paragraph 6-3.9e.

b. Dry as specified in paragraph 6-3.9f.

c. Preserve as specified in paragraph 6-3.9g.

d. The replacement of conformal coating shall be as specified in NAVAIR 01-lA-23 (Navy) or TO 00-25-234 (Air Force).

6-3.11. Multipin Electrical Connectors, Cleaning and Preservation. Multipin electrical connectors require special attention, especially in areas exposed to salt water, such as speed brake, wing fold, landing gear, etc. The following techniques will assist in limiting corrosion attack:

WARNING

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

CAUTION

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

NOTE

Continuity test does not preclude a visual inspection of connectors because corrosion can still occur externally from pin areas.

a. Protect open connectors with plastic/metal caps or pressure sensitive tape as specified in paragraph 4-9.5.

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 cut in the low point of the connector boot to allow water to escape.

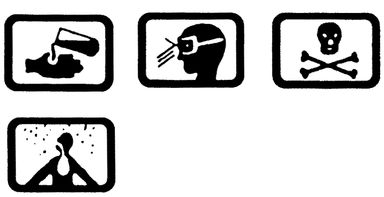
c. Special attention should be given to connectors using replaceable pins. These connectors use a self-sealing gasket that automatically seals the connector against water intrusion. “Dog bones” (plastic inserts) are used to fill unused contactor cavities. The repeated removal and replacement of the pins or omission of the “dog bones” may cause the watertight seal to lose its effectiveness. The use of potting compounds may be required to prevent water intrusion in extreme cases where the connector cannot be replaced. Refer to paragraph 5-5.2.

d. Connectors mounted on avionic equipment that are susceptible to the same environment as aircraft wire harness connectors shall be treated with the same corrosion removal/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.

6-3.11.1. External Corrosion Removal and Cleaning. The removal of corrosion shall be as follows:

a. Disassemble the connector back shell, if possible, and inspect for corrosion damage. If the damage is too heavy, the connector may require replacement.

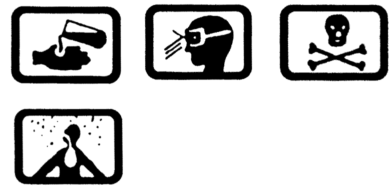
b. Remove corrosion on plated surfaces by srcubbing with Non-Abrasive Pad (Appendix A, Item 3), or on unplated surfaces with Abrasive Mat, A-A-58054, Type I, Grade A (Appendix A, Item 1), as appropriate. Ensure connector mating surfaces, threads, shell and mounting plate (if used) are cleaned.



Sodium Hydroxide 25

A 10-percent solution of Sodium Hydroxide with water can be applied to the corrosion site to further clean the area. This solution also has a passivating effect with helps stops the corrosion process in the corrosion site. The solution should be washed off with water after approximately 60 seconds contact time.

c. Wipe residue with Cleaning cloth, CCC-C-46, Class 7 (Appendix A, Item 23)

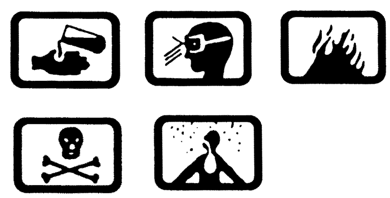


Alcohol, Isopropyl 6

d. Apply Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15) mixed with one part alcohol to one part fresh water with Brush, Typewriter, A-A-3077, Style T (Appendix B, Item 4) or Toothbrush (Appendix B, Item 3). Scrub connector mating areas, threads, shell and mounting plates.

e. Remove excess solvent and residue with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23).

6-3.11.2. Internal Corrosion Removal and Cleaning.



Alcohol, Isopropyl 6

NOTE

On most connectors the receptacle (female) contacts are difficult to clean. If corrosion is found, the most practical solution is pin replacement.

a. Apply Isopropyl Alcohol, TT-1-735 (Appendix A, Item 15), with Acid Brush, A-A-289 style opt. (Appendix B, Item 1).

b. Wipe excess solvent and residue with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23). Use Pipe Cleaner (Appendix B, Item 5) to remove solvent from pin area.

c. For those connectors exposed to fluids that adversely affect Room Temperature Vulcanizing (RTV)

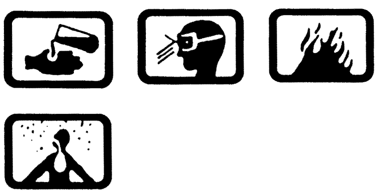
Coating, MIL-A-46146 (dielectric coolant, turbine oil, etc.), apply Sealing Compound, Synthetic Rubber, Accelerated, MIL-PRF-8516 (Appendix A, Item 30) to the connector backshell and wire bundle instead of the MIL-A-46146. The Sealing Compound, Synthetic Rubber, Accelerated, MIL-PRF-8516 (Appendix A, Item 30) provides very stable (fluid resistant) sealing where temperatures do not exceed 250°F (121°C).

6-3.11.3. 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 contactor cavities.

b. Remove retainer ring and mylar tape (if present) from the back of the electrical connector. Pull backshell and retainer ring clear of electrical connector.

c. Tie back shielded wire pigtails, where applicable.



Adhesive/Sealant, Silicone RTV, Non-Corrosive 1

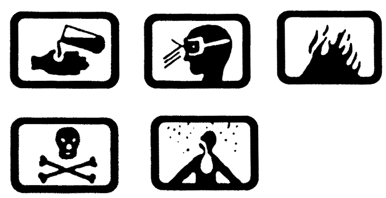
d. Apply RTV, MIL-A-46146 (Appendix A, Item 40) by inserting sealant applicator nozzle into wire bundle at the back of the connector (refer to Figure 6-2). Squeeze the tube while slowly withdrawing the nozzle from the wire bundle at the back of the connector. Repeat the application of sealant two or three times at different locations around the wire bundle. The sealant will self-level in approximately 15 minutes. Recommended thickness is 1/16 inch across the entire rear grommet. If, after 15 minutes following the first application, there is not enough to entirely seal the back of the connector, additional sealant may be added, but in no case shall the depth of sealant exceed 1/8 inch.

e. After sealant application, position the connector so that the connector face is parallel to the floor. This allows the sealant to flow to a uniform thickness over the back of the connector during initial cure. After 30 minutes, the connector may be placed in any position, although the cure will continue for about 24 hours.

f. Contactors may later require replacement. After making such a replacement, add a drop of the sealant around the replaced wire near the rear of the grommet. Position connector face parallel to the floor for 30 minutes for initial cure.

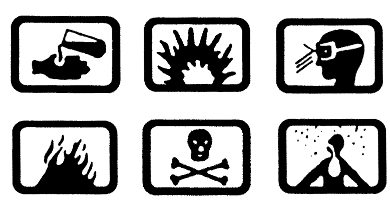
g. Connectors exposed to severe environments, such as wheel wells, wing butts, bilges, etc., may be taped using Electrical Insulating Tape, 604-1 (black) or 604-2 (red), (Appendix A, Item 35). RTV, MIL-A-46146 (Appendix A, Item 40) shall be brushed over the tape.

6-3.11.4. Water-Displacement and Treatment. After corrosion removal/cleaning or at any time connectors, plugs, or receptacles are separated for maintenance, treat as follows:



Alcohol, Isopropyl 6

a. Apply Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15) liberally using an Acid Brush (Appendix B. Item 1) to internal/external sections of male and female connectors. Mate and unmate connector several times to clean. Rinse with Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15) and allow to dry.



Compound, Corrosion Preventive, Water-Displacing 3

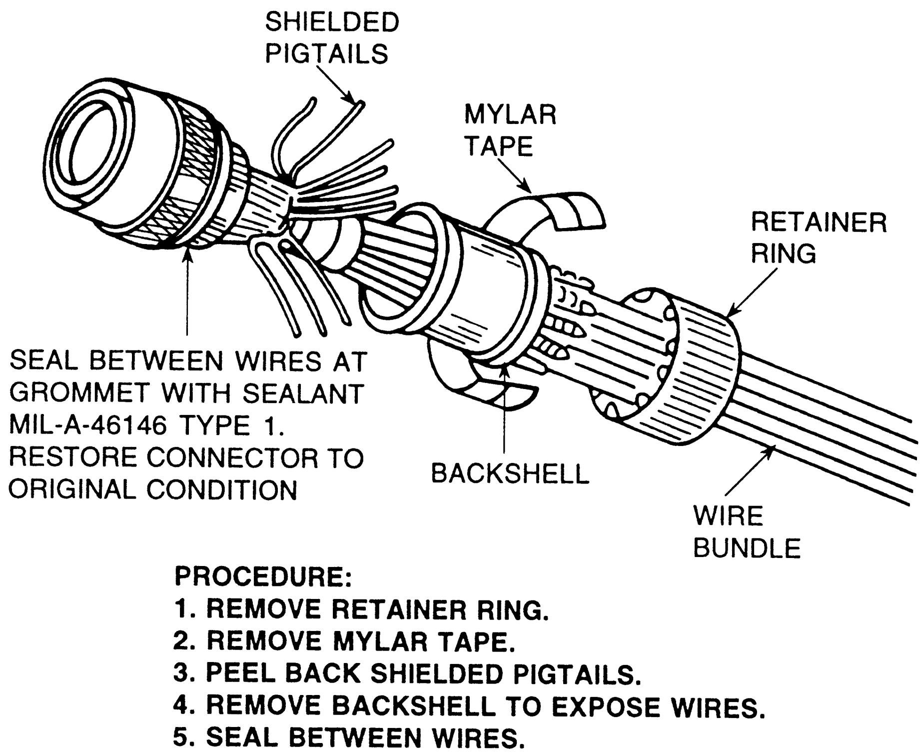


Figure 6-2. Connector Sealing Procedures

NOTE

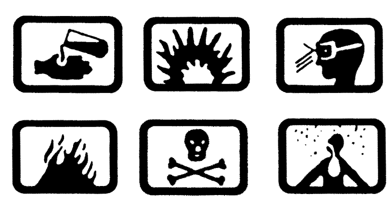
The application of Water-Displacing Corrosion Preventive Compound, Ultra-Thin Film, Avionics Grade, MIL-C-81309, (Appendix A, Item 16), will assist in displacing any moisture present from the metallic surfaces in connector internal sections.

b. Apply a light film of Water-Displacing Corrosion Preventive Compound, Ultra-Thin Film, Avionics Grade, MIL-C-81309, (Appendix A, Item 16), to the internal sections of the connectors, plugs, and receptacles. Avoid excessive application or overspray of preservative.

c. Tilt connector down, if possible, to drain excess. Wipe off excess preservative with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23).

d. Prior to connecting threaded sections of connector, plug, or receptacle backshells, treat threaded area with Water-Displacing Corrosion Preventive Compound, Ultra-Thin Film Avionics Grade, MIL-C-81309, (Appendix A, Item 16).

e. Mate connector sections. Wipe off excess preservative with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23).



Compound, Corrosion Preventive, 3
Water-Displacing

CAUTION

For connectors requiring frequent mating and unmating, use MIL-C-81309, (Appendix A, Item 16).

f. Apply film of Water-Displacing Corrosion Preventive Compound, MIL-C-81309 (Appendix A, Item 16) to the shell (exterior) of connectors, plugs, and receptacles.

6-3.12. Coaxial Connectors. Coaxial connectors require special steps in order to avoid water intrusion. In most cases, contaminants in fuel/oil quantity, and similar capacitive-type indicating system connectors, will cause erroneous quantity indications in cockpit systems. Antenna coaxial connectors have similar moisture problems. Coaxial connectors shall be cleaned and treated as specified in paragraphs 6-3.11.1, 6-3.11.2, and 6-3.11.4.

6-3.13. Wire Harnesses and Cables. When corrosion is found at the pin to wire connection on electrical connectors, plugs, and receptacles, the wire harness/cables should be inspected for corrosion/cracking of the wire insulation. Coaxial cable shielding is particularly susceptible to corrosion. Wire harnesses and cables shall be cleaned and treated as follows:

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

Alcohol, Isopropyl 6

b. Apply Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15), with Brush, Typewriter, A-A-3077, Style T (Appendix B, Item 4), or Toothbrush (Appendix B, Item 3). Scrub affected area until contaminants are loosened. Re-apply Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15), to flush area.

c. Shake excess solvent from wire harness and wipe with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23).

d. Allow to air dry.

e. Treat as specified in paragraphs 6-3.11.1, 6-3.11.2, and 6-3.11.4.

f. Where applicable, repair wire harness and cable covering.

6-3.14. Printed Circuit Boards. Edge connectors (and mating plugs) used in miniature and microminiature printed circuit boards (PCBs) are cleaned and preserved as specified in paragraph 6-3.8.

6-3.15. Filters. The cleaning of filters is essential to maintaining the cleanliness and, thus, reliable operation of avionic/test equipment. The frequency of cleaning shall be as appropriate based on local conditions. Filters shall be cleaned as follows:

a. The Primary Method.

(1) Clean as specified in cleaning Track CSR3 or CSR2B, as applicable. Refer to Table 4-1.

(2) If grease is present, clean and degrease as specified in cleaning track DB2A. Refer to Table 4-1.

b. The Secondary Method.

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

(2) Scrub rigid or metal filters with Cleaning Brush, A-A-2074 (Appendix B, Item 31).

Compound, Aircraft Cleaning 4

(3) If oil or grease is present in filter, clean the filter with a solution of nine parts fresh water to one part Cleaning Compound, MIL-PRF-85570, Type II (Appendix A, Item 11). Scrub rigid or metal filters with Cleaning Brush, A-A-2074 (Appendix B, Item 31). Rinse thoroughly with fresh water.

CAUTION

Compressed air used for drying can create airborne particles that may enter the eyes. Pressure shall not exceed 10 psi. Eye protection is required.

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

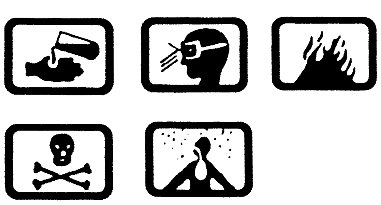
(5) Allow to air dry.

(6) Do not preserve filters.

6-3.16. Sensitive Internal Metal Surfaces. Metal surfaces such as resonant cavities, tube covers, and other delicate metal components, shall be inspected for signs of corrosion. Remove corrosion and preserve as follows:

a. Remove dirt and contaminants with Cleaning and Polishing Pad, Non-Abrasive (Appendix A, Item 3). Scrub affected area until all contaminants are dislodged.

b. Remove corrosion and tarnish with Typewriter Eraser, (Appendix A, Item 8), or Eraser, Ruby Red, (Appendix A, Item 6). Care should be taken not to remove thin plating from the surfaces.



Alcohol, Isopropyl 6

c. Clean residue with Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15). Apply with Acid Brush, A-A-289 style opt. (Appendix B, Item 1), or Brush, Typewriter, A-A-3077, Style T (Appendix B, Item 4).

d. Remove residue with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23).

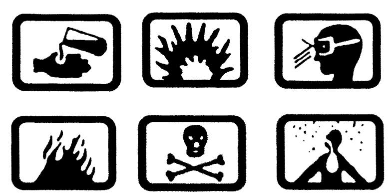
e. Rinse affected area with Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15), and wipe dry with Cleaning Cloth, CCC-C-46, Class 7, (Appendix A, Item 23). This step will assist in removing water.

CAUTION

Exercise care when using Hot Air Gun near plastic materials. Excessive heat may decompose the plastic and/or change its electrical characteristics.

f. Air dry or dry with Hot Air Gun, A-A-59435 (Appendix B, Item 16), or Hot Air Gun, Raychem, HT-900 (Appendix B, Item 17), or equivalent.

g. Preservation, where circuit function will not be affected, shall be as follows:



Compound, Corrosion Preventive, 3
Water-Displacing

(1) Apply a thin film of Water-Displacing Corrosion Preventive Compound, Ultra-Thin Film, Avionics Grade, MIL-C-81309, (Appendix A, Item 16), on all metal surfaces.

(2) Remove excess preservative with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23).

6-3.17. Static Wick Dischargers. Corrosion, deterioration, and/or damage of the static wick dischargers can result in poor performance of the aircraft's radios and communications systems, erratic operation of instruments, and potential electrical shock to personnel. When found to be damaged or corroded, the static wick dischargers should be replaced as follows:

a. Remove old static wick discharger and discard.

b. Remove corrosion and contaminants from the mounting area with Cleaning and Polishing Pad, Non-Abrasive (Appendix A, Item 3). Scrub affected area until all corrosion and contaminants are loosened.

Alcohol, Isopropyl 6

c. Clean mounting area with Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15). Use Acid Brush, A-A-289 style opt. (Appendix B, Item 1).

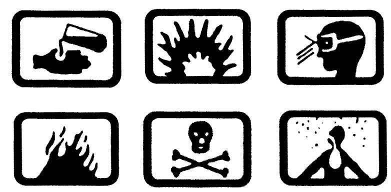
d. After cleaning, re-apply Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15) on mounting area to flush out remaining residue.

e. Wipe with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23).

f. Allow to dry.

g. If magnesium or aluminum, treat the bare metal surface with Chemical Conversion Material as described in paragraphs 5-3.1.1 through 5-3.1.4.

h. Install new static wick discharger in accordance with aircraft specific technical manual.



Compound, Corrosion Preventive, 3
Water-Displacing

i. Apply film of Water-Displacing Corrosion Preventive Compound, MIL-C-81309 (Appendix A, Item 16), to the exterior of the attachment point.

CHAPTER 7
CORROSION CONTROL MEASURES FOR ELECTRICAL BONDING/GROUNDING

7-1. ELECTRICAL BONDING/ GROUNDING CONNECTIONS.

7-1.1. 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 one or all of several functions:

a. Provide a common ground for the proper electrical functioning of the units involved.

b. Provide a path to minimize lightning strike damage.

c. Prevent the buildup of static potentials that could result in a spark discharge.

d. Minimize static and stray currents in units involved.

e. Prevent a unit from emitting electromagnetic energy that would interfere with other units and provide a signature for enemy detection/recognition.

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

7-1.2. Bimetallic Junctions. The connecting 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 if suitable precautions are not observed. Aluminum alloy jumpers (bonding straps) are used in most bonding situations. However, copper jumpers sometimes are used to bond together parts made of stainless steel, cadmium-plated steel, aluminum, brass, or other metals. Where contact between dissimilar metals cannot be avoided, the choice of binding material and associated hardware material is important. Materials should be chosen such that the part most prone to corrode (anode) is the easiest and least expensive to replace. At bimetallic junctions, where finishes are removed to provide good electrical connection, a protective finish/ sealant shall be reapplied 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. Refer to Chapter 2 for discussion on galvanic corrosion.

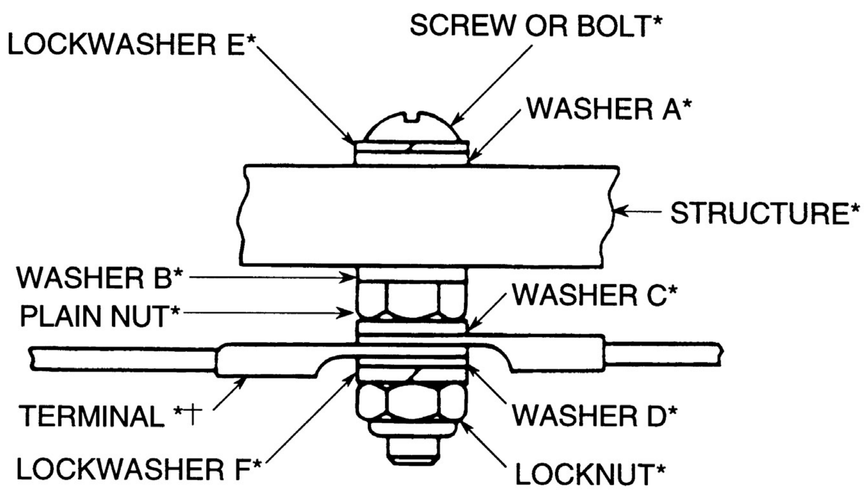
NOTE

For additional information on bonding and grounding straps and selection of hardware, refer to NAVAIR 01-1A-505, NAVAIR 01-1A-1 (Navy); TO 1-1A-14, TO 1-1A-8 (Air Force); or TM 55-1500-323-24 (Army) as well as other applicable service directives.

7-1.3. Hardware Selection. When repairing/replacing existing bonding or grounding connections, use the same kind of attaching hardware as the original. This hardware has been selected on the basis of mechanical strength, electrical requirements, corrosion resistance, and ease of installation. When the original connection displays evidence of galvanic corrosion, use a washer of anodic material installed between the dissimilar metals. This will cause any corrosion to occur in the washer, the easiest and lease expensive part to replace. To accomplish this, Figures 7-1 through 7-6 show the proper assembly configurations. The corresponding material selections are recorded in Tables 7-1 through 7-3. Selection of hardware material(s) and order of assembly depend on the particular metal(s) specified for the structure/jumper terminal. For example, using the configuration shown in Figure 7-1, a bolt is secured as a stud through a flat structural surface. The structure is aluminum alloy and bond/ground jumper terminal is also aluminum. This terminal maybe attached over a cadmium-plated steel bolt (stud) and clamped together by a cadmium-plated steel nut. Uncoated aluminum washers are used in the position as shown.

7-2. BONDING/GROUNDING SURFACE PREPARATION.

7-2.1. General. Procedures for preparation of a metallic surface before mating electrical conductor(s) are as follows:



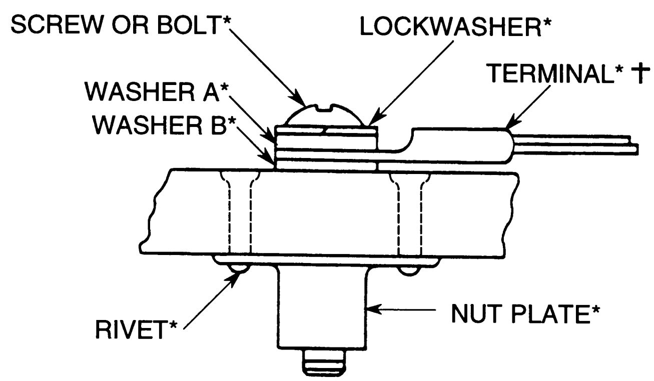
NOTES:
***SEE TABLE 7-1 FOR SPECIFIC MATERIALS**
†LIMITED TO A QUANTITY OF FOUR (4)

Figure 7-1. Stud Bonding or Grounding to Flat Surface

Table 7-1. Hardware for Stud Bonding or Grounding to Flat Surface

Structure	Screw or bolt and lock nut	Plain nut	Washer** A	Washer** B	Washers** C and D	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	Magne-sium* Alloy	Magne-sium* 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
THINNED COPPER TERMINALS AND JUMPERS							
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	Cadmium Plated Steel

* When not available, use aluminum alloy.
** Uncoated aluminum washers shall be used throughout.



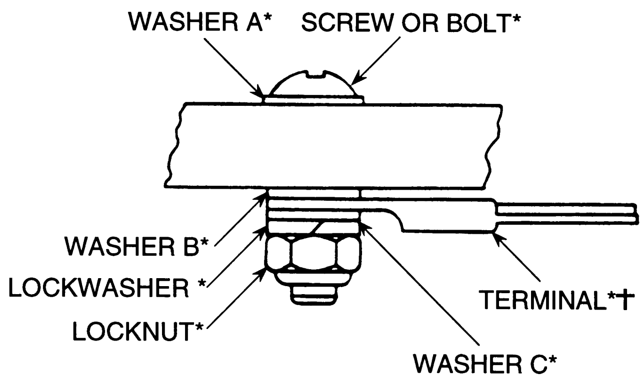
NOTES:
***SEE TABLE 7-2 FOR SPECIFIC MATERIALS**
†LIMITED TO A QUANTITY OF FOUR (4)

Figure 7-2. Nut Plate Bonding or Grounding to Flat Surface

Table 7-2. Hardware for Nut Plate Bonding or Grounding to Flat Surface

Structure	Screw or bolt and nut plat	Rivet	Lockwasher	Washer A	Washer B
ALUMINUM TERMINAL AND JUMPER					
Aluminum alloys	Cadmium Plated Steel	Aluminum Alloy	Cadmium Plated Steel	Cadmium Plated Steel or Aluminum	Aluminum
Magnesium alloys	Cadmium Plated Steel	Aluminum Alloy	Cadmium Plated Steel	Cadmium Plated Steel or Aluminum	Magnesium* Alloy
Steel, cadium plated	Cadmium Plated Steel	Corrosion Resistant Steel	Cadmium Plated Steel	Cadmium Plated Steel or Aluminum	Aluminum
Steel, corrosion resistant	Corrosion Resistant Steel	Corrosion Resistant Steel	Cadmium Plated Steel	Cadmium Plated Steel or Aluminum	Cadmium Plated Steel
TINNED COPPER TERMINAL 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, cadium 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	Cadmium Plated Steel or Corrosion Resistant Steel

*When not available, use aluminum alloy.



NOTES:
***SEE TABLE 7-3 FOR SPECIFIC MATERIALS**
†LIMITED TO QUANTITY OF FOUR (4)

Figure 7-3. Bolt and Nut Bonding or Grounding to Flat Surface

Table 7-3. Hardware for Nut Plate Bonding or Grounding to Flat Surface

Structure	Screw or bolt and nut plate	Lockwasher	Washer A	Washer B	Washer C
ALUMINUM TERMINAL AND JUMPER					
Aluminum alloys	Cadmium Plated Steel	Cadmium Plated Steel	Cadmium Plated Steel or Aluminum	None	Cadmium Plated Steel or Aluminum
Magnesium alloys	Cadmium Plated Steel	Cadmium Plated Steel	Magnesium Alloy	Magnesium* Alloy	Cadmium Plated Steel or Aluminum
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 TERMINAL 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 Resistant Steel	Corrosion Resistant	Corrosion Resistant Steel	Cadmium Plated Steel or Corrosion Resistant Steel

*When not available, use aluminum alloy.

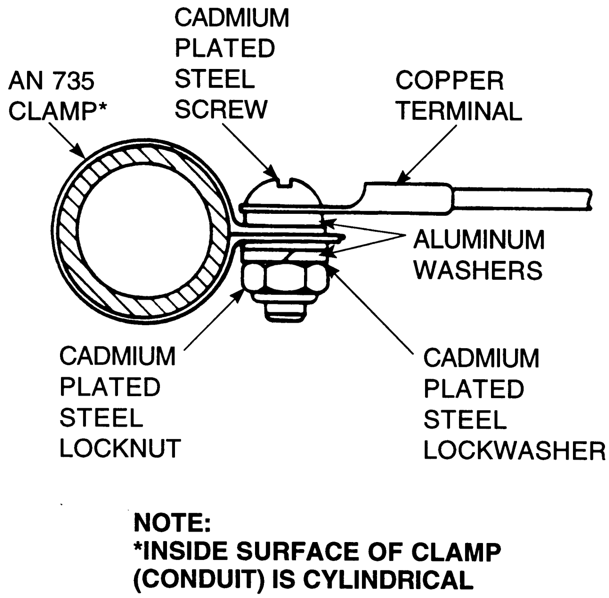
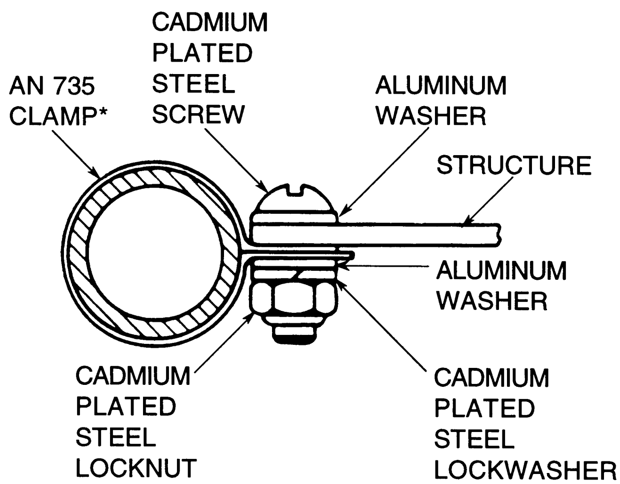
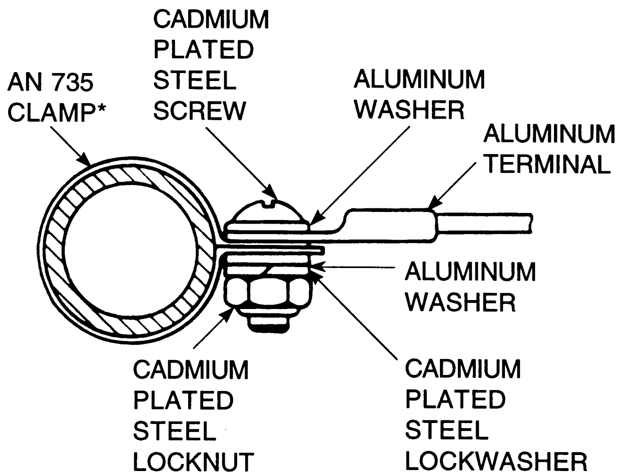


Figure 7-4. Copper Jumper Connector to Tubular Structure



NOTE:
***ALUMINUM ALLOY OR CORROSION RESISTANT STEEL CONDUIT (INSIDE SURFACE)**

Figure 7-5. Bonding Conduit to Structure



NOTE:
***INSIDE SURFACE OF CLAMP (CONDUIT) IS CYLINDRICAL**

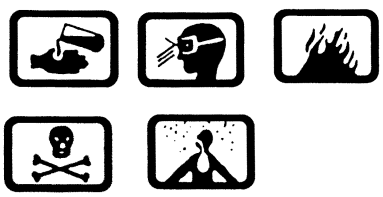
Figure 7-6. Aluminum Jumper Connector to Tubular Structure

a. Remove all dirt, oil, and grease from a circular area slightly larger than the connection. This area should correspond to about 1 1/2 times the diameter of the connection. Use Cleaning Cloth, A-A-59323, Type II (Appendix A, Item 24) dampened with Cleaning Solvent, (Appendix A, Item 12).

b. If more vigorous soil removal is required, scrub with Brush, Typewriter, A-A-3077 (Appendix B, Item 4) until all contaminants are removed.

c. Wipe with a dry, Cleaning Cloth, A-A-59323 Type II (Appendix A, Item 24).

d. Remove paint, anodic, or conversion coating film and surface corrosion from the planned attachment area with Abrasive Mat, A-A-58054, Type I (Appendix A, Item 1). For corrosion beyond the surface corrosion stage, refer to NAVAIR 01-1A-509 (Navy), TO 1-1-691 (Air Force), or TM 55-1500-344-23 (Army).



Alcohol, Isopropyl 6

e. Wipe clean with a Cleaning Cloth, A-A-59323, Type II (Appendix A, Item 24) dampened with Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15).

f. Allow to air dry.

g. If magnesium or aluminum, treat the bare metal surface with Chemical Conversion Material as described in paragraphs 5-3.1.1 through 5-3.1.4.

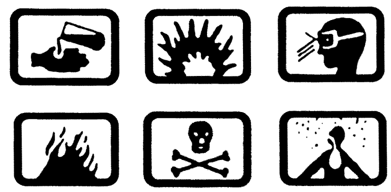
h. Clean bonding cable with a Cleaning Cloth, A-A-59323, Type II (Appendix A, Item 24) dampened with Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15).

i. If necessary, use a Brush, A-A-3077 (Appendix B, Item 4) to scrub the strap until all corrosion products and contaminants are dislodged.

j. Wipe clean with the solvent-dampened cloth and allow to air dry.

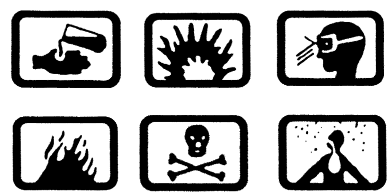
k. Assemble connection(s) and torque in accordance with the requirements of the applicable service directives.

l. Test electrical resistance in accordance with paragraph 6-3.1.12.



Compound, Corrosion Preventive 3
Water-Displacing

7-2.2. Preservation. Apply Water-Displacing Corrosion Preventive Compound, MIL-C-81309 (Appendix A, Item 16) according to Table 4-6. The following procedures apply for bonding/grounding connections that are not environmentally protected continually.



Sealing Compound 2

Compound, Corrosion Preventive, 3
Water-Displacing

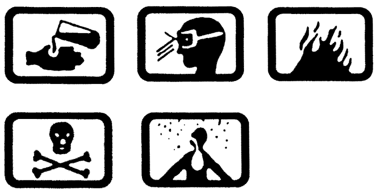
Compound, Corrosion Preventive 9

a. For bonding/grounding connections that require fairly frequent disassembly, preserve the connection area by applying Corrosion Preventive Compound, MIL-C-81309, (Appendix A, Item 16), followed by a coating of Corrosion Preventive Compound, MIL-PRF-16173, Grade 4 (Appendix A, Item 17).

b. For connections that seldom require disassembly, preserve with the more permanent and abrasion-resistant Sealing Compound, MIL-PRF-8516,

(Appendix A, Item 30), applied with a Spatula, A-A-277 (Appendix B, Item 18).

7-2.3. Electronic Equipment Shock Mount Bonding Preservation. This type of electrical bonding uses a bonding wire (jumper assembly) or strips of aluminum/copper. The following corrosion prevention method applies:

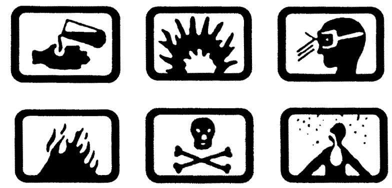


Alcohol, Isopropyl 6

a. Clean disassembled bonding connection by wiping with a Cleaning Cloth, A-A-59323, Type II (Appendix A, Item 24) dampened with Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15).

b. Allow to air dry.

c. Assemble bonding connection.



Compound, Corrosion Preventive, Water-Displacing 3

d. Apply Water-Displacing, Corrosion Preventive Compound, MIL-C-81309, (Appendix A, Item 16), over jumper assembly.

CHAPTER 8
EFFECT AND TREATMENT OF CORROSION ON ELECTROMAGNETIC INTERFERENCE SHIELDING EFFECTIVENESS

8-1. OVERVIEW.

Electromagnetic energy that is generated/absorbed aboard military aircraft can interfere with avionic systems causing malfunctions. This radiation, known as electromagnetic interference (EMI), is produced by radar antennas, electric motors, inadequately shielded avionics units, etc. Lightning and other natural effects can also affect normal performance of aircraft electrical/electronic systems. Some examples of EMI-related system malfunctions are microprocessor bit errors, computer memory loss, false indicators (i.e., alarms, lights, readouts), and power loss. The results of such malfunctions can cause a flight safety situation, aborted mission, or unacceptable system/subsystem operation. In order to minimize EMI-induced failures, avionic housings must absorb and reflect incident electromagnetic energy. Usually the shielding system consists of a conductive gasket sandwiched between an aluminum housing and an aluminum lid. This gasket provides sufficient electrical conductivity across the enclosure/gasket/lid junction per military grounding/EMI shielding requirements. It also prevents fluid intrusion into the components.

8-2. FACTORS INFLUENCING EMI.

EMI involves the interaction of electromagnetic energy (electric or magnetic fields) with the circuitry of an electronic device. Currents or voltages caused by EMI can couple with digital signal lines and produce erroneous data. Analog devices can also malfunction as a result of EMI. Corrosion is a major cause of EMI shielding deterioration. Corrosion protection typically relies on oxides, organic coatings, and nonconductive films. Conversely, EMI protection requires a conductive path. A typical low electrical resistance joint of silver and aluminum is a dissimilar metal couple that is highly susceptible to galvanic corrosion. Corrosion produces nonconductive films allowing EMI intrusion and degrades the load bearing capabilities of a structure.

8-3. SOURCES OF AVIONIC EMI.

8-3.1. General. EMI can affect avionics by introducing garbled/false signals, disrupting memory, and destroying circuits. This is because modern circuits operate at low power levels which can be disrupted with low level noise. Sources of avionic EMI include the following:

a. Devices that are part of a peripheral to a system/subsystem within the aircraft (intrasystem EMI).

b. Radiated emissions from ground-based on other external emitters (intersystem EMI).

c. Electrostatic discharges on the airframe or inside the aircraft.

d. Lightning strikes to the aircraft.

e. Electromagnetic Pulse (EMP) generated from a high-altitude nuclear detonation.

8-3.2. EMI Threat Categories. Military aircraft often operate in severe electromagnetic environments while carrying out intended missions. This presents a potential threat to digital flight controls and mission essential avionics due to single/multiple EMI sources. The following are examples of the kinds of problems that can result from EMI-induced malfunctions. Aircraft can jettison bombs while taking off from an aircraft carrier due to the response of bomb release circuits to carrier transmitters. Helicopter rotor blades and aircraft wings can inadvertently fold when illuminated by radar. EMI can cause aircraft computers to “dump” programs necessary for the operation of mission essential equipment. Table 8-1 compares several typical electromagnetic threats.

8-3.3. Intrasystem/Intersystem EMI. Aircraft avionic subsystems operate over a frequency range from a few kilohertz to tens of gigahertz. Ensuring that these pieces of equipment operate compatibility is a primary concern. Intrasystem EMI principally involves receivers responding to undesired signals and transmissions causing undesired responses in receivers and other equipment. Other examples of EMI are interphone noise due to magnetic coupling and equipment malfunction via relay/solenoid generated transients. Intersystem EMI is caused by transmission from external sources such as ground-based emitters (radar, TV, radio, etc.) through various couplings.

8-3.4. Static Electrification. The three ways that static electrification of an aircraft can occur are frictional charging, engine charging, and induction charging. If the charge accumulation is sufficient, a number of interference-generating processes can occur. First, if the total aircraft structure is charged, electric fields at its extremities can become sufficient to cause arcing. Second, if insulated dielectric surfaces are charged, such as a windshield or radome, spark-like discharges across the dielectric surface to the surrounding metal structure can result. Third, if isolated (unbonded) metal sections of the aircraft become charged, arcing to adjacent metal structures can occur. Finally, slowly varying induction pulses can be produced in antennas moving through clouds of charged particles. These processes create an uncontrolled electromagnetic environment that generally impacts receiver inputs via antennas. This degrades the operational performance of navigation and communication equipment. Broadband digital systems can also be affected because discharges occur as pulses that may be misinterpreted as control signals. Chapter 9 provides more in depth theory on electrostatic discharge (ESD) as it relates to military avionic equipment, modules, and components.

8-3.5. Lightning. Lightning is probably the most severe uncontrolled electromagnetic environment to which aircraft are exposed. The severity of the lightning threat depends on the probability of a lightning strike to the aircraft. Lightning strike is a function of weather, temperature, geographical region, aircraft altitude, aircraft type, and other parameters. Statistics show that an aircraft experiences less than one strike every 3000 hours of flight operation. The damage from a lightning strike to the aircraft depends on its characteristics, such as peak current, rate-of-rise, risetime, charge, action integral, and number of subsequent strikes. The direct effects of a lightning strike are burning, eroding, blasting and structural deformation caused by arcing. Also, high pressure shock waves and magnetic forces are produced by the associated high currents. These effects pose great dangers to flight safety in addition to the aborted missions. The indirect (induced) effects result mostly from the interaction of electromagnetic fields with electrical/ electronic circuits. These effects also can be hazardous since lightning may generate high voltages and currents in circuits through coupling mechanisms.

8-3.6. Electromagnetic Pulse. EMP is a threat to military electronics which arises primarily from high altitude nuclear detonations. Gamma rays produced in the explosion interact with air molecules and particulates with sufficient energy to eject electrons. These electrons interact with the earth's magnetic field, radiating high intensity fields. Field strengths can be on the order of 50,000 volts per meter with pulse durations of hundreds of nanoseconds. The large skin currents generated on the surface of an enclosure require that joint impedances are low. This prevents large voltage drops at these discontinuities in the shield. The characteristics of this EMP appear to be very similar to that of the lightning transient. The differences are in pulse risetime, rate-of-rise, and pulse duration.

8-4. EMI SHIELDING PRINCIPLES AND PRACTICES.

8-4.1. EMI Shielding Practices. Some form of EMI shielding is required for avionics aboard all modern military aircraft. Shielding is used to protect avionics from the electromagnetic environment present in field service. Shielding is accomplished by enclosing electronic equipment in a conductive shell or enclosure (Faraday shield). The enclosure reduces the incident electromagnetic energy to tolerable levels by reflection and absorption. Radiation incident on the interior and exterior surfaces does not escape or penetrate the enclosure. Openings in the shield required for power/signal cables, covers and access doors, ventilation, and windows allow EMI leakage. Shielding for these openings usually take the form of gaskets, seals, or joints that provide electrical continuity across voids to ensure a continuous protective shell. In addition, this shielding also aids lightning strike protection by providing a conductive path. Performance of an EMI shielding system is a function of the weakest component. Shielding effectiveness of the various components (wall material, access doors, vents, cabling, connectors, joint seals, etc.) should be maintained. Changes in the shielding effectiveness of individual components over time should be correctable through routine maintenance. Conditions that can inhibit the life and shielding effectiveness of EMI gaskets are:

a. The environment in which a gasket is stored.

Table 8-1. Military Aircraft Electromagnetic Threat Comparison

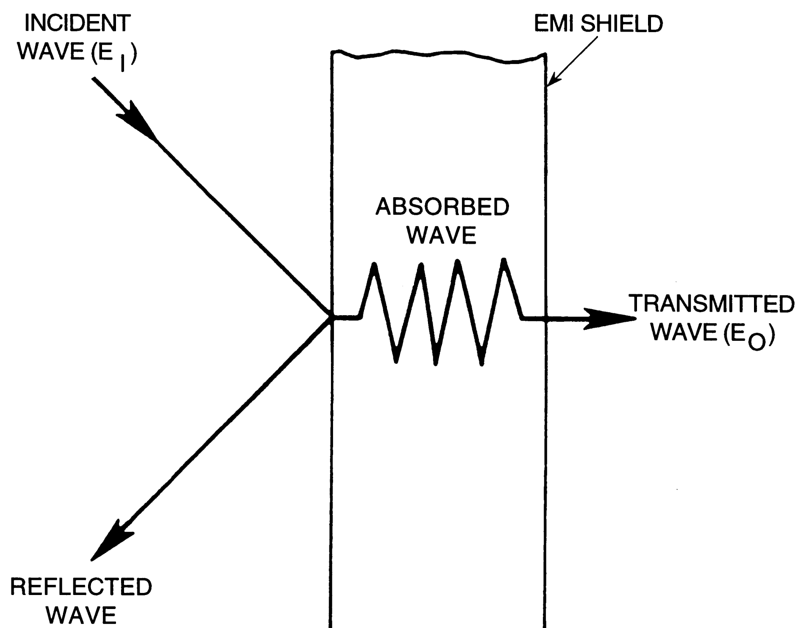
	Intra/Intersystem electromagnetic interference (EMI)	Static electrification	Lightning	Electromagnetic pulse (EMP)
Threat exposure	Local Usually antenna-related	Local Usually particle-related	Local Usually cloud-related	Regional Nuclear burst related
Nature of environ-ment	Man-made Continuous or transient signals Controlled/uncontrolled Known, partially known	Corona/spark discharge Streamers Uncontrolled Unknown	Natural Arc discharge Uncontrolled Partially known	Man-made Plane wave transient Uncontrolled Partially known
Effects	Induced Direct	Induced	Direct Induced	Induced
Criticality	Flight safety mission	Mission	Flight safety mission	Flight safety mission
Threat spectrum	Broadband/narrowband (up to 100 GHz)	Broadband (up to 100 MHz)	Broadband (up to 100 MHz)	Broadband (up to 100 MHz)
Analysis	Ant/ant coupling Wire/ant coupling Ant/wire coupling Wire/wire coupling	Field/ant coupling Field/wire coupling	Field/ant coupling Field/wire coupling Component failure Probability of survival	Field/ant coupling Field/wire coupling Component failure Probability of survival
Testing	Equip-level radiated/ conducted emission/ susceptibility Safety-of-flight Ground/in-flight	High voltage DC Charged particle bombardment	High-current pulse Attachment-point Pin injection Cable induction	Free-field Pin injection Cable induction
Protection measures	Shielding Filtering Bonding Grounding Limiters Circuit design Software design Frequency management Cable/equipment placement Fiber optics	Discharges EMI control techniques	Diverters Surge arresters EMI control techniques	EMI control techniques
Protection assurance	Operational exposure Noise source investigation Coupling reduction Measures	Operational exposure Noise source detection Corrective bonding Discharge management	Operational exposure Mishap investigation Repair/replacement	No peacetime exposure Recurring surveillance Repair/replacement
MIL-STD/ Specs	MIL-STD-461 MIL-STD-464	MIL-STD-464	MIL-STD-464	None

b. The environment in which the gasketed joint is to be used.

c. The available force on the gasketed joint.

d. The unevenness of the joint.

8-4.2. EMI Shielding Effectiveness. When electromagnetic energy impinges on a conductive barrier, a portion of the energy is reflected/transmitted. Absorption of the energy by the material attenuates the transmitted wave. When the wave reaches the opposite side of the wall reflection and transmission again occur at this discontinuity. Figure 8-1 illustrates this process for an electric field. Shielding effectiveness (SE) is defined as SE = 20 log (E_i/E_o). SE is shielding effectiveness in decibels (dB), E_i is the incident field strength, and E_o is the transmitted field strength. This ratio of electric/magnetic field strength at a point before and after the placement of a shield for a given external source is a measure of the shielding element's ability to control EMI. For example, to shield avionics of older aircraft tested at 20 V/m form an external field of 1000 V/m, 34 dB attenuation is required. Absorption losses depend on the shield's bulk electrical properties (relative permeability and conductivity), thickness of the material, and frequency of the impinging energy. Reflection losses depend on the impedance of the incident wave and the electrical properties of the material. In most applications, magnetic fields present problems only for nonferrous shields, due to the lower reflection losses/larger skin depths associated with low frequencies. MIL-STD-461 is a tri-service specification for testing of electronic systems for radiated and conducted emissions and susceptibility. IEEE-299 describes procedures for measuring shielding effectiveness of enclosures. A modified version of this procedure is used in MIL-G-83528 for characterizing the shielding effectiveness of conductive elastomers. MIL-STD-464 is an electrical bonding specification, which has been applied to EMI joints. Low resistance values do not guarantee high shielding effectiveness. High resistance values indicate potential problems but do not provide a measure of shielding effectiveness.



SHIELDING EFFECTIVENESS (dB)=20 LOG $_{10}$(E_O /E_I)*

*THE ELECTRIC FIELD E IS IN VOLTS PER METER. FOR A MAGNETIC FIELD SUBSTITUTE H_I /H_O (AMPERES PER METER) FOR E. FOR A PLANE WAVE SUBSTITUTE P_I /P_O (WATTS PER SQUARE CENTIMETER) FOR E.

Figure 8-1. Basic EMI Shield

8-4.3. Shielding Requirements. For practical purposes, the range of shielding extends up to around 120 dB. Table 8-2 lists the amount of signal passing through an enclosure for different levels of shielding. At 120 dB, 0.0001% of the signal penetrates the shield. (Measurement of shielding levels beyond the 110 to 120 dB range is experimentally difficult.) Shielding requirements cover both susceptibility of equipment to external signals and the emission form equipment. EMI can be radiated through the atmosphere or conducted along power and signal lines (see Figure 8-2). Reduction of conducted EMI entails filtering of the signal lines. Test specifications cover individual pieces of equipment or all of the components integrated into a system. Frequently, individual components may pass a test but fail when connected together in a system. This is due to inadequate shielded cabling, which acts like an antenna to receive or radiate EMI. Operating modes of a system may generate different levels of EMI depending on the signals transmitted between the components.

8-4.4. EMI Shielding Enclosure Materials. Conductive gasketing is used to provide electrical ground and EMI shielding across a joint and often employs an environmental seal. They are used on temporary apertures such as access panels. These panels have seams that must be electromagnetically sealed. The form of a gasket is determined by attachment methods, force available, joint unevenness, available space, and applicable EMI shielding criteria. Table 8-3 lists some of the materials used in EMI shielding enclosures. The major material requirements for EMI gaskets include:

a. Conductivity - Good conductivity is taken as a rough, indirect measure of EMI shielding. In addition, a contact resistance of 2.5 milliohms is specified across joints for grounding, lightning strike protection.

b. Corrosion resistance of gasket material - Properties should not change with service (e.g. corrosion which produces an insulting layer of material).

c. Compatibility with the mating surface - Electro-chemical compatibility to prevent galvanic corrosion.

d. Good adhesive qualities - Required for electrical contact and environmental sealing.

e. Chemical resistance to solvents - Properties should not change with exposure to operational chemicals (e.g. fuel, paint stripper, hydraulic fluid, etc).

Table 8-2. Shielding Effectiveness vs Percent Leakage

Shielding effectiveness (dB)	Attenuation ratio	Leakage through shield (percent)
20	10:1	10.0
40	100:1	1.0
60	1000:1	0.1
80	10000:1	0.01
100	100000:1	0.001
120	10^6:1	0.0001

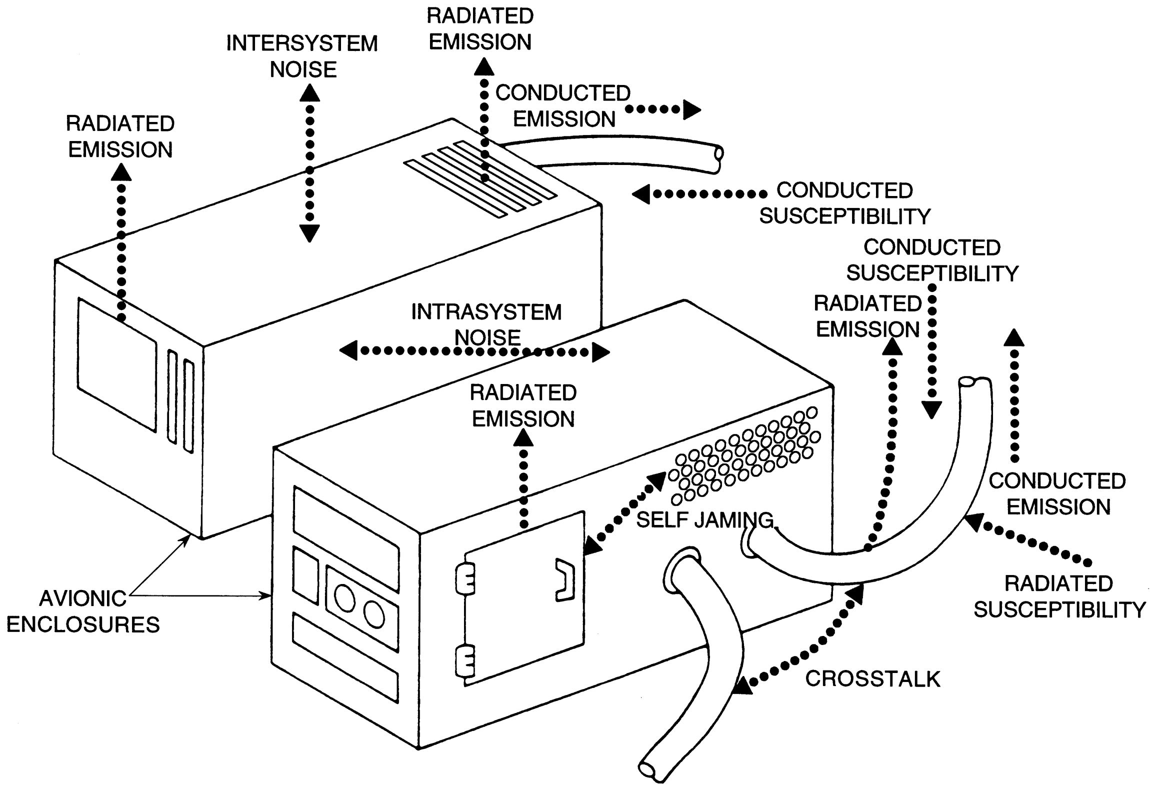


Figure 8-2. Classification of EMI Problems

Table 8-3. Materials Used in EMI Joints

Enclosure	Coatings	Fillers used in EMI gaskets
Steel	Silver	Carbon
Aluminum	Copper	Silver
Magnesium	Nickel	Copper
Composites	Tin	Beryllium/Copper
Plastic	Cadmium	Phosphor Bronze
	Aluminum (IVD)	Monel
	Zinc	Stainless Steel
	Chromate	Steel
	Phosphate	Nickel
		Tin
		Aluminum

f. Resilience - Resistance to compression required for electrical contact and environmental sealing. Long term pressure should not cause permanent deformation (compression set). Normal deflection for solid rectangular elastomer seals range from 5 to 15%.

g. Wear resistance - Important when the gasket is repeatedly compressed and depressed.

h. Conformability - Accommodate joint unevenness.

8-5. THE EFFECTS OF CORROSION.

8-5.1. General. Corrosion can degrade the electrical and mechanical properties of a joint. The exposure of EMI gaskets to various environmental conditions can significantly reduce its shielding effectiveness and service life. Under field service conditions, military avionics experience corrosion between metal surfaces such as joints. In these environments, exclusion of electrolyte from the joint is essential to maintaining an EMI seal. Use of nonconductive environmental seals (gaskets, sealants, and coatings) must be used to exclude moisture from the joint. Corrosion-induced changes in bulk resistivity of the EMI gasket may contribute to degradation of the EMI seal.

8-5.2. Corrosion-Induced Characteristics. Although no valid method of evaluating the effect of corrosion on EMI shielding exists presently, certain trends can be identified. The difficulty lies in the fact that conductive gaskets may not be evaluated by simply measuring EMI shielding performance before and after environmental exposure. This is because the change in EMI shielding is due to both corrosion and disassembly/reassembly between EMI tests. EMI/EMP protection for enclosed avionic equipment can degrade in shielding performance over time. This occurs often after only 3 or 4 months of exposure to the field environment and normal use. Galvanic corrosion is usually the principal form of attack. In most military applications, the flange is made of an aluminum alloy, such as 6061-T6. Steel, magnesium, and composite materials are occasionally used in flange construction. All of the common conductive materials used in EMI gaskets are dissimilar to varying degrees with aluminum. Gasket metals include monel, beryllium copper, silver, carbon, nickel, and stainless steel. Composite fillers are substrates plated with a more conductive material. These include tin plate on various substrates (beryllium copper, phosphor bronze, copper-plated steel); silver on copper, aluminum, nickel, and glass powders; and nickel on graphite or carbon particles. Conductive composites offer significant advantages over aluminum, such as improved corrosion resistance and lighter weight. EMI attenuation properties are usually imparted to these composites by filling the polymer with conductive fibers, flakes, or particles. Applying a conductive coating to the polymer surfaces is also employed. Galvanic series for homogeneous materials, such as those contained in Table 2-3, do not necessarily apply to composite fillers. Interaction between the plated surfaces and substrate can alter the potential and ability of the surface to support cathodic reactions. In addition, relative surface areas of the EMI gasket and aluminum will have some influence on the rate of dissolution of the aluminum. The presence of copper ions accelerates corrosion of aluminum by deposits that form local cathodes and increase the concentration of cathodic reactants. The copper ion concentration can be higher that the other cathodic reactants (dissolved oxygen) allowing higher currents. Copper goes into solution through either galvanic coupling to the conductive surface coating or general corrosion of copper. Corrosion of the aluminum flange also depends on the presence of aggressive ions in the solution. Initiation of corrosion creates more acidic conditions further accelerating the corrosion rate. In general, corrosion products are nonconductive materials that increase the electrical resistance of the bond or joint between surfaces. This will result in an impedance high enough to destroy the EMI shielding effectiveness of many avionic systems.

8-6. THE PREVENTION, TREATMENT, AND CONTROL OF CORROSION ON EMI SHIELDING.

8-6.1. General. Changes in the shielding effectiveness can occur over time due to environmental exposure. These changes are usually the result of the operational/ maintenance environment (salt solution, vibration, pressure and temperature cycling, etc.) and complicate routine maintenance of avionic equipment. In general, exclusion of moisture and electrolyte from the joint is essential to maintaining an EMI seal. Since EMI protection is a function of the electrical continuity of the joint, conductive environmental seals (gaskets, sealants, and coatings) must be used. Paints and sealants used in proximity of the joints to exclude moisture shall be applied with care and only as prescribed. In cases where conductive paths depend on the use of specific types of fasteners and other hardware, only use of these items is authorized. Proper and complete grounding/bonding, with visual inspection after maintenance, is mandatory. In those instances where electrical bonding depends on bringing conductive surfaces into contact with threaded fasteners, standard torque values shall be used unless otherwise specified.

8-6.2. Corrosion Preventive Maintenance and Control. EMI gaskets should be periodically checked to ensure they are continuing to provide their intended functions. Inspection intervals should balance the need for proper operation and the environment, with the destructiveness caused by surface wear of gaskets with disassembly/reassembly. Gaskets may deteriorate via attack by operational chemicals, corrosion, and wear. Therefore inspection should include the following.

a. Check for corrosion products, pitting of the aluminum surface, or bulges in the sealant due to corrosion beneath the gaskets.

b. Check the bonding of the gasket to the structure to prevent moisture intrusion.

c. Check for loss of electrical conductivity of the gasket or its electrical bond to the aircraft.

d. Check for wear and swelling of the gasket.

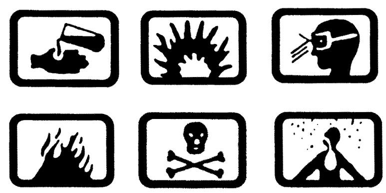
e. Check for compression set of the seal.

f. Check maintenance procedures are being followed (e.g. avoid solvents which can wash away conductive particles).

g. Check for excessive bending and/or pulling of electrical cables and shields.

8-6.3. EMI Shielding Corrosion Repair and Treatment. Corrective maintenance of EMI gaskets depends on the type of gasket involved, size of the damaged area, and degree/type of corrosion. EMI gaskets are usually of either metal or conductive elastomer construction. Finger stock, mesh, and spiral ribbon are examples of metal gaskets. Conductive elastomers consist of dispersions of conductive particles (spheres, irregular shapes, fibers) in elastomer matrices. Oriented wire gaskets have characteristics of both categories. Since each type of EMI gasket has its own precularities, each will require special corrosion treatment/repair. The following "generic" gasket repair procedure is outlined below for general guidance. Maintenance personnel should refer to the applicable service directives for more specific repair information.

a. When corrosion is observed, disassemble only the affected area and remove the corrosion using the mildest available method.



Compound, Corrosion Preventive, Water-Displacing	3
Alcohol, Isopropl	6

b. Carefully clean the area with Isopropyl Alcohol, TT-I-735 (Appendix A, Item 15). If replacement seals are available, install them in accordance with aircraft maintenance instructions or bulletins. If replacement seals are not available or do not exist, spray the contacting surfaces with a light coating of MIL-C-81309 (Appendix A, Item 16) and then reassemble.

c. Inspect repairs and areas known to be chronic problems often.

8-6.4. EMI Packaging Requirements. Unless otherwise specified, items that are sensitive to EMI should be packaged in accordance with MIL-E-17555 for electromagnetic protection. Marking shall be accordance with MIL-STD-129.

CHAPTER 9
EFFECT AND TREATMENT OF CORROSION ON ELECTROSTATIC DISCHARGE SENSITIVITY

9-1. OVERVIEW.

9-1.1. General. Very Large Scale Integration (VLSI) digital components are steadily increasing in functional power, speed, and system applications in military avionics. By making the VLSI devices small, less voltage is needed to operate circuitry and the noise immunity decreases. Many of these devices are highly susceptible to damage from the discharge of static electricity. Electrostatic discharge (ESD) affects many components such as transistors, resistors, integrated circuits (ICs), and other types of semiconductor devices. A spark discharge resulting from the accumulation of electrostatic charges may not immediately destroy a device or cause it to become nonfunctional. The device can be permanently damaged, yet perform its intended function. Additional exposure to spark discharges or continued use of the device can further damage the item until failure occurs. This is known as a latent failure and can seriously affect a system's reliability. It is essential that everyone involved in the repair handling, transporting, and storing of electrostatic discharge sensitive (ESDS) items be concerned about ESD. All ESDS items should be packaged, shipped, and stored in ESD protective materials. Further information on the Air Force ESD program is contained in TO 00-25-234.

9-1.2. Definition. ESD is the transfer of electrostatic charge between bodies with different electrostatic potentials. This is caused by direct contact or induced by an electrostatic field. The most formidable ESD is lightning or electromagnetic pulse (EMP). Discharges from human bodies are the most frequent, least noticeable, and most ignored ESD. ESD affects ESD devices in a number of different ways. It can degrade performance, change the electrical characteristics, or cause complete failure of the device.

9-1.3. Failure Mechanisms. Three of the most common failure mechanisms are junction burnout, oxide punch-through, and metallization burnout. Junction burnout usually occurs in bipolar discrete and integrated circuits. Metal Oxide Semiconductor (MOS) discrete and integrated circuits often experience oxide punch through. Metallization burnout is usually associated with both bipolar and MOS ICs. The following paragraphs describe some of the mechanisms that cause avionics to fail in field service and storage. In addition, procedures are outlined to prevent these failures from occurring.

9-2. FACTORS INFLUENCING ESD.

Maintenance of avionic equipment for ESD prevention requires an understanding of the factors that contribute to ESD. Most modern aircraft electrical and electronic components are susceptible to conditions and activities that can cause ESD. For example, walking on concrete floors, rubbing or separating materials, using electrostatic copiers, wearing synthetic clothing, etc. Separating dry materials generates greater ESD than moist materials because moisture is conductive and helps to dissipate charge. For this reason, ESD effects are more noticeable in the winter since heating systems reduce moisture on the surfaces of furniture and other objects. Any circumstances that results in a low relative humidity (RH) will permit a greater accumulation of electrostatic charges.

9-3. SOURCES OF AVIONIC ESD.

9-3.1. Charging Effects and IC Breakdown. Static charge is generated as a result of direct or indirect electrostatic field effects. The ESD problems that result from direct charge interaction with an IC are caused by triboelectrically generated charges. That is, charges that come in contact with the exposed leads of the IC, consequently cause breakdown. The indirect source of ESD is either by induction or capacitance change in the immediate environment. Inductive charge generation can be caused by a large static charge away from an IC. This occurs if the charge is oriented such that the IC receives an induced potential across its leads. A capacitance change can also occur via a large static charge existing some distance away. This causes the charge distribution near the IC to vary corresponding to the capacitance change, resulting in ESD. For example, insulators near an IC can result in direct charge contact sufficient to cause breakdown.

9-3.2. Generation of Static Charges. Static electrical charges are caused by the movement of dissimilar materials against one another. Generally, these charges are attributed to some form of contact between two dissimilar surfaces. The triboelectric series is a list of materials in order of static charge generation. A partial triboelectric series is outlined in Table 9-1. Materials that are further apart on the table generate the greatest static charge when rubbed together. This occurs with the materials nearest to the top of the table retaining the positive change. An example of this is the motion of air against synthetics generates the highest static charge. Also, rubbing polyethylene and human hair will generate a greater static charge than the charge resulting from rubbing nylon and cotton. Another possible explanation of charge accumulation between two bodies is that ion transfer between surfaces causes static charge buildup. Other possible causes of electron transfer between contacting surfaces include differences in dielectric constant, thermal effects, and piezoelectric or pressure effects.

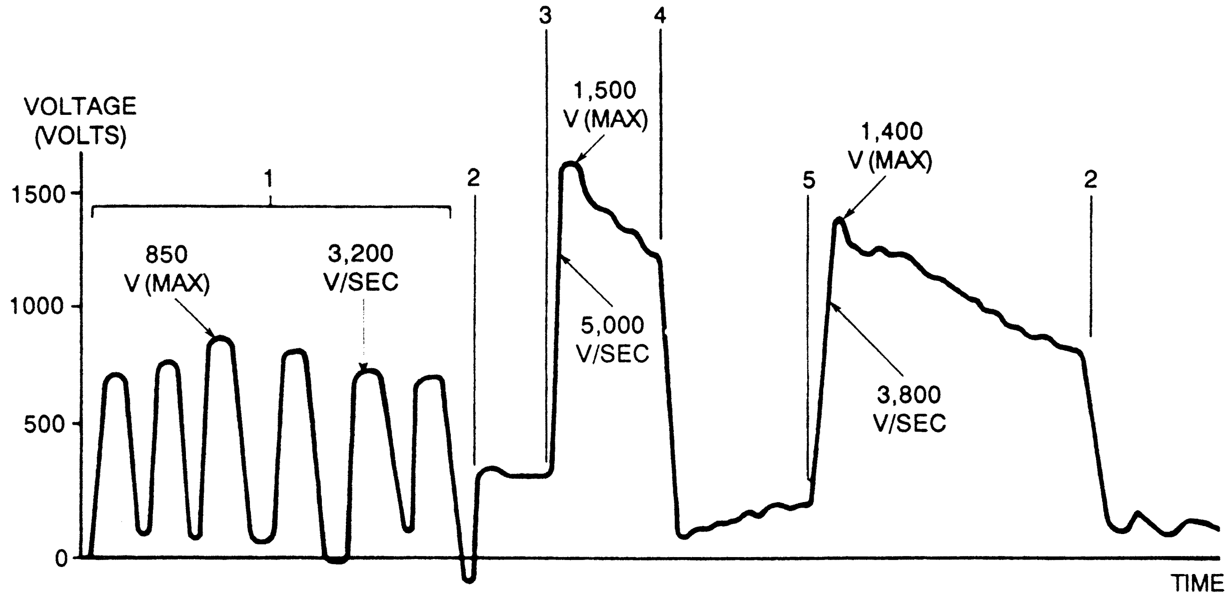
9-3.3. Human Body Generated ESD. People are prime sources of ESD that damage avionic components. Electrostatic charges generated by rubbing or separating materials are readily transmitted to a person's conductive layer. This causes that person to be electrostatically charged. When an electrostatically charged person handles or comes near an ESDS part, he can damage it from direct discharge. The change in voltage of a human body with normal maintenance activities is shown in Figure 9-1. In addition to accumulating electrostatic charges, the human body can retain electrostatic potential over time. An example of this is a low relative humidity, it may take a human form more than one hour to bleed off 400V potential. A graph that contrasts electrostatic potential with bleed-off time is outlined in Figure 9-2 for Teflon and concrete floors. This general trend should highlight the need for using ESD control devices, particularly in repair shops where relative humidity is low.

9-3.4. Prime Sources of Static Charge. Some items create or maintain charges better than others. This is because some materials readily give up electrons while others tend to accumulate excess electrons. An item having an excess of electrons is negatively charged while an item having an electron deficit is positively charged. When two materials are rubbed together, then separated, one material gains electrons and the other loses electrons. This also occurs when materials flow relative to one another, such as gas or liquid or liquid over a solid. These electron charges are equal and in the case of nonconductors tend to remain in the localized area of contact. Charges on conductors, however, are rapidly distributed over its surface and the surfaces of other conductive objects it contacts. These items can be considered as typical prime charge sources. Prime sources are essentially insulators and are typical synthetic. Table 9-2 lists typical prime charge sources. Electrostatic charge on these items may be extremely high, as the charge is localized and is not distributed over the entire surface. This charge could be reduced in high humidity environments as this allows more conduction/ distribution of the charge. Table 9-3 lists typical electrostatic charges generated by personnel in a repair facility.

9-3.5. Special Considerations. Many microelectronic circuit repair facilities include clean room conditions. These conditions are designed to maintain the absence of dust and other particles in the maintenance environment. Materials used in this environment eliminate contamination during handling of devices. However, their use in conjunction with other materials often result in a very high static charge. Specifically, synthetic materials are used frequently because they are nonporous, flexible, and easily fabricated. Static charges can be generated from common materials found in the clean room or maintenance work place. For example, latex finger cots rubbed against a plastic box can charge to 6 kV while bare fingers can generate only 200 volts. Note that even 200 volts of static charge can degrade or destroy some ESDS devices. An additional source of static charge is during wave soldering and general cleaning operations. Normally, low surface energy solvents such as chlorinated hydrocarbons are used in these operations. Although such solvents provide excellent cleaning capacity, rapid

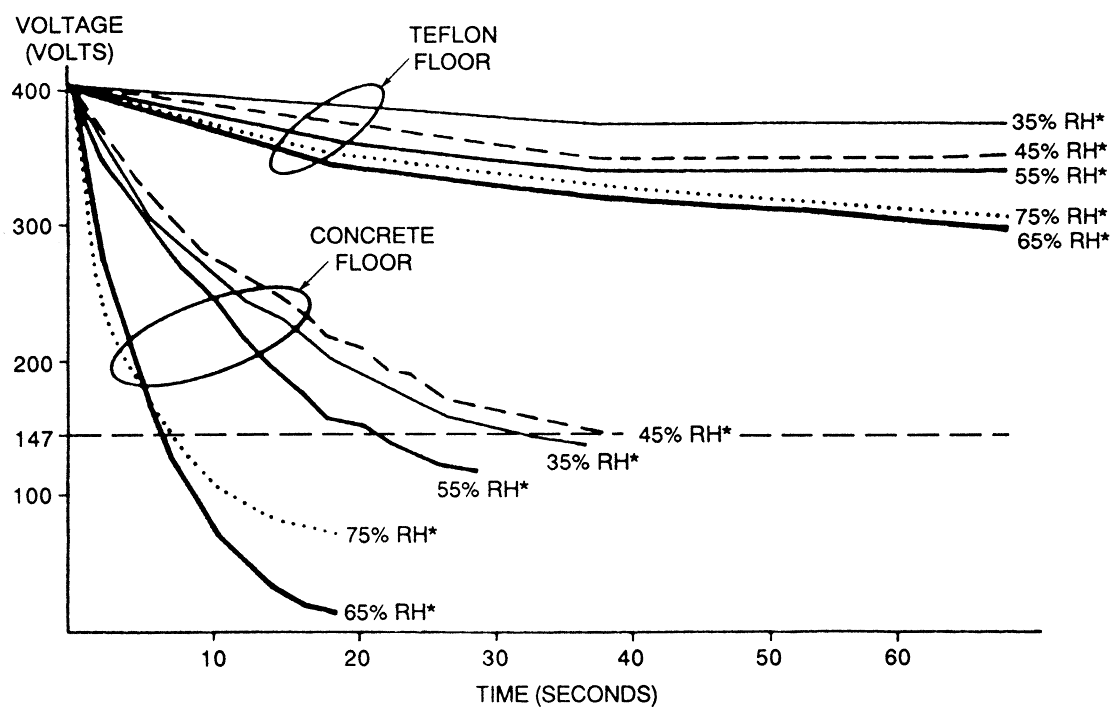
Table 9-1. Triboelectric Series (Partial)

	More positively charged
INCREASING POSITIVE CHARGE ↑	Air
	Human Hands
	Asbestos
	Rabbit Fur
	Glass
	Mica
	Human Hair
	Nylon
	Wool
	Fur
	Lead
	Silk
	Aluminum
	Paper
	Cotton
	Steel
	Wood
	Amber
	Sealing Wax
	Hard Rubber
	Nickel Copper
	Brass Silver
	Gold Platinum
	Acetate Rayon
	Polyester
	Orlon
	Saran
	Polyurethane
	Polyethylene
	Polypropylene
	PVC (vinyl)
	Silicon
INCREASING NEGATIVE CHARGE ↓	Teflon
	More negatively charged



1. WALKING
2. SITTING
3. SITTING WITH FEET RAISED
4. SITTING WITH FEET LOWERED
5. STANDING UP

Figure 9-1. Graph of Human Body Generated Charge Versus Activity



*RELATIVE HUMIDITY

Figure 9-2. Graph of Human Charged Voltage Versus Bleed-Off Time at Varying Humidities

Table 9-2. Typical Prime Charge Sources

Prime source	Composition/Application
Work surfaces	Formica Finished wood Synthetic mats Metal plates
Floors	Wax-finished Vinyl
Clothes	Clean room smocks Personal garments (i.e., wool, nylon, dacron, etc.)
Chairs	Finished wood Vinyl Fiberglass
Packaging/Handling	Polyethylene bags, wraps, envelopes; bubble pack; foam; plastic trays, boxes
Repair/cleaning areas	Spray cleaners Solder suckers Solder irons Solvent brushes
Moving air	Forced air drying of equipment/components

Table 9-3. Typical Electrostatic Voltages

Means of generation	Electrostatic voltage (volts)	
	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
Maintenance Action Form (MAF) bag (work card envelope)	7,000	600
Common poly bag picked up from bench	20,000	1,200
Work chair padded with polyurethene foam	18,000	1,500
Styrofoam coffee cup	5,000	Undetermined
Plastic solder sipper	8,000	Undetermined

evaporation, and noncorrosive properties, they increase static control problems. As indicated in Table 9-4, rubbing a printed circuit board (PCB) with a solvent saturated cloth can generate substantial charges. This is much like rubbing the PCB with a Teflon or chlorinated plastic film. This problem can be solved by using a chlorinated-glycol hydrocarbon antistatic solvent.

9-4. TYPES OF ESD FAILURES.

9-4.1. Intermittent Failures. ESD can cause intermittent or upset failures as well as hard failures of aircraft electronics. Intermittent or upset failures can occur on Large Scale Integration (LSI) ICs when equipment is in operation. This is usually characterized by a loss of information or temporary distortion of its functions. No apparent hardware damage occurs and proper operation resumes automatically after ESD exposure and system reset. Upset failures can be the result of a spark near the equipment. The EMP generated by the spark causes erroneous signals to be routed through equipment circuitry. Upset failures can also occur by capacitive/inductive coupling of ESD pulses or direct discharge through a signal path providing an erroneous signal.

9-4.2. Catastrophic Failures. These are failures that result from direct contact between an IC and a high voltage static charge, sufficient to cause breakdown in the device.

9-4.2.1. Direct Failures. While upset failures occur when the equipment is operating, catastrophic failures can be the results of electrical overstress of electronic parts caused by ESD. For example, discharge from a person or object, an electrostatic field, or high voltage spark discharge. Some catastrophic failures may not occur until some time after exposure to an ESD. Such is the case with marginally damaged ESD parts, which require operating stress and time to cause further damage and complete failure. Only certain parts seem to be susceptible to this latest failure process. There are some types of catastrophic failures that could be mistaken for upset failures. For example, ESD could result in aluminum short circuiting the SiO_2 dielectric layer of an IC. Subsequent high currents flowing through this circuit path could vaporize the aluminum and block current flow.

9-4.2.2. Latent Failures. These are failures that occur by damage of the device over time and usually reduce operating life. This suggests that an IC can be subjected to repeated exposure to static charges that are cumulative in effect. Latent failure may be confused with upset failure if it occurs during equipment operation.

9-5. FAILURE MECHANISMS.

9-5.1. General. Regardless of the type of failure, the device itself is either power sensitive or voltage sensitive. Voltage sensitive parts fail due to dielectric breakdown of insulating layers. Other parts are power sensitive, where the pulse, shape, duration, and energy can produce power levels resulting in thermal breakdown. For example, hybrid ICs are voltage sensitive in the form of thick film resistors. Likewise, piezoelectric crystals are voltage sensitive. Some monolithic ICs are power sensitive.

Table 9-4. ESD Effect of Various Solvents

PC board rubbed with	Typical static charge (volts)
Fluorinated cleaner	5,000
Antistatic cleaner	0
Water	0

9-5.2. ESD Related Failure Mechanisms. ESD related failures typically include the following:

a. Thermal secondary breakdown

b. Metallization melt

c. Dielectric breakdown

d. Gaseous arc discharge

e. Surface breakdown

f. Bulk breakdown

g. Chip memory losses

9-5.3. Voltage and Power Dependent Failure Modes. Thermal secondary breakdown, metallization melt, and bulk breakdown are power-dependent failure mechanisms. Dielectric breakdown, gaseous arc discharge, and surface breakdown are voltage-dependent failure modes. Refer to MIL-HDBK-773, MIL-HDBK-263 and MIL-STD-1686 for more detailed descriptions of these microelectronic/ semiconductor device failure mechanisms.

9-6. IDENTIFICATION OF ESDS MATERIALS.

NOTE

For further assistance in identifying ESD devices, avionic technicians should refer to MIL-HDBK-773, MIL-HDBK-263, and MIL-STD-1686.

9-6.1. General. The electronic industry has only recently become aware of the cost and hazards of ESD. Materials that have been in the military supply system for several years may not be identified as ESD sensitive. Avionic technicians should treat any device as ESD if there is any doubt as to its classification. For example, a piece of avionic equipment may use a small relay that has a driver or diodes encased within it. These packages are probably ESD senstivie devices, yet relays are not usually considered ESD.

9-6.2. Supply System Practices. The military supply system currently marks packages containing ESD items as shown in the examples of Figure 9-3. However, these markings are subject to change as the ESD program established by each parent service organization becomes more sophisticated. Therefore, users should be alert for different markings as well as those shown. The presence of the symbol indicates the item is considered an ESD sensitive device.

9-6.3. ESD Classification. Electronic components subject to ESD related damage or failure are grouped as ESD materials. These are grouped into three major categories as defined in MIL-STD-1686 (Table 9-5):

a. Class 1: Extremely sensitive - Ranges from 0 to 2 kV.

b. Class 2: Sensitive - Ranges from 2 to 4 kV.

c. Class 3: Less sensitive - Ranges from 4 to 16 kV (Class 3 items are sometimes considered non ESD sensitive).

9-7. DISSIPATION OF STATIC CHARGES.

9-7.1. General. Dissipation of static charge usually occurs by one of three different paths as shown in Figure 9-4. These paths represent corona discharge into the air, surface conduction to ground and conduction through the volume of the material to ground. Therefore, the tendency to build up static charge may be decreased by increasing these paths of conduction away from the material.

9-7.2. General Solutions to Static Charge Problems. The techniques that can be used include increasing corona discharge by ionization of surrounding air, increasing surface electrical conductivity, or increasing bulk material electrical conductivity. It is often very difficult to promote corona discharge into the air for most avionics systems. Therefore, static protection has been commonly brought about by methods that would increase the surface and/or volume electrical conductivity.

9-7.3. ESD Problem Solutions. For protecting ESD devices, it is important to provide a conductive path to ground. This provides for rapid dissipation of static electrical charge. Practical solutions of dealing with ESD may be summarized as follows:

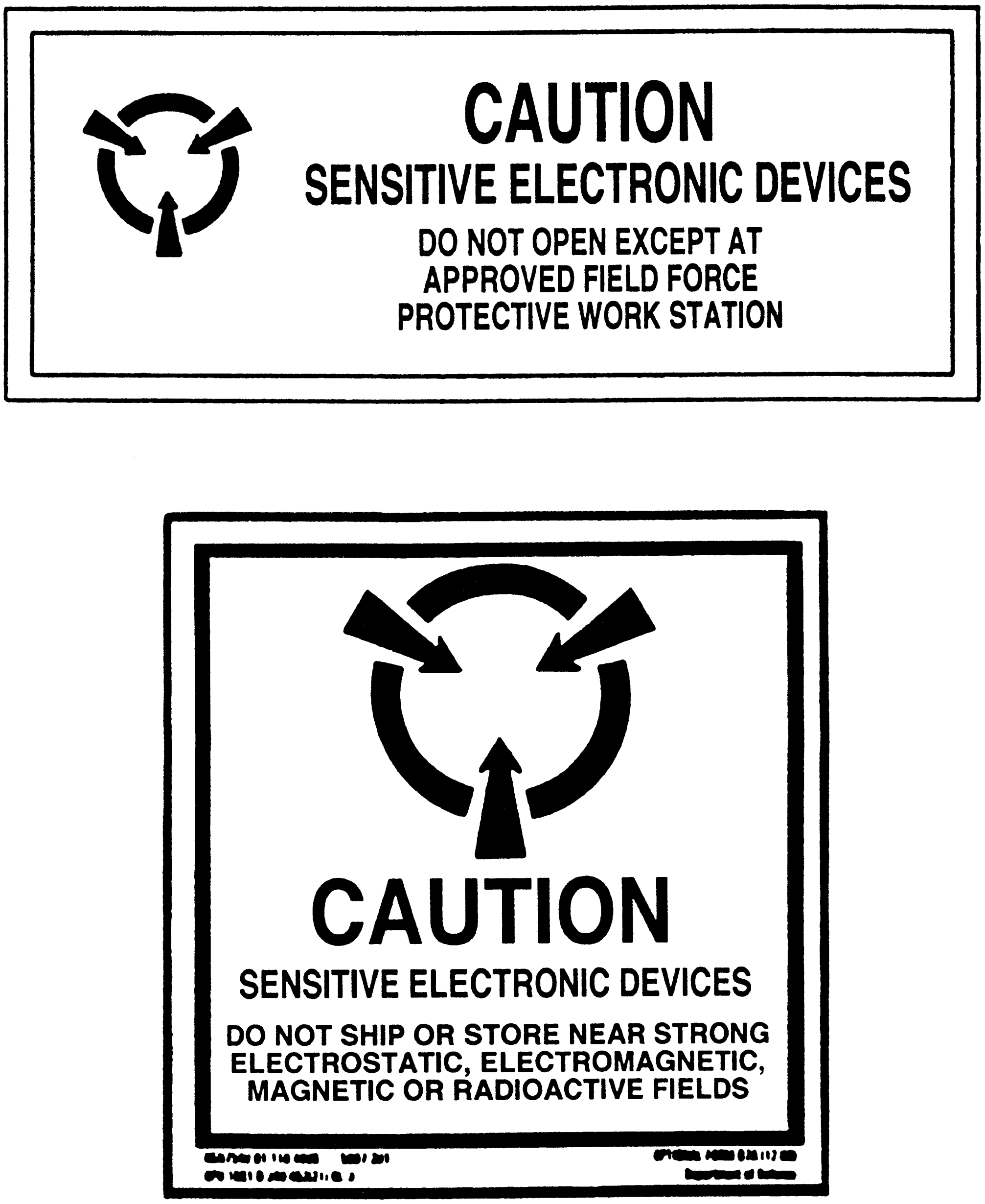


Figure 9-3. Examples of Typical Markings on ESD Sensitive Item Package

Table 9-5. ESD Sensitivity Categories

Class 1: Extremely Sensitive - Voltage ranges from 0 to 2 kV

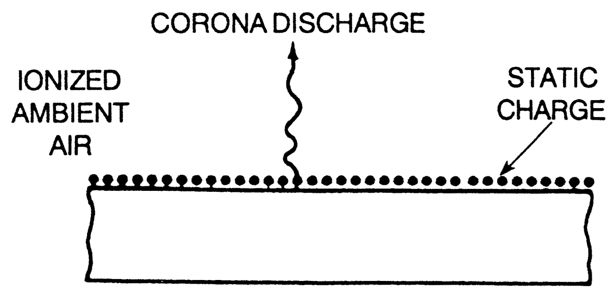
- Unprotected metal oxide semiconductor (MOS) and field effect transistors (FETs) Integrated Circuits (ICs). Particularly very large scale integration (VLSI) devices, including microprocessors.
- MOS capacitors (op amp internal compensation).
- Junction FETs (JFETs) and low current silicon controlled rectifiers (SCRs) with current capacity less than 0.15A.
- Microwave maximum operating frequency of very high frequency (VHF) transistors and ICs. Especially Schoattky device with more than 1 gigahertz.
- Precision IC voltage regulators (tolerance less than 0.5%).
- Precision thin film resistors (tolerance less than 0.1%).
- Low power thin film resistors (power consumption less than 0.5W).
- VLSI with dual-level metallization.
- Hybrids using Class 1 parts.

Class 2: Sensitive - Voltage ranges from 2 to 4 kV

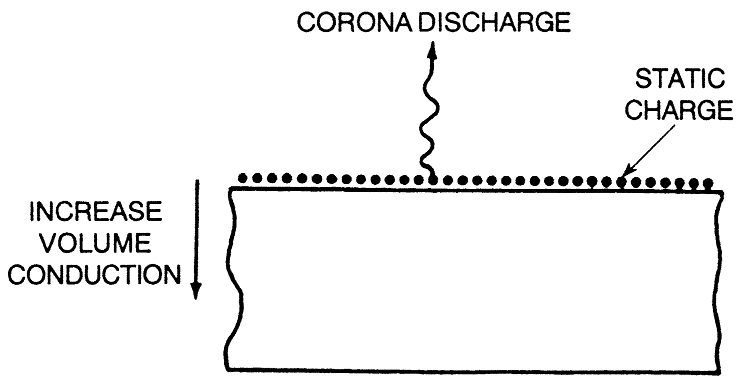
- MOS with ESD protection networks (CMOS, NMOS, PMOS).
- Schottky diodes (silicon switching diodes).
- High-speed bipolar logic, emitter coupled logic (ECL), and low power Schottky.
- Transistor logic (LS-TTL).
- Schottky TTL (S-TTL).
- Linear ICs.
- Precision resistors (RL).
- LSI devices with ESD protection circuits.
- Hybrids utilizing Class 2 parts.

Class 3: Less Sensitive - Voltage ranges from 4 to 16 kV (sometime considered non ESD sensitive)

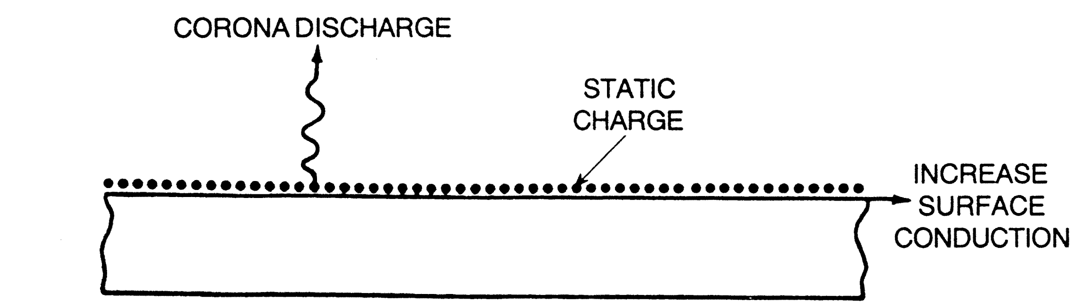
- Small signal diodes (power consumption less than 1 W).
- Small signal transistors (power consumption less than 5W).
- Low speed bipolar logic (TTL), diode transistor logic (DTL), and high threshold TTL (H-TTL).
- Quartz and piezoelectric crystals.



(A) INCREASING STATIC CHARGE DISSIPATION VIA IONIZED AIR



(B) INCREASING STATIC CHARGE DISSIPATION VIA VOLUME CONDUCTION



(C) INREASING STATIC CHARGE DISSIPATION VIA SURFACE CONDUCTION

Figure 9-4. Dissipation of Static Charges

a. Dissipate by distribution over conductive surface.

b. Shield ESD sensitive components from induced potentials (shielding).

c. Provide conductive path to ground.

9-8. EFFECTS OF CORROSION.

9-8.1. General. Corrosion can degrade the electrical and mechanical properties of ESD protection systems. The exposure of ESD devices/ESD protection systems to various environmental conditions can significantly increase their susceptibility to damage from the discharge of static electricity. Under field service conditions, military avionics experience corrosion between metal surfaces such as electrical bonding/grounding connections. This problem is two-fold. First, corrosion between metal surfaces in avionics creates structural weaknesses that undermine its effectiveness to shield ESDS components from induced potentials. Second, the corrosive process creates nonconductive products that decrease the paths of conduction of static charge away from the device or assembly.

9-8.2. Corrosion-Induced Characteristics. Although no valid method of evaluating the effect of corrosion on ESD sensitivity exists presently, certain trends can be identified. ESD protection for enclosed avionic equipment can degrade in performance over time. This occurs often after only 3 or 4 months of exposure to the field environment and normal use. Galvanic corrosion is usually the principal form of attack. This type of corrosion can rapidly destroy a bonding connection if suitable precautions are not observed (refer to Chapter 7). Damage to bonding/grounding hardware can cause the buildup of static potentials that could result in a spark discharge. Without regular maintenance, the buildup of metal oxides, absorbed atmospheric pollutants, dust, and field debris will also contribute to ESD shielding degradation of the avionic enclosure. This buildup introduces a nonconductive film between electrical contact materials which can often severely degrade ESD protection.

9-9. RECOMMENDED PRACTICES FOR ESDS EQUIPMENT, MODULES, AND COMPONENTS.

NOTE

Some ESD control procedures involve conditions or operations that may produce corrosion. Special handling methods and materials must be used to prevent equipment damage. In case of conflict, refer to the applicable service directives and TO 00-25-234 (Air Force only).

9-9.1. Basic ESD Precautions. ESD precautions are not limited to manufacturing or component repair personnel only. Anyone handling, processing, or using ESD devices must take precautionary steps. It would be futile for component repair personnel to take full precautions, only to turn the repaired item over to technicians who ignore all precautions and inadertvently destroy the module. Maintenance personnel should refer to MIL-HDBK-773, MIL-HDBK-263, and MIL-STD-1686 for more detailed descriptions of ESD control measures.

9-9.2. ESD Packaging Practices.

CAUTION

Packaging of ESD items must only be done at an ESD protective workstation. See Figure 9-5.

a. Packaging for electrostatic discharge protection requires the use of one or more of the following materials:

(1) MIL-PRF-81705, Type II barrier material, transparent, waterproof, electrostatic protective, static dissipative.

(2) Cushioning material, flexible, cellular, plastic film.

(3) Cushioning material, plastic open cell.

(4) PPP-C-1797, cushioning material, resilient, low density, unicellular, polyproplene foam.

b. ESD items may be further protected in reusable ESD fast pack containers, PPP-B-1672, Type II, style D or shielded in a bag or pouch conforming to MIL-PRF-81705, Type I barrier material, water-vaporproof, grease-proof, electrostatic and electromagnetic protective (opaque).

c. Protection will be provided to prevent physical damage and to maintain leads and terminals in an as-when-manufactured condition during handling and transportation.

d. Packaging of ESD items shall be in accordance with MIL-E-17555 for electrostatic protection. Marking shall be in accordance with MIL-STD-129.

9-9.3. ESD Workstation Shop Practices.

a. Control humidity within 40% to 60% range. Humid air helps dissipate electrostatic charge.

b. Ionized air helps to bleed off static charges.

c. Prohibit prime generators (Table 9-2) and carpeting from avionics shop areas.

d. Chairs and stools should have conductive surfaces and should be grounded through a 250-kilohm to 1-megohm resistor to ground.

e. Trays, carriers, cushioning materials, bags, etc, should be made of conductive ESD protective material.

f. Electrical equipment, tools, soldering irons, etc, that come in contact with ESD devices should be grounded. Resistance to top of soldering irons should be less than 20 ohms. Only ESD safe tools should be used.

g. Test equipment with exposed metal surfaces should be grounded.

h. Personnel handling ESD devices should wear long sleeve ESD smocks or short sleeve shirts. Prohibit materials such as common plastic, rubber, or nylon.

i. Personnel grounding straps should have minimum resistance of 250 kilohms and maximum of 2 megohms.

9-9.4. ESD Device Handling Practices.

CAUTION

Damage to ESD items may occur if untrained personnel are allowed to handle ESD items when the items are outside of an ESD protective package.

a. Protective apparel should be checked frequently, especially after cleaning, by scanning personnel with an electrostatic field meter to monitor for damaging ESD voltages.

b. Be sure to attach the wrist strap (mandatory) and heel straps (if used) before handling any ESD items.

c. Avoid the presence of any nonantistatic or insulative material near work areas. For example, styrofoam cups, plastic or masking tape, wrapping or barrier materials, synthetic materials, etc.

d. Do not store or use magnetic material near work areas.

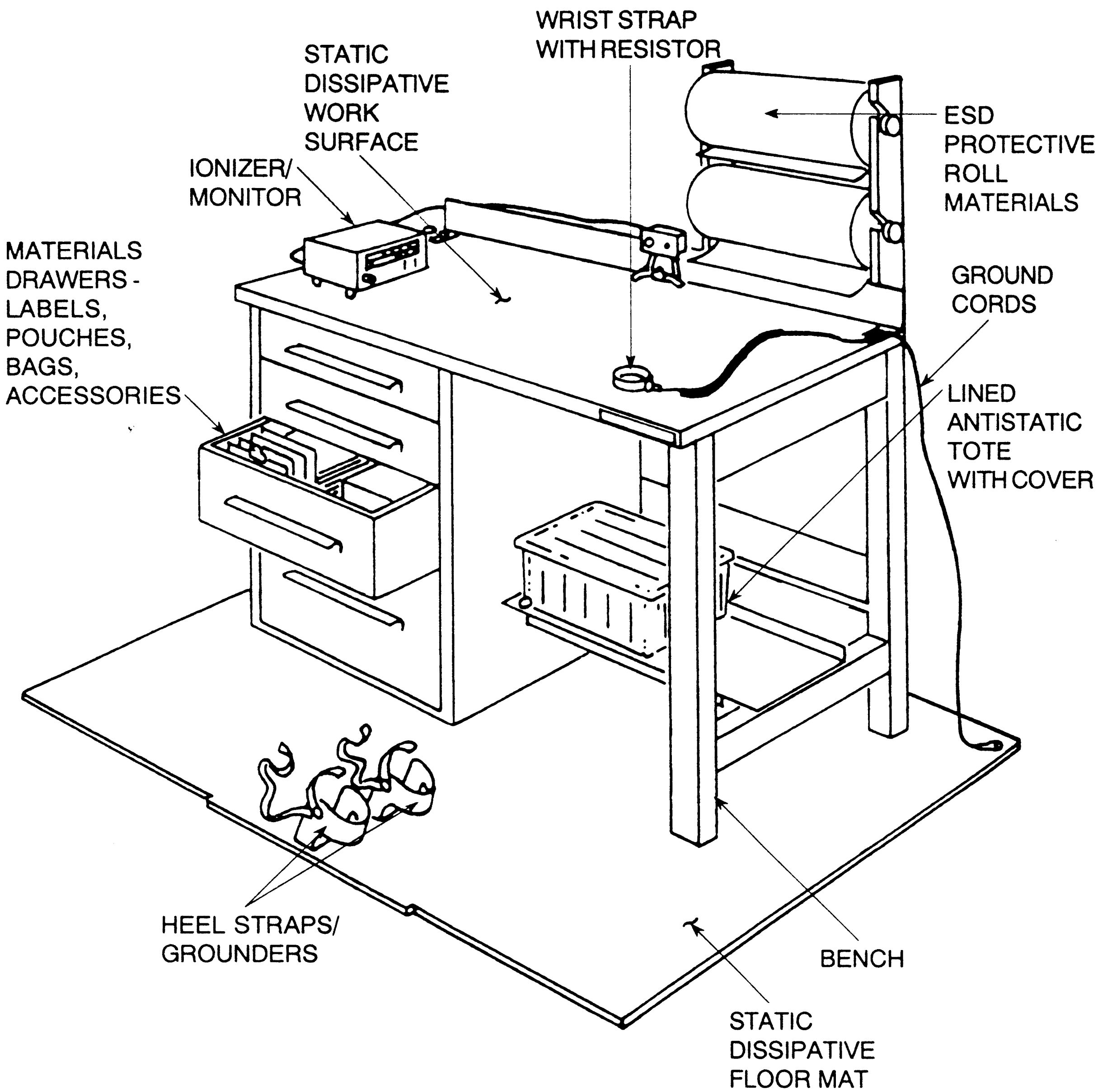
e. Do not perform stretch or shrink-wrapping operations within the ESD-controlled work area.

f. Do not use waxes, polishes, or similar materials on floormats or tabletops. They may deposit an insulating layer of residue. This reduces or eliminates the effectiveness of the floormat or tabletop. For the same reason, the use of topical antistatic spray is not recommended on packaging materials.

g. Sweep dust and dirt from the tabletop and floormats as often as needed to prevent any accumulation. This will also insulate these surfaces and make them ineffective.

h. Antistatic pouches should be used for technical manuals, drawings, work instructions, etc., rather than plain plastic pouches.

i. Ensure all containers, tools, test equipment, and fixtures are grounded before and/or during use by direct ground or by touching a grounded surface.



NOTE: SPECIAL CHAIRS/STOOLS AND GARMENTS ARE NOT SHOWN

Figure 9-5. Typical ESD Protective Packaging Workstation

j. Avoid friction producing activities near ESD devices. For example, removing smocks, wiping feet, sliding objects over surfaces.

k. Wear cotton smock or other antistatic clothing.

l. Prohibit prime generators (Table 9-2) from ESD areas.

m. Place ESD protective material on grounded surface to remove any charge before opening package.

n. Remove ESD item from package only after grounding and place item on grounded surface.

o. Use noncorrosive ESD protective conductive foam or connect shorting clip, or bars to terminal of ESD device.

p. Perform periodic electrostatic checks to ensure work station meets specification.

9-9.5. Testing and/or Repair Practices.

a. Ensure work area, equipment, and work strap assembly are grounded.

b. Attach wrist strap and place metal tools and accessories on grounded bench surfaces.

c. Place conductive container on bench. Remove component or assembly from package. Remove shorting device if present. Handle components by their body and place 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. Do not use Simpson 260 (or equivalent) multimeter to test parts. Instead use the Fluke 8000A or other high-impedance digital multimeter (DMM).

h. Dielectric strength tests are prohibited.

i. Only the use of anti-static type solvents is allowed.

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. Apply dc voltages prior to applying signal inputs.

n. The use of air to clean components/assemblies is prohibited unless a filtered ionizing air gun is used.

o. Do not use solvent ultrasonic cleaning bath for component assemblies.

p. Device supply connections on the assembly should be made prior to making the ground connection.

q. Cure conformal by normal ambient curing or in an oven that contains grounding provisions to prevent static charge buildup.

9-10. PREVENTION, TREATMENT, AND CONTROL OF CORROSION ON ESD SENSITIVE EQUIPMENT.

9-10.1. General. ESD damage to aircraft electrical/electronic devices can be caused by voltage or current depending on the item's composition and construction. This damage can be caused by direct contact or by the electrostatic field associated with other charged items. It is important to note that some modern military circuits are sensitive to voltages as low as 25 volts. The threshold of sensitivity or voltage level required for a human being to feel a static discharge is approximately 3500 volts. Therefore, ESD devices can be damaged by maintenance personnel without their knowledge. ESD control measures must be employed to minimize the impact of ESD damage on aircraft electrical/electronic parts, assemblies, and equipment.

9-10.2. Corrosion Preventive Maintenance and Control. ESD devices must be protected from static fields and/or static discharge when being transported, handled, or stored. The following preventive measures will help provide this protection.

a. Handle ESD devices only at protected work stations. These sites eliminate all sources of ESD with good grounding techniques by electrically bonding all the surfaces, tools, and furnishings together. A protective stool should also be used and any support equipment (soldering irons, text fixtures, test equipment, lights, etc.) must be grounded.

b. ESD devices should be covered or packaged in ESD-protective packaging when not being handled.

c. Conductive carriers protect static sensitive devices by shielding them from static. These carriers are used to transport, store, and ship static sensitive devices and should be placed on a conductive table top. This allows safe removal of their contents. Example of conductive carriers are conductive trays, boxes, and containers.

d. Shunting mechanisms short circuit all the leads of a device. This enables the entire device to be at the same electrical potential and prevents ESD. Shunting mechanisms for discrete components include shorting clips, rings, and conductive foam. Conductive shunt bars are a type of shunting mechanism for printed circuit boards (PCBs).

e. Nonconductive objects that can generate and hold different static potentials on different areas on their surface are poor conductors and cannot be grounded.Static neutralizing equipment should be used to eliminate static charges on nonconductive objects. Use of an ionized air blower will neutralize static charge by continuously blowing a cloud of ionized air over the surface.

f. Personnel should not wear synthetic fiber clothes. Cotton clothes with short sleeves or a cotton smock over clothing are recommended.

g. Work areas shall be clear of static hazards such as ordinary plastics, coffee cups, and candy wrappers.

h. Personnel shall only use uninsulated hand tools when working with electrostatic sensitive devices. Don't use plastic-coated tweezers, plastic lead-forming tools, or plastic solder suckers. Also, personnel shall use only natural bristle brushes.

9-10.3. ESD Protective Systems Corrosion Repair and Treatment. Corrective maintenance of ESD protection systems depends on the type of protection system involved, size of the damaged area, and degree/type of corrosion. Control, treatment, and repair measures must be employed to minimize the impact of corrosion on ESD protection systems. Maintenance personnel should refer to Chapters 6 and 8 and the applicable service directives for specific repair procedures.

CHAPTER 10
EMERGENCY ACTION FOR SERIOUS CORROSION OF AVIONIC EQUIPMENT

10-1. GENERAL.

a. This chapter describes emergency corrosion cleaning and treatment procedures to be followed after aircraft accidents. Particular incidents involving exposure to gross amounts of salt water, fire extinguishing agents, industrial pollutants, soot, smoke, etc. It is imperative that immediate action be taken to remove, clean, dry, and preserve all affected avionic equipment. When removal of this equipment is impractical, cleaning, drying, and preserving efforts shall be performed aboard the aircraft.

b. Steps outlined in the emergency procedures are normally used only in preventing further corrosion damage. Affected equipment will usually require further treatment at a higher level of maintenance. Treated equipment that is of questionable operating status should be forwarded to the nearest Intermediate Maintenance Activity (IMA). This will enable further cleaning, drying, preservation, inspection, and operational check. Equipment damaged beyond the capability of local repair shall be cleaned, preserved, packaged, and forwarded to the appropriate repair activity. Equipment shall be screened and repaired in accordance with the applicable service directives.

10-2. EMERGENCY RECLAMATION TEAM.

NOTE

In cases involving aircraft accidents, permission must be obtained from senior member of the accident investigation board, prior to start of emergency procedures.

10-2.1. Goal of Emergency Reclamation Team. The primary goal of the emergency reclamation team is to accomplish the necessary salvage operations after an aircraft accident. This includes the associated corrosion control efforts.

10-2.2. Emergency Reclamation Team Organization. Each reporting custodian shall designate a Corrosion Control Officer, whose duties include organizing and supervising the emergency reclamation team. Maintenance control will direct the team to accomplish salvage operations or corrosion control action. The size and composition of the team depends on the urgency of the situation and/or workload. Additional personnel, if required, will be selected and placed under the direction of the Corrosion Control Officer. In case of fire damage, the Material Engineering Division of the cognizant activity must be contacted. This group will determine the effects of heat or excessive salt water contamination prior to continued use/repair of affected parts.

10-3. EMERGENCY PREPARATIONS.

10-3.1. Removal Priority. Emergency preparations shall include the preparation of priority lists for removal of equipment, emergency reclamation team planning, tools, materials, and equipment availability. For more specific information on removal of the avionic equipment, refer to NAVAIR 01-1A-509 (Navy), TO 1-1-691 (Air Force), or TM 55-1500-344-23 (Army).

CAUTION

Magnesium parts are particularly susceptible to corrosion attack while exposed to salt water, water immersion, or fire extinguishing agents. Avionic equipment known to contain magnesium components shall be given high priority emergency procedures. The procedure for identification of magnesium is contained in paragraph 5-3.1.

10-3.2. Equipment Replacement. Various degrees of damage will be encountered when equipment is exposed to salt water, water immersion, or fire extinguishing agents. Each maintenance officer shall prepare or have access to a list of equipment indicating removal priority. This information shall be used to make the decision to retain or replace equipment. Special attention shall be given to the availability of replacement parts, capability of the repair facility, and importance of continuing flight operations. In the event of an aircraft mishap, reclamation of the aircraft is secondary to preserving evidence necessary to support the Accident Investigation Board and associated engineering investigations. Emergency procedures shall not commence until authorized.

10-3.3. Required Tools, Materials, and Equipment. Immediate availability of the necessary corrosion control tools, materials, and equipment will significantly aid in reducing further damage. Refer to material and equipment lists in Appendixes A and B. Certain special items of equipment which will be useful and should be readily available are:

a. Dry Nitrogen Source.

b. Dry Air Source.

c. Vented Drying Oven (Forced Air).

d. Vented Drying Ovens (Bulb Type).

e. Hot Air Blowers (Appendix B, Item 16 and Item 17).

f. Pump, Backpack (Appendix B, Item 11).

g. Clean Empty 55 Gallon Drums.

10-3.4. Production Planning. Whenever possible, all salvageable components of the aircraft shall be treated simultaneously. The most experienced personnel available shall be assigned to disassemble and process the aircraft. This will minimize damage and ensure that the work is accomplished in a thorough and competent manner. Whenever possible, examination and evaluation personnel shall be assigned to work with the disassembly and preservation crew. This enables unreclaimable items to be scrapped immediately and only areas exposed to corrosive agents to be disassembled and treated. The time saved by this procedure may be utilized in preserving salvageable components.

10-4. EMERGENCY CLEANING PROCEDURES.

CAUTION

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

10-4.1. General. Where possible, the primary method of emergency cleaning (refer to paragraph 10-4.2) shall be used. One of the alternate methods of emergency cleaning shall be used when a sufficient quantity of fresh water is not available.

10-4.2. Primary Method. The primary method for removing salt water and fire extinguishing agents shall be used when a sufficient quantity of fresh water is available.

a. Flush all internal and external areas with clean, fresh water. Whenever possible, units or components 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 equipment back and forth to aid in draining off excess water

CAUTION

Compressed air used for drying can create airborne particles that may enter the eyes. Pressure shall not exceed 10 psi. Eye protection is required.

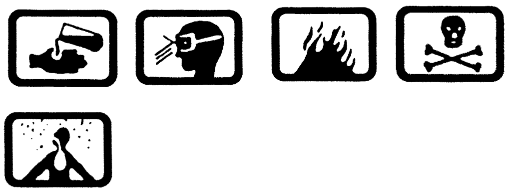
b. Blow off excess water with not more than 10 psi air pressure or dry nitrogen. Deflect jet of air off interior, back, and sides of enclosures to diffuse.

c. If any evidence of salt or fire extinguishing agents remain, a second cleaning action should be initiated, using a solution of one part Aircraft Cleaning Compound, MIL-PRF-85570, Type II (Appendix A, Item 11), to ten parts of distilled water. Scrub the affected areas with the solution. Flush thoroughly with fresh water and drain excess. The equipment may be immersed in fresh water to aid in removing hidden contaminants. Tilt the equipment back and forth to aid in draining excess water.

d. Blow off excess water as specified in step b.

10-4.3. Alternate Methods.

10-4.3.1. Solvent Method.



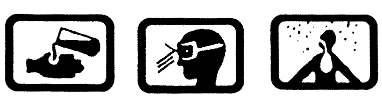
Solvent Degreasing 7

a. If soil or soot remain on external equipment chassis, scrub the affected areas using Paint Brush (Appendix B, Item 2) and Solvent, MIL-PRF-680, Type III (Appendix A, Item 14) or Solvent (Appendix A, Item 12).

b. Collect excess solvent and dispose as hazardous waste.

c. Clean as specified in paragraph 10-4.2. steps c and d.

10-4.3.2. Aircraft Cleaning Compound Method.



Compound, Aircraft Cleaning 4

a. Dip a cloth or brush in mixture of one part Aircraft Cleaning Compound, Class I, MIL-PRF-85570, Type II (Appendix A, Item 11), in nine parts water. Rub over affected exterior and interior areas until contaminants become intermixed or emulsified. Wipe off thoroughly with Cleaning Cloth, CCC-C-46, Class 7(Appendix A, Item 23), removing both contaminant and cleaner.

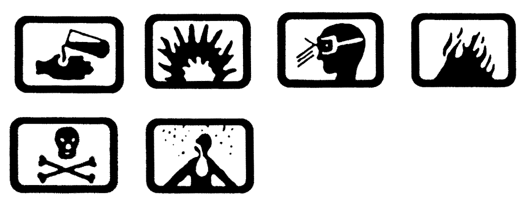
CAUTION

Compressed air used for drying can create airborne particles that may enter the eyes. Pressure shall not exceed 10 psi. Eye protection is required.

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

10-4.3.3. Water-Displacing Method. The water-displacing method is to be used as a last resort and only for temporary preservation prior to thorough cleaning. Water-Displacing Corrosion Preventive Compound, Ultra-Thin Film, MIL-C-81309, (Appendix A, Item 16), will deposit a nonconductive film. This film must be removed for proper function of contact points and other electromechanical devices where no slipping or wiping action is involved. Tag equipment with appropriate marking and indicate application of the corrosion preventive compound. This compound is easily removed with Dry Cleaning Solvent, P-D-680, Type III (Appendix A, Item 14).

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



Compound, Corrosion Preventive, Water-Displacing 3

b. Totally immerse equipment in a 55-gallon drum of Water-Displacing Corrosion Preventive Compound, Ultra-Thin Film, MIL-C-81309, (Appendix A, Item 16). If immersion is not possible, spray, brush, or wipe the interior and exterior of equipment with water-displacing corrosion preventive compound.

10-5. EMERGENCY DRYING AND PRESERVATION.

10-5.1. General. Drying and preservation are essential to eliminate any traces of water and control corrosion until equipment is received at next higher level of maintenance.

10-5.2. Drying and Preservation Procedures. The following drying and preservation procedures shall be used in accordance with availability of special equipment.

10-5.2.1. Vented Drying Oven (Forced Air).

CAUTION

Compressed air used for drying can create airborne particles that may enter the eyes. Pressure shall not exceed 10 psi. Eye protection is required.

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

b. For all avionic components and electrical connectors, apply by spraying Water-Displacing Corrosion Preventive Compound, Ultra-Thin Film, Avionics Grade, MIL-C-81309, (Appendix A, Item 16).

c. Dry the equipment at approximately 130°F (54°C) for 1 to 2 hours.

10-5.2.2. Vacuum Oven Drying.

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

b. Dry the equipment at approximately 130°F (54°C) and a minimum of 25 in. Hg for 1 to 2 hours.

c. After completion of drying step for all avionic components, apply Water-Displacing Corrosion Preventive Compound, Ultra-Thin Film, Avionics Grade, MIL-C-81309, (Appendix A, Item 16).

10-5.2.3. Vented Drying Oven (Bulb Type).

a. Procedure shall be as specified in paragraph 10-5.2.1.

b. Dry the equipment at approximately 130°F (54°C) for 4 to 6 hours.

10-5.2.4. Hot Air Blower.

a. Procedures shall be in accordance with paragraph 10-5.2.1.

b. Dry the equipment with a Hot Air Blower (Appendix B, Item 16).

10-5.2.5. Heated Compartment.

a. Procedure shall be in accordance with paragraph 10-5.2.1.

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

10-6. ORGANIZATIONAL/UNIT LEVEL EMERGENCY CLEANING PROCEDURES.

WARNING

Ensure that all electrical power is disconnected from the aircraft and all systems in the aircraft are deactivated and disarmed. Disconnect all batteries. Voltages used may cause severe shock or death on contact. Use caution and avoid contact with energized components.

10-6.1. Removable Avionic Equipment. Inspect equipment for damaged seals, smoke, heat, and fire damage. Obtain maximum available engineering assistance to determine extent of damage. Most avionic equipment contains dissimilar metals and particular attention shall be given to dissimilar metal joints. If contaminated avionic equipment can be immediately inducted into the IMA for expeditious cleaning and repair, then drying and preservation steps are not necessary. However, if induction directly into the IMA for early cleaning and repair is not possible, then proceed with drying and preservation procedures as specified in paragraph 10-5.2. Equipment exposed to salt water, water immersion, and fire extinguishing agents shall be cleaned as follows:

a. Electrically ground the aircraft.

b. Turn off all electrical power and disarm aircraft, including ejection seat. Disconnect all batteries.

c. The emergency removal priority list shall be as contained in NAVAIR 01-1A-509 (NAVY only). Inspect equipment to determine extent of damage. Remove contaminated equipment as soon as possible.

d. Remove all covers, modules, and component, (which are normally removed).

e. Tilt the equipment back and forth to allow accumulated water to drain off.

f. Examine the individual items thoroughly for evidence of salt water, fire extinguishing agents, smoke, oil films, etc.

g. Items that are contaminated shall be cleaned using the primary method (paragraph 10-4.2) whenever possible.

h. If the primary method cannot be followed, use one of the alternate methods specified in paragraph 10-4.3.

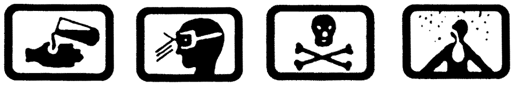
10-6.2. Removal and Cleaning of Identification/ Modification Plates. The following procedures are applicable for cleaning identification and modification plates:

NOTE

If sealant (adhesive) is undamaged, do not remove identification plate. Removable plates shall be removed.

a. As appropriate, remove plates.

b. Thoroughly clean plates and mounting areas as specified in paragraphs 10-4.2 or 10-4.3.



Sealing, Compound 2

c. After cleaning, allow plates and mounting areas to dry. Apply coat of Sealing Compound, MIL-PRF-81733 (Appendix A, Item 29), and reinstall identification plates.

10-6.3. Hermetically Sealed Avionic 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 air-tight integrity of the seal. The presence of air bubble will positively indicate a faulty seal.

a. Clean as specified in paragraph 10-4.2 or 10-4.3, as applicable.

b. Dry and preserve as specified in paragraph 10-5.2.

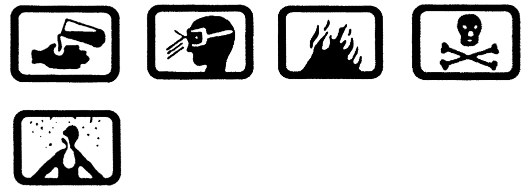
c. There are exceptions to this cleaning procedure, such as hermetically sealed pressurized units that would not be contaminated unless the unit had lost its internal pressure. Units showing evidence of damage to seals shall be forwarded to the next higher level of maintenance for disposition.

10-6.4. Electric Motors and Generators. Cleaning is an essential preliminary procedure in salvaging electric motors, generators, inverters, miniature synchro transmitters, and receivers.

a. Clean using the primary method, paragraph 10-4.2.

b. Dry and preserve as specified in paragraph 10-5.2.

c. Inspect equipment to determine whether it is to be used or removed and forwarded to the IMA. Carefully check the equipment with sealed bearings. These bearings are not necessarily waterproof and may require replacement by the designated repair facility.



Solvent, Degreasing 7

d. Equipment shall be deemed serviceable after emergency preservation by the Organizational/Unit Maintenance Activity. Remove the water-displacing corrosion preventive compound with Solvent, MIL-PRF-680, Type III (Appendix A, Item 14).

10-6.5. Cockpit Area Components. The cockpit area contains various types of components. Nonremovable components and equipment shall be cleaned and preserved as specified in paragraphs 10-6.9 through 10-6.14. Removable components shall be cleaned and preserved as follows:

a. Remove all control boxes, equipment, relay boxes, and indicators.

b. Examine all equipment and components for evidence of salt water, fire extinguishing agents, smoke, oil films, etc.

c. Items that are contaminated shall be cleaned using the primary method, paragraph 10-4.2.

d. Dry and preserve as specified in paragraph 10-5.2.

e. Special attention shall be given to cockpit electrical connectors. Clean and preserve connectors as specified in paragraph 10-6.13.

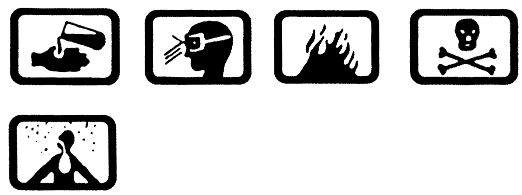
f. Cockpit circuit breakers, toggle, rotary, interlock, and pushbutton switches shall be cleaned/preserved as specified in paragraph 10-6.6

10-6.6. Switches and Circuit Breakers. Switches such as toggle, rotary, interlock, pushbutton, cam operated, and circuit breakers vary in shape and size. Most switches are enclosed in a sealed case. Cleaning of internal parts is not possible. Exposed areas such as terminal posts, toggles, pushbuttons, or rotary switches shall be cleaned and preserved as follows:

a. Remove contamination with fine spray of fresh water. The use of Acid Brush, A-A-289 Style opt. (Appendix B, Item 1), will help dislodge contaminants.

b. Rinse with a fine spray of fresh water.

c. Blow excess water from the switches and circuit breakers with not more than 10 psi dry air pressure. Wipe with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23), to reduce drying time.



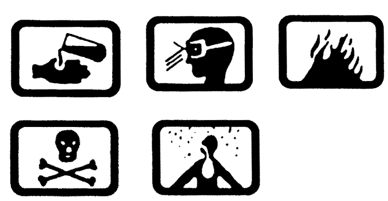
Solvent, Degreasing 7

CAUTION

Compressed air used for drying can create airborne particles that may enter the eyes. Pressure shall not exceed 10 psi. Eye protection is required.

d. To remove stubborn oil and grease stains, use Solvent, MIL-PRF-680, Type III (Appendix A, Item 14), applied with Acid Brush, A-A-289 Style opt., (Appendix B, Item 1).

e. Dry as specified paragraph 10-5.2, excluding the application of water-displacing corrosion preventive compounds.



Solvent, Degreasing 7

NOTE

In each case after application of water-displacing corrosion preventive compound, on toggle, rotary, interlock, pushbutton, cam operated switches, or circuit breakers, it is necessary to remove the preservative from sliding contacts, contact points, circuit breaker points, etc.

f. Wipe sliding contacts, contact points, circuit breaker points, etc, with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23). Ensure the removal of all traces of water-displacing corrosion preventive compounds. Solvent, MIL-PRF-680, Type III (Appendix A, Item 14), can be used to remove these preservatives.

10-6.7. Antennas. For maximum efficiency, antennas and their insulators must be free of contaminants. For more efficient cleaning, it may be necessary to remove the antenna according to instructions in applicable service directives. In-place cleaning and preservation may be accomplished as follows:

a. Check antenna insulators for damage or cracks before cleaning. Replace if found defective.

Compound, Aircraft Cleaning 4

b. Brush or spray a mixture of one part Aircraft Cleaning Compound., Class 1, MIL-PRF-85570 (Appendix A, Item 11), to nine parts water on antenna surfaces. Scrub the area with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23).

c. Wipe antenna surfaces with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23).

d. Rinse with clean, fresh water. Wipe excess water with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23).

e. Let antenna air-dry.

f. Preserve and reseal antenna to airframe as specified in Chapter 6.

10-6.8. Mounting Racks and Shock Mounts. Mounting racks and shock mounts shall be cleaned and preserved as follows:

a. Remove the mounting racks, shock mounts, and associated hardware.

b. Clean as specified in paragraph 10-4.2.

c. Inspect for signs of damage. Replace accordingly.

d. Dry as specified in paragraph 10-5.2 excluding the use of water-displacing corrosion preventive compound.

e. Preserve mounting racks, shock mounts, and associated hardware with a thin film of Water-Displacing Corrosion Preventive Compound, MIL-C-81309 (Appendix A, Item 16).

f. Tag the units to be shipped to the IMA for further disassembly, cleaning, preservation, repair, and operational check. The tag will indicate the type of cleaning, drying, and preservation method used. This is in accordance with NAVAIR 01-1A-509 (NAVY only). Refer to Water/ Crash/Fire Damage Form, NAVAIR 3750/1 (Rev. 10/98) 0102-LF-994-3300, Pg 50.

NOTE

The emergency cleaning, drying, and preservation of equipment bays and airframe structures shall be in accordance with applicable NAVAIR 01-1A-509 (Navy), TO 1-1-1-691 (Air Force), and TM 55-1500-344-23 (Army).

10-6.9. Nonremovable Avionic Equipment. Those nonremovable avionic components exposed to salt water or fire extinguishing agents shall be cleaned as follows:

a. Electrically ground the aircraft.

WARNING

Ensure that all electrical power is disconnected from the aircraft and all systems in the aircraft are deactivated. Disconnect all batteries. Voltages used may cause severe shock or death on contact. Use caution and avoid contact with energized components.

b. Turn off all electrical power and disarm aircraft, including ejection seats. Disconnect and remove all batteries.

c. Refer to emergency priority list in NAVAIR 01-1A-509 (Navy only).

d. Open all equipment bay doors. Remove all access panels, equipment, and components that are normally removed.

e. Examine all nonremovable avionic equipment and components for evidence of salt water, extinguishing agents, smoke, oil films, etc.

f. Items that are contaminated shall be cleaned using the primary method in paragraph 10-4.2, whenever possible. Ensure that areas behind and under mounting structures/components are thoroughly cleaned.

g. If the primary method cannot be followed, use on of the alterntae methods specified in paragraph 10-4.3.

10-6.10. In-place Cleaning. If cleaning must be accomplished while the equipment is installed, the use of Pump, Backpack (Appendix B, Item 11), is recommended for flushing inaccessible areas.

10-6.11. Drying and Preservation of Nonremovable Avionic Equipment. In most cases the only technique for drying installed, nonremovable avionic equipment is through the use of Hot Air Gun, Raychem, HT-900 (Appendix B, Item 17), or air drying. where specified.

CAUTION

Compressed air used for drying can create airborne particles that may enter the eyes. Pressure shall not exceed 10 psi. Eye protection is required.

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

b. Dry the equipment with Hot Air Gun, Raychem HT-900 (Appendix B, Item 17).

c. After drying, preserve a specified in paragraph 10-5.

d. Wipe off excess with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23).

10-6.12. 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 shall be cleaned according to the following procedures:

a. Remove covers and access panels.

b. Clean using the primary method in paragraph 10-4.2.

c. Dry the equipment with Hot Air Gun, Raychem, HT-900 (Appendix B, Item 17), excluding the application of water-displacing corrosion preventive compound.

d. Preserve as specified in paragraph 4-7.7.

e. Check the terminal boards and junction boxes for loose mountings, loose or broken connections, cracks, and breaks, before returning equipment to service.

10-6.13. Electrical Connectors and Receptacles. Electrical connectors and receptacles require special procedures for cleaning and preservation. Connectors and receptacles that cannot be opened and separated for cleaning shall be cleaned and inspected in place under the direction of the Maintenance Officer. Clean and preserve electical connectors and receptacles as follows:

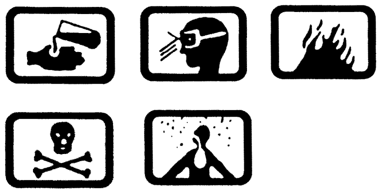
a. Disconnect and disassemble connectors and receptacles to release entrapped contaminants.

b. Rinse with fresh water.

CAUTION

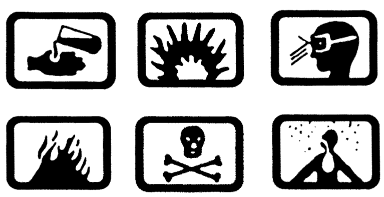
Compressed air used for drying can create airborne particles that may enter the eyes. Pressure shall not exceed 10 psi. Eye protection is required.

c. Blow excess water from the connectors or receptacles with not more than 10 psi low-pressure clean, dry air/dry nitrogen. Wipe with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23), to reduce drying time.



Solvent, Degreasing 7

d. To remove stubborn oil and grease stains, use Solvent, MIL-PRF-680, Type III (Appendix A, Item 14), applied with Acid Brush, A-A-289 style opt. (Appendix B, Item 1), or Brush, Typewriter, A-A-3077, Type T (Appendix B, Item 4), followed by wiping with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23).



Compound, Corrosion Preventive, 3
Water-Displacing

e. Apply a light film of Water-Displacing Corrosion Preventive Compound, Ultra-Thin Film Avionics Grade, MIL-C-81309, (Appendix A, Item 16). Avoid excessive applicaiton of preservative; wipe off excess with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23).

f. Dry as specified in paragraph 10-5.2. Connectors and receptacles may be allowed to air dry.

g. Reapply a light film of Water-Displacing Corrosion Preventive Compound, Ultra-Thin Film, Avionics Grade, MIL-C-81309, (Appendix A, Item 16).

h. Prior to connecting threaded sections of connectors plugs and receptacles, lubricate threaded area with Water-Displacing Corrosion Preventive Compound, Ultra-Thin Film Avionics Grade, MIL-C-81309, (Appendix A, Item 16).

10-6.14. Wire Harnesses and Cables. Electrical wire harnesses and cables exposed to salt water or fire extinguishing agents shall be cleaned and preserved according to the following procedures.

a. Remove the strap hangers.

CAUTION

Compressed air used for drying can create airborne particles that may enter the eyes. Pressure shall not exceed 10 psi. Eye protection is required.

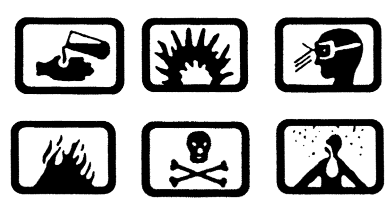
b. If possible, separate wiring. Rinse with fresh water to wash away entrapped contaminants. Blow excess water from wiring with not more than 10 psi clean dry air or dry nitrogen.

c. Open and separate connectors. Raise and position connector to facilitate thorough rinsing with fresh water and minimize the forcing of contaminants into connectors. If the cable harness is encased, the exterior will be flushed with fresh wataer to dislodge accumulated salt desposits. Blow excess waer from the cable with not more than 10 psi clean dry air or dry nitrogen.

d. Wipe with Cleaning Cloth, CCC-C-46, Class 7 (Appendix A, Item 23), to reduce drying time.

e. Cables and harnesses readily removable from the aircraft shall be dried as specified in paragraph 10-5.1.

f. Cables and harnesses not readily removable from the aircraft shall be dried with Hot Air Gun, Raychem, HT-900 (Appendix A, Item 17).



Compound, Corrosion Preventive, 3
Water-Displacing

g. Apply Water-Displacing Corrosion Preventive Compound, Ultra-Thin Film, Avionics Grade, MIL-C-81309, (Appendix A, Item 16) to metal components.

10-7. INTERMEDIATE LEVEL EMERGENCY CLEANING PROCEDURES.

10-7.1. GENERAL. The initial emergency salvage steps taken at the Organization/Unit level are only designed to stop further corrosion damage. Particularly, avionic equipment exposed to salt water, water immersion, or fire extinguishing agents. The ability to immediately induct avionic equipment into the IMA for cleaning, drying, preservation, repair, and operational check is limited. In many cases, the equipment may not be accessible for some time depending upon an Accident Investigation Board. It is essential that the IMA be ready to provide services after major multi-aircraft incidents.

10-7.2. Emergency Reclamation Team. The Intermediate Maintenance Activity Emergency Reclamation Team Officer will assist the Maintenance Control Officer in establishing an initial screening of avionic equipment. Both officers will determine the condition of each piece of equipment and the Intermediate Maintenance Activity will have the capability to execute further reclamation. Repairable equipment damaged beyond the capability of local repair shall be cleaned, preserved, packaged and forwarded to the appropriate maintenance repair facility for screening and repair in accordance with applicable service directives.

NOTE

Units to be shipped to the appropriate maintenance repair facility for further disassembly, cleaning, preservation, repair, and operational check shall be tagged. The tags will indicate the type of cleaning and preservation used in accordance with NAVAIR 01-1A-509 (Navy only). Water/Crash/Fire Damage Form, NAVAIR 3750/1 (Rev. 10/98) 0102-LF994-3300, Pg 50, and Water/Crash/Fire Damage Form label NAVAIR 4035/13 (Rev. 6/98) 0102-LF-994-2800 Pg. 50. Post on outside of shipping container of damaged part.

10-7.3. Initial Screening Procedure. Avionic equipment that is damaged beyond local repair capability must be inspected to see if adequate cleaned and preserved. Equipment shall be cleaned and preserved, as appropriate, prior to packaging and shipment to the repair activity. Each piece of avionic equipment will be screened to determine the following:

a. Extent of damage.

b. Local repair capability.

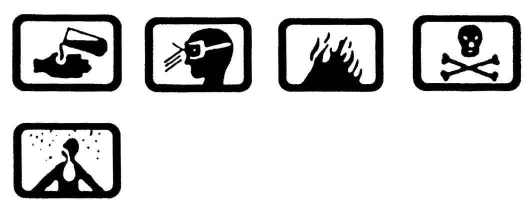
c. Cleaning method.

d. Drying method.

e. Preservation method.

10-7.4 Cleaning Priority. After initial screening, cleaning priority will be established by the IMA Emergency Reclamation Team Officer.

10-7.5. Disassembly Inspection Procedure. The extent of damage by smoke, heat, or flame must be determined. Most avionic equipment contains dissimilar metals and particular attention shall be given to dissimilar metal joints. Equipment exposed to salt water, water immersion, and fire extinguishing agents shall be inspected as follows:



Solvent, degreasing 7

a. Remove Corrosion Preventive Compounds, MIL-C-81309, MIL-C-85054, and MIL-PRF-16173 with Solvent, MIL-PRF-680, Type III (Appendix A, Item 14) to facilitate inspection.

b. Remove all covers, access panels, modules, and normally removed components.

c. Examine the individual items thoroughly for evidence of salt water, fire extinguishing agents, smoke, oil films, heat, and fire damage.

d. Examine the individual items for evidence of corrosion.

e. Examine encapsulated and conformal coated laminated circuit boards for damage caused by salt water, fire extinguishing agents, and cleaning solvents. Pay particular attention to conformal coatings and circuit board laminates that are discolored, softened, or deformed.

f. Examine electrical cables, wires, and harnesses for signs of damage and deterioration from cleaning solvents. Pay particular attention to any signs of softened or cracked wire coating.

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

h. Examine hermetically scaled components for damage and signs of deterioration from cleaning solvents. Pay particular attention to hermetically sealed pressurized equipment. Broken sealed units shall be forwarded to next higher level of maintenance if considered beyond local repair capability.

i. Examine electric motors, generators, inverters, miniature synchro transmitters, and receivers for damage. Pay particular attention to lubricated fittings and sealed bearings.

j. Examine control boxes for damage and signs of deterioration from cleaning solvents. Pay particular attention to faceplates, seals, and rubber boots around toggle switches and knobs.

k. Examine shock mounts, mounting racks, cases, chassis, and cover plates for buckling, disfiguration, and fire damage. Check painted surfaces for cracks or nicks. Pay particular attention to rubber shock mounts.

l. Disassemble and inspect all components for smoke and heat damage.

10-7.5.1. Undamaged Items. Items that show no signs of damage or corrosion shall be functionally checked. This shall be done as specified by the applicable service directives. Equipment shall be put back into service in accordance with established procedures.

10-7.5.2. Damaged Items. Those items that show damage shall be repaired as specified by the applicable service directives.

10-7.6. Emergency Cleaning and Preservation Procedures. The cleaning and preservation procedures shall be as follows:

a. Equipment exposed to salt water, water immersion, or fire extinguishing agents and cleaned at the Organizational/Unit Maintenance Activity, shall be inspected as specified in paragraph 10-7.5. General corrosion removal and preservation shall be as specified in Chapter 5.

b. Equipment exposed to salt water, water immersion, or fire extinguishing agents and not cleaned at the Organizational/Unit Maintenance Activity, shall be cleaned as specified in paragraph 10-4.2.

(1) Where possible, use the primary cleaning method outlined in paragraph 10-4.2.

(2) On equipment to be put back into service, dry as specified in paragraph 10-5.2. Preserve as specified in Chapter 5.

(3) On equipment to be sent to depot for processing, dry and preserve as specified in paragraph 10-5.2.

APPENDIX A
CONSUMABLE SUPPLIES AND MATERIALS

A-1. INTRODUCTION.

This appendix lists the accepted consumable supplies and materials available for avionic corrosion control.

A-2. SCOPE.

Table A-1 provides consumable supplies and materials used for avionic cleaning and corrosion control. Nonmenclature, specification/part number, national stock number (NSN), unit of issue and intended use of material are provided. Items are located by function in the following groupings.

a. Abrasives

b. Cleaning compounds and solvents

c. Corrosion preventive compounds

d. Lubricating oils and greases

e. Cleaning cloths

f. Sealants

g. Potting compounds

h. Masking materials and tapes

i. Conformal coatings

j. Neutralizing agents

k. Paint, primer, and stripper

l. Packaging materials

m. Tracers

A-3. DESCRIPTION.

Consumable materials of a particular specification are provided in various sized containers. If the particular sized container required is not available/listed, request the next size container under the same specification from the Supply Department.

Table A-1. Avionic Cleaning/Corrosion Removal Materials

ITEM NO.	NOMENCLATURE	SPECIFICATION	NATIONAL STOCK NO.	UNIT ISSUE	INTENDED USE
ABRASIVES					
1	Abrasive Mat, Aluminum Oxide Abrasive	A-A-58054 Type I, Grade A, Class I (Very Fine) or A-A-58054 Type I, Grade B, Class 1 (Fine)	5350-00-967-5089 5350-00-967-5093	Pkg. of 10, 9" x 6" pads Pkg. of 10, 9" x 6" pads	Aluminum oxide impregnated nylon webbing used for removal of dirt and corrosive products from external avionic chassis, covers, mountings, hardware, antennas, electrical connector shells, etc.
2	Intentionally left blank				
3	Cleaning and Polishing Pad, Non-Abrasive		7920-00-151-6120	Pkg. of 10, 5" x 11" pads	Avionic washing pad used for removal of dirt and contaminants from internal avionic structures, laminated circuit boards, waveguides, TR tubes, cavities, circuit components, relay contacts, control box faceplate, etc.
4	Cloth, Abrasive Aluminum Oxide	ANSI-B74.18 320 Grit, Type I, Class 1; Type I, Class 2; Type I, Class 2	5350-00-246-0330 5350-00-187-6289 5350-00-229-3092	Pkgs., 50 sheets, 9" x 11" Roll, 2" x 50 yd. Roll, 3" x 50 yd.	Removal of heavy corrosive products from steel, iron, aluminum, and magnesium structures, mountings, racks, chassis, covers, scuff sanding of avioinic boxes prior to painting, etc. CAUTION: Do not use Silicon Carbide Abrasive Cloth, ANSI-B74.18.
5	Eraser, Magic Rub, Plastic	(Block Shape)	7510-00-949-5055	Doz., 2" x 5/8" x 1/2"	Removal of light tarnish on silver. Removal of light corrosion on copper, zinc, nickel, etc. For brightening of gold. CAUTION: Only to be used if component is sufficiently rigid to resist rubbing motion.
6	Eraser, Ruby Red	(Block Shape)	7510-00-223-7046	Doz. 2-1/4" x 1-1/8" x 11/16"	Removal of medium tarnish on silver. Removal of medium corrosion on copper, zinc nickel, etc. For brightening of gold. CAUTION: Only to be used if component is sufficiently rigid to resist rubbing motion.
7	Eraser, Wood or Paper Encased	(Pencil Shape)	7510-00-582-3756	Doz., 7" x 3/16" dia.	Removal of medium tarnish and corrosion products in tight areas. CAUTION: Care should be taken not to remove thinly plated surfaces.
8	Eraser, Typewriter	(Pencil Shape)	7510-00-619-7714	Doz., 6" x 3/16" dia.	Removal of heavy tarnish on silver. Removal of heavy corrosion on copper, zinc, nickel, etc. For brightening of gold. CAUTION: Care should be taken not to remove thinly plated surfaces.
CLEANING COMPOUNDS AND SOLVENTS					
CAUTION Cleaning solvents may react with coatings and circuit components. When in doubt as to reaction, test the affected area prior to wholesale application of the solvent.					

Table A-1. Avionic Cleaning/Corrosion Removal Materials (Continued)

ITEM NO.	NOMENCLATURE	SPECIFICATION	NATIONAL STOCK NO.	UNIT ISSUE	INTENDED USE
9	Intentionally left blank				
10	Detergent, Liquid Nonionic	MIL-D-16791, Type I	7930-00-282-9699 7930-00-985-6911	Can, 1 gal. Can, 5 gal.	For cleaning and polishing transparent plastic and glass. Note: Mix 1 oz. per gal. water. Apply with cloth, cotton flannel, CCC-C-458, Type II. When dry, wipe with dry flannel cloth. Also used as a detergent in the Aqueous Ultrasonic Cleaner and Aqueous Spray Cleaning Booth.
11	Cleaning Compound	MIL-PRF-85570, Type II	6850-01-235-0872	Can, 5 gal.	General cleaning. For removal of soil and fire extinguishing chemicals. Excellent cleaner for light oils and hydraulic fluids. It can be used in areas of reduced ventilation.
12	Cleaning Solvent	Envirosolv 654CR	6850-01-388-9803 6850-01-388-9732		For use in ultrasonic cleaning. Or as wipe solvent.
		Vertrel	open purchase		For use as wipe solvent for cleaning electronics
		PD-108	open purchase		For use as wipe solvent for heavy oils and greases
		Ethyl Lactate/Mehtyl Soyate (Vertec)	open purchase		For parts cleaning and degreasing
		Novec Engineered Fluids	open purchase		These fluids contain hydrofluoroethers for cleaning/degreasing. Cleaning electrical contacts. Use as wipe solvent or as spray.
13	Cleaning Compound, Avionics components non-ozone depleting	MIL-PRF-29607			Used for aqueous avionic cleaner designed for batch cleaning processes. It can be used in heated (up to 140°F) or unheated tanks. Parts must be rinsed well and air dried or dried in a force draft oven at 120°F.
13A	Cleaning and cleaning-lubricating compounds, electrical contact, low ozone depletion potential	MIL-PRF-29608 Type I or II, Class C and L	6850-01-412-5579	12 oz aerosol can	Used for the cleaning of electrical contacts and switches. It is intended for the removal of aircraft avionics soils, salt, dielectric fluid and hydraulic fluid. Class C is used for cleaning of electrical contacts.
		Type I, Class C	(open purchase)		

Table A-1. Avionic Cleaning/Corrosion Removal Materials (Continued)

ITEM NO.	NOMENCLATURE	SPECIFICATION	NATIONAL STOCK NO.	UNIT ISSUE	INTENDED USE
14	Intentionally left blank				
15	Isopropyl Alcohol	TT-I-735	6810-00-286-5435 6810-00-855-6160 6810-00-983-8551 6810-00-753-4993	Can, 1 gal. Can, 5 gal. Can, 1 qt. Can, 8 oz.	For removal of fungus and bacteria. For removal of solder flux residue. For removal of contaminants on microminiature circuit components. For general cleaning and removal of salt residue and contaminants on circuit components. WARNING: Flash point is 53°F (12°C).
CORROSION PREVENTIVE COMPOUNDS (PRESERVATIVE)					
WARNING Do not use Corrosion Preventive Compounds around oxygen, oxygen fittings, or oxygen regulators, since fire or explosion may result.					
16	Corrosion Preventive Compound, Water-Displacing, Utra-thin Film, Avionics Grade	MIL-C-81309 Type II or III, Class 2 (Aerosol) Class 1 (Bulk)	8030-00-546-8637 8030-00-262-7358 8030-00-524-9487	Aerosol can, 16 oz. Can, 5 gal. Drum, 55 gal.	Water-displacing corrosion preventive on highly critical metal surfaces. For use on electrical connectors in interior areas.
16A	Corrosion Preventative Compound, water displacing, clear (amlguard)	MIL-C-85054, Type I, Class Optional Type II	8030-01-066-3971 8030-01-347-0981	Can, 12 oz. Can, 1 qt.	For corrosion prevention on metals, on paint, scratches, or other areas of bare metal. Not for use around oxygen lines, fittings or gauges.
17	Corrosion Preventive Compound, Solvent Cutback Cold Application	MIL-PRF-16173, Grade 4 (Transparent Film)	8030-00-526-1605 8030-00-062-5866 8030-00-903-0931	Can, 5 gal. Can, 1 gal. Can, 1 pint	Preservative material, thin, 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					
18	Lubricating Oil, General Purpose, Preservative (Water-Displacing	VV-L-800	9150-00-231-9062 9150-00-231-6689 9150-00-273-2389 9150-00-458-0075	Can, 5 gal. Can, 1 qt. Can, 4 oz. Aerosol can, 16 oz.	General lubrication and protection of avionic components, hinges, and quick release devices. Suitable for use where a general purpose lubricating oil with low temperature and corrosion preventive properties is desired.

Table A-1. Avionic Cleaning/Corrosion Removal Materials (Continued)

ITEM NO.	NOMENCLATURE	SPECIFICATION	NATIONAL STOCK NO.	UNIT ISSUE	INTENDED USE
19	Grease, Instrument, Ultra-clean	MIL-G-81937	9150-01-009-6235	Tube, 4 oz.	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.
20	Lubricating Oil, Instrument, Ball Bearing, High Flash Point	DOD-L-81846	9150-00-238-5203	Bottle, 4 oz.	For use in precision instruments and miniature ball bearings. Temperature range of -65°F (-54°C) to 302°F (150°C).
21	Grease, Aircraft, General Purpose, Wide Temperature Range	MIL-PRF-81322	9150-00-145-0268 9150-00-181-7724	Can, 5 lb. Tube, 8 oz.	For use on blower motors, servomotors and gyro spin motors.
22	Lubricating, Solid Film, Air-Cured, Corrosion Inhibiting	MIL-L-23398	9150-00-954-7422 9150-00-754-0064	Can, 1 qt. Aerosol can, 12 oz.	For use on aluminum, aluminum alloys, copper and copper alloys, steel, stainless steel, titanium, and chronmium and nickel bearing surfaces. For use on sliding motion applications such as locks, small internal cables, plain and spherical bearings, flap tracks, hinges, threads, and cam surfaces. For use in mechanisms that are lubricated for life and in mechanisms operated at in-frequent intervals. CAUTION: Not to be used in operations consisting of rotary motion over 100 RPM under heavy loads where the possibility of conventional fluid lubricants contamination exists. Not to be used on bearings containing rolling elements.
CLEANING CLOTHS					
23	Cloth, Non-Woven Fabric	A-A-162, Class 7	7920-01-180-0556	Box 2700/ pkg.	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 avionic 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).
24	Cloth, Cleaning, Lint-free	A-A-59323 Type I A-A-59323 Type II	7920-00-165-7195 7920-00-044-9281	Box, 10 lb. Box, 10 lb.	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 cleanroom applications. CAUTION: Not authorized to be used with solvents having flash points of less than 100°F (38°C); such use may result in fire.

Table A-1. Avionic Cleaning/Corrosion Removal Materials (Continued)

ITEM NO.	NOMENCLATURE	SPECIFICATION	NATIONAL STOCK NO.	UNIT ISSUE	INTENDED USE
25	Cheesecloth, 100% Cotton	A-A-1491	8305-00-267-3015 8305-00-205-3496 8305-00-205-3495	Bolt, yd. Bolt, 10 yd. Bolt, 100 yd.	Moderate lint, high absorbency, and disposable. For general cleaning on external surfaces of avionic equipment. For use as tackrag and final wipe prior to painting.
26	Cloth, Flannel	A-A-50129	8305-00-641-5606	Bolt, 50 yd.	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 to be used for cleaning plastic and acrylics with solvents with a flash point less than 100°F (38°C).
SEALANTS					
CAUTION RTV silicone sealants, adhesives, and coatings that contain acetic acid curing agents are not authorized for use in avionic, electronic, or electrical equipment.					
27	Adhesive- Sealant, Silicone, RTV, Non-Corrosive, 3145 RTV	MIL-A-46146	8040-00-145-0020 8040-00-938-1535	Tube, 3 oz. Kit, 12 oz. Kit	For use on sensitive metals and avionic equipment. Sealing areas where temperature is expected to be between 250°F (121°C) and 350°F (177°C).
28	Sealing Compound	MIL-S-83318	8030-00-474-1419	Kit, 6 oz.	A quick cure sealant that contains corrosion inhibitor. For use in sealing gaps, seams, etc. during extreme cold weather activities.
29	Sealing and Coating Compound, Corrosion Inhibitive	MIL-PRF-81733, Grade B Class Optional (Brush application)	8030-00-753-5009 8030-00-723-5343 8030-00-723-5344	Kit, 6 oz. Kit, 1 pt. Kit, 1 qt.	Sealing of gaps, seams and faying surfaces on high performance aircraft. For use up to 250°F.
POTTING COMPOUND					
CAUTION Potting Compounds Pro-Seal 777A/B (green) and EC-2273 (black) revert to liquid after a year or two, depending on environment, and are not authorized for use in electrical connectors and avionic equipment.					
30	Sealing Compound, Synthetic Rubber, Accelerated	MIL-PRF-8516, Type II (24 hr. cure) (48 hr. cure) (72 hr. cure)	8030-00-881-2618 8030-00-181-7884 8030-00-881-5238 8030-00-297-6677 8030-00-174-2597 8030-00-616-7696 8030-00-684-8790	Kit, 2.5 oz Kit, 6 oz. Kit, 1 qt. Kit, 1/2 pt. Kit, 1 qt. Kit, 1/2 pt. Kit, 1 qt.	For sealing low voltage electrical connectors, wiring and other electrical apparatus against moisture and corrosion where temperature does not exceed 200°F (93°C). Good resistance to gasolines, oils, grease, water and humidity. CAUTION: Not authorized for use in engine bays, keel areas or areas adjacent to bleed air ducts.

Table A-1. Avionic Cleaning/Corrosion Removal Materials (Continued)

ITEM NO.	NOMENCLATURE	SPECIFICATION	NATIONAL STOCK NO.	UNIT ISSUE	INTENDED USE
MASKING MATERIALS AND TAPES					
31	Preservation and Sealing Tape, Pressure Sensitive Adhesive	SAE-AMS-T-22085 Type II	7510-00-852-8179 7510-00-852-8180 7510-00-926-8939 7510-00-916-9659	Roll, 1” Roll, 2” Roll, 3” Roll, 4”	For holding barrier material in place during shipping. Treated, non-corrosive, non-fungus supporting. For use on equipment without overcoatings.
32	Tape, Pressure Sensitive Adhesive, paper Masking, Nonstaining	SAE-AMS-T - 21595, Type I	7510-00-680-2450 7510-00-685-4963 7510-00-680-2395 7510-00-680-2471	Roll, 1/2” x 60 yd. Roll, 1” x 60 yd. Roll, 2” x 60 yd. Roll, 3” x 60 yd.	For masking of undamaged areas during paint touch-up on equipment cases, covers, mounting rack, etc. For masking electrical and electronic components during replacement of conformal coating and varnishing. CAUTION: Only to be used if components sufficiently rigid to stand application of tape and removal.
33	Tape, Pressure Sensitive Adhesive for Masking During Paint Stripping Operations	SAE-AMS-T-23397, Type II	7510-00-473-9513	Roll, 2” x 60 yd.	For masking during paint stripping operations on avionic equipment and airframe structures.
34	Tape, Pressure Sensitive	A-A-59298	7510-00-472-4021	Roll, 1” x 72 yd.	For isolating dissimilar metals where galvanic action may take place in avionic equipment.
35	Insulating Tape Electrical, Self Bonding, Silicone	604-1 Black 604-2 Red	5970-00-955-9976 5970-00-949-4846	Roll Roll	
36	Paper, Kraft, Untreated, Wrapping	A-A-203	8135-00-160-7766 or 8135-00-290-3407 8135-00-160-7771	Roll, 24” x 820’ Roll, 24” x 980’ Roll, 36” x 700’	Protection of surrounding areas during paint spray operations.
CONFORMAL COATING					
NOTE Materials listed are for general purpose use in conformal coated circuit boards. For special applications on highly critical components, refer to the appropriate equipment manual.					
37	Epoxy Coating, Two Part Application	Hysol 0151	8040-00-061-8303	Kit, each	For coating and patching epoxy and parylene coated circuit boards and components.
38	Polyurethane Coating (Brush Application)	Humiseal 1A27	5970-00-995-3652 5970-01-036-4488	Can, 1 qt. Can, 12 oz. aerosol	For coating and patching polyurethane and varnish coated circuit boards and components.
39	RTV Coating Nonflowable (Brush Application), 738 RTV (White)	MIL-A-46146	8040-00-118-2695	Tube, 3 oz.	For coating and patching RTV coated circuit boards and components. NOTE: Not flowable into crevices and hard to reach areas.

Table A-1. Avionic Cleaning/Corrosion Removal Materials (Continued)

ITEM NO.	NOMENCLATURE	SPECIFICATION	NATIONAL STOCK NO.	UNIT ISSUE	INTENDED USE
40	RTV Coating, Flowable (Brush Application), 3140 RTV (Clear)	MIL-A-46146	5970-00-110-8234 5970-00-791-3716	Can, 1 lb. Tube, 3 oz.	For coating and patching RTV coated circuit boards and components. NOTE: Use in applications where a flowable material is required such as potting connectors.
41	Acrylic Coating	Humiseal IB15H	5790-00-990-4924	Aerosol can, 16 oz.	For coating and patching of acrylic and lacquer coated circuit boards and components.
42	Varnish	ASTM D3955	8180-00-180-6343 5970-00-285-0269 5790-00-285-0271	Can, 1 qt. Can, 5 gal. Can, 1 gal.	Moisture and fungus resistant varnish for electrical equipment and for clear coating on copper. For coating and patching of varnish coated circuit boards. Thinner: Thinner, Synthetic, Resin, Enamels, ASTM D263.
NEUTRALIZING AGENTS					
43	Sodium Bicarbonate, Technical	ASTM D928	6810-00-264-6618 6810-00-290-5574	Box, 1 lb. Bag, 100 lb.	For neutralizing spilled sulfuric acid (electrolyte) in lead acid battery installations. For neutralizing leaking tantalum capacitors in avionic equipment.
44	Sodium Phosphate, Monobasic, Anhydrous, Technical	AWWA-B504	6810-00-281-1858	Bag, 100 lb.	For neutralizing spilled potassium hydroxide (electrolyte) in nickel-cadmium and silver-zinc battery installations. Also used as abrasive material in the Mini-Abrasive Unit.
45	Chemical Conversion Material for Coating Aluminum and Aluminum Alloys Touch-n-prep pen	MIL-C-81706 Class 1A Class 3 (Avionic Grade)	8030-00-142-9272 8030-00-823-8039 8030-01-460-0246	Can, 1 pt. Can, 1 gal. Can, 1 lb.	Treatment of bare aluminum. For all small touch up
46	Chemical Conversion Material for Coating Magnesium Alloy	SAE-AMS-M-3171 Type VI (Macro Mag D-19)	(Available from MacDermid Inc., Waterbury, CT)	Bottle, 1 pt.	Treatment of bare magnesium.
47	Boric Acid	A-A-59282	6810-00-264-6535	lb.	For neutralizing electrolyte leakage from nickel-cadmium batteries.
PAINT, PRIMER, AND STRIPPER					
48	Epoxy Primer Water Reducible	MIL-PRF-85582 Type I Type II	8010-01-218-0856 8010-01-218-0857	Kit, 1 pt. Kit, 1/2 gal. each	Covers low moisture sensitivity corrosion inhibited primers. Intended for spray application on surface treated metal.

Table A-1. Avionic Cleaning/Corrosion Removal Materials (Continued)

ITEM NO.	NOMENCLATURE	SPECIFICATION	NATIONAL STOCK NO.	UNIT ISSUE	INTENDED USE
49	Coating Aircraft Touchup	MIL-PRF-81352 (Instrument) (Black-color number 37038) (Dark Gull Gray - color number 36231) (Red - color number 31136) (White - color number 37875) MIL-PRF-81352 (Orange/Yellow - color number 33538)	8010-00-830-1822 8010-00-935-7079 8010-01-150-9907 8010-01-124-5048 8010-00-530-6383 8010-00-068-8778 8010-01-157-2292	Can, 1 gal. Can, 16 oz. Can, 1 gal. Can, 16 oz. Can, 1 qt. Can, 1 gal. Can, 1 gal.	Use for cockpit instrument, control box, and avionic box touch-up. For equipment markings. Thinner: Thinner, Acrylic Nitrocellulose Lacquer, A-A-857.
50	Epoxy Paint Remover	MIL-R-81294	8010-00-926-1489 8010-00-926-1488 8010-00-181-7568 8010-00-142-9273	Drum, 55 gal. Drum, 5 gal. Can, 1 gal. Can, 1 pt.	Removal of paint finishes.
51	Thinner, Acrylic Nitrocellulose Lacquer	A-A-857	8010-00-160-5788 8010-00-160-5789	Can, 5 gal. Drum, 55 gal.	For thinning, MIL-PRF-81352 lacquers, MIL-PRF-22750 epoxy topcoats, and MIL-PRF-23777 primer.
52	Primer Coating, Epoxy Polyamide	MIL-PRF-23377 Type I Type II	8010-00-142-9279 8010-00-935-7080 8010-01-437-8657 8010-01-417-1215	Kit, 1 pt. 12 each Kit, 1/2 gal., each Kit, 4 qt. 1 gal.	Cover low moisture sensitivity corrosion inhibited primers. Intended for spray application on surface treated metal.
53	Coating, Epoxy-Polyamide	MIL-PRF-22750 (Flat Black - color number 37038) (White Highgloss Insignia - color number 17925) (Flat Black - color number 37038) (White Insignia - color number 17925) (Flat Dark Gull Gray - color number 36231) (Flat Dark Gull Gray - color number 36231)	8010-00-441-5932 8010-01-419-1164 8010-01-419-1142 8010-01-419-1153 8010-01-414-8446 8010-01-441-5921	Kit, 1 qt. each (compnt 1&2) Kit, 1 gal. each (compnt 1&2) Kit, 1 qt. each (compnt 1&2) Kit, 1 qt. each (compnt 1&2) Kit, 1 qt. each (compnt 1&2) Kit, 1 qt. each (compnt 1&2)	Use as topcoat on all avionic equipment. NOTE: Mix only materials from the same kit (the brand and batch number on the pigmented compound can must be the same as those on the converter can).

Table A-1. Avionic Cleaning/Corrosion Removal Materials (Continued)

ITEM NO.	NOMENCLATURE	SPECIFICATION	NATIONAL STOCK NO.	UNIT ISSUE	INTENDED USE
54	Thinner, Paint, Petroleum Spirits	A-A-2904	8010-00-290-4079 8010-00-242-2089 8010-00-558-7026 8010-00-246-6112	Can, 1 qt. Can, 1 gal. Can, 5 gal. Can, 1 gal. (heavy thinner)	For aircraft topcoat application (avionics), 420 grams/liter maximum VOC. For ground support equipment application, 340 grams/liter maximum VOC.
55	Coating, Polyurethane High Solids	MIL-PRF-85285, Type I (Aircraft Black - color number 37038) (Interior Aircraft Gray - color number 26231) (Aircraft White - color number 17925) (Aircraft Red - color number 11136)	 8010-01-285-3554 8010-01-285-3555 8010-01-285-2489 8010-01-285-3035 8010-01-265-9143 8010-01-265-9154	 Kit, 2 qt. Kit, 2 gal. Kit, 2 gal. Kit, 2 qt. Kit, 2 gal. Kit, 2 qt.	For aircraft topcoat application (Avionics) 420 grams/liter maximum VOC. For ground support equipment application, 340 grams/liter maximum VOC.
56	Sempen	MIL-PRF-85285	Open purchase		For small areas.
57	Coating Aliphatic, Polyurethane, Chemical Agent Resistant	MIL-C-46168			
58	Thinner, Synthetic Resin, Enamels	ASTM D263	8010-00-160-5791 8010-00-087-1953 8010-00-160-5794 8010-00-558-7027 8010-00-254-4218	Can, 1 pt. Can, 1 qt. Can, 1 gal. Drum, 5 gal. Drum, 55 gal.	Use for thinning varnish ASTM D3955. CAUTION: Do not use in lacquers.
59	Thinner, Aliphatic Polyurethane Coatings	MIL-T-81772 Type I	8010-00-181-8080 8010-00-181-8079 8010-00-280-1751 8010-01-200-2637 8010-01-212-1704 8010-01-168-0684 8010-01-165-6760	1 gal 5 gal. Drum, 55 gal. Container, 1 gal. Container, 5 gal. Drum, 55 gal. Container, 1 gal.	Used for thinning MIL-PRF-85285 polyurethanes, MIL-PRF-22750 epoxy polyamide coatings, MIL-PRF-81352 acrylic nitrocellulose lacquers, and MIL-PRF-23377 epoxy polyamide primers.
PACKAGING MATERIALS					
60	Polyethylene Foam	A-A-59135 A-A-59136 Type II	8135-01-088-6582	6’ x 1/4” 36	For cushioning equipment, and protection against shock on shelves, work benches, pallets, etc. Use double layers for heavy equipment.

Table A-1. Avionic Cleaning/Corrosion Removal Materials (Continued)

ITEM NO.	NOMENCLATURE	SPECIFICATION	NATIONAL STOCK NO.	UNIT ISSUE	INTENDED USE
61	Cushioning Material, Plastic Open Cell		8135-01-057-3607	4'x 1/4" x 500'	To protect ESDS items from damage due to shock, vibration, corrosion, and abrasion during handling and shipment.
62	Cushioning Material, Cellular Plastic Film (Bubble Wrap)	A-A-549, Class 1	8135-00-142-9005 8135-00-142-9008 8135-00-142-9016 8135-00-142-9004	12" x 500' x .188" 16" x 500' x.188" 24" x 500' x .188" 48" x 250' x .5"	For cushioning equipment, and protection against shock. Provides limited protection against moisture. Seal with Pressure Sensitive Tape, SAE AMS-T-22085.
		PPP-C-795, Class 2	8135-01-235-9142	48" x 500' x .188"	
63	Unicellular Polypropylene Packaging Foam	PPP-C-1797	8135-00-300-4904	12" x 1/8" x 450'	Lint-free, non-dusting, non-abrasive. For cushioning equipment, and protection against shock. Provides protection against moisture. Use in conjunction with Barrier Material, Water Vapor Proof, MIL-PRF-131. Seal with Pressure Sensitive Tape, SAE AMS-T-2085.
64	Bags, Plastic (General Purpose)	A-A-1799	8105-00-837-7753 8105-00-837-7754 8105-00-837-7755 8105-00-837-7756 8105-00-837-7757	4" x 4", pkg. of 1000 6" x 6", pkg. of 1000 8" x 8", pkg. of 1000 10" x 10", pkg. of 500 12" x 12", pkg. of 500	For protecting miniature and microminiature circuit components and laminated circuit boards against moisture and contamination. Considered for short term, temporary protection during maintenance operation.
65	Barrier, Material, Water Vapor Proof, Grease Proof, Flexible, Heat Sealable	MIL-PRF-131	8135-00-282-0565	Roll, 36" x 200 yd., over 10 lb/40cu. in.	For protecting miniature and microminiature circuit components, laminated circuit boards, and critical avionic components, against moisture and contamination. heat sealable, protects material during transportation and storage under all weather conditions.
66	Barrier Material, Watervapor, Proof, Electro-static Protective, Electrostatic and Electromagnetic Shielding	MIL-PRF-81705, Type I	8135-00-092-3220	Roll, 36" x 600 ft.	To provide ESD/EMI packaging protection for hardware and components. May be used for long or short term protection. Seal with heat seal.

Table A-1. Avionic Cleaning/Corrosion Removal Materials (Continued)

ITEM NO.	NOMENCLATURE	SPECIFICATION	NATIONAL STOCK NO.	UNIT ISSUE	INTENDED USE
66 (Cont)	Barrier Material, Transparent, Waterproof, Electrostatic Protective, Static Dissipative	MIL-PRF-81705, Type II	8135-01-158-7786 8135-01-163-3486	Sheet, 48” x 48” Sheet 24” x 36”	
TRACER					
67	Indicator, Thymol Blue Reagent	A-A-59282	6810-00-664-1622	Bottle, 25 ml	For detecting reverse voltage damage to wet-slug tantalum capacitors. (Dissolve 1/4 teaspoon of Indicator in three 8-oz. cups of deionized or distilled water to which eight drops of Ammonium-Hydroxide, O-A-451 has been added.) Also used as a Nicad electrolyte indicator.
67A	Litmus Paper	Blue Litmus Paper Red Litmus Paper	6640-00-290-0146 6640-00-290-0147	HD(100) HD(100)	Color change to red indicates acid present (lead acid batteries) Color change to blue indicates alkali (base) present (nickel cadmium batteries)
68	Desiccant, Bagged	MIL-D-3464, Grade A	6850-00-264-6754 6850-00-264-6571 6850-00-264-6572	Drum 500 each 4-unit bags Drum, 300 each 8-unit bags Drum 150 each 16-unit bags	Absorbs moisture, lowers relative humidity when sealed in container.
69	Humidity Indicators	AN7511-1	6685-00-752-8240	Can, 125 cards	Used to determine that desiccant, within a package, is sufficiently active to maintain a relative humidity below that at which corrosion will occur.
70	Water, Distilled		6810-00-107-1510	Container, 5 gal.	Used for cleaning in critical soldering operations.
71	Ammonium Hydroxide, Technical	A-A-59370	6810-00-584-3793	Bottle, 1 pt.	Used to assist in dissolving Indicator, Thymol Blue Reagent, A-A-59282.
72	Intentionally left blank				
73	Glass Beads	SAE AMS 2431	5350-00-576-9634	Bag, 50 lb.	Used as abrasive in hand-held tool in Blast Cleaning Cabinet (Appendix B, Item 29).
74	Silver Nitrate	A-A-59282	6810-00-282-1218	1 lb.	Identification of magnesium metal.
75	Silver Nitrate, Solution		6810-00-233-0126	Bottle, 4 oz.	Identification of magnesium metal.
76	Damping Fluid	VV-D-1078 Grade 100/ 100K cs	9150-00-269-8246	5 gal.	Lubricant for use on small switches and potentiometers where a residual lubricant is required after cleaning.

APPENDIX B
TOOLS AND SUPPORT EQUIPMENT

B-1. INTRODUCTION.

This appendix lists the accepted corrosion removal and cleaning tools available for avionic corrosion control Table B-1 provides tools and support equipment used in the avionic cleaning and corrosion control The column headings list nomenclature, specification/part number, national stock number (NSN), unit of issue, and intended use. The appendix includes the following types of items:

a. Cleaning accessories

b. Corrosion removal accessories

c. Conversion coating accessories

d. Lighting accessories

e. Painting accessories

f. Safety accessories

g. Sealing accessories

Table B-1. Accessories for Avionic Corrosion Control

ITEM NO.	NOMEN-CLATURE	SPECIFI-CATION	NATIONAL STOCK NO.	UNIT ISSUE	INTENDED USE
1	Brush, Acid, Swabbing	A-A-289 Style opt.	7920-00-514-2417	Box of 144 (3/8” x 6”)	For cleaning connectors, circuit boards, and small components.
2	Brush, Paint, Metal, Bound Flat		8020-00-263-3866	Each	For paint touch-up. For removal of dirt and soil.
2A	Brush, Artist’s		8020-00-224-8022	Each	For touch-up of small areas of paint damage.
3	Toothbrush		8530-01-293-1387	Dz	For scrubbing dirt, soil, and corrosive products from circuit components.
4	Brush, Typewriter	A-A-3077, Style 1	7510-00-550-8446	Each	For scrubbing dirt, soil, and corrosive products from circuit components.
5	Pipe Cleaners		9920-00-292-9946	Pkg. of 32	For removal of cleaning solvent residues in hard to reach crevices and corners of small components.

Table B-1. Accessories of Avionic Corrosion Control (Continued)

ITEM NO.	NOMEN-CLATURE	SPECIFI-CATION	NATIONAL STOCK NO.	UNIT ISSUE	INTENDED USE
6	Applicator, Disposable, Cotton Tipped		6515-00-303-8250	Pkg. of 100	For removal of cleaning solvent residues on microminiature circuit boards, coaxial connectors, etc.
7	Face shield, Industrial	ANSI Z87.1	4240-00-542-2048	Each	Eye and face protection while using solvents.
8	Goggles, Industrial and Spectacles, All Plastic	ANSI Z87.1	4240-01-243-5805	Pair	Eye protection while using solvents.
9	Gloves, Rubber, Industrial (Synthetic)	ZZ-G-381	8415-00-266-8679 8415-00-266-8677	Pair, size 8, small Pair, size 9, medium	Handling of solvents, paint strippers or other materials which may be injurious to the skin.
10	Magnifying Glass		6650-00-958-7408 6650-00-431-4375	10X illuminated 14X folding	Detailed inspection of corrosion cracks and small surface corrosion damage.
11	Pump, Backpack		4320-00-289-8912	5 gal.	Localized cleaning of aircraft surfaces and equipment bays.
12	Respirator (without cartridge)	465825 (Small) 460968 (Medium) 466486 (Large)	4240-01-150-7937 4240-01-022-8501 4240-01-086-7670	Each Each Each	Personnel protection from organic vapors, dust, and paint sprays in nonconfined areas during spraying operations.
12A	Respirator parts: Cartridge, Organic vapor Prefilter Retainer for prefilter	 464031 465667 448844	 4240-01-230-6892 4240-01-231-0150 4240-01-020-8782	 Box Box Each	For use with above respirators.
13	Vacuum Cleaner, Air Operated			Each	Removal of dirt and debris from cockpit and equipment bays.

Table B-1. Accessories of Avionic Corrosion Control (Continued)

ITEM NO.	NOMEN-CLATURE	SPECIFI-CATION	NATIONAL STOCK NO.	UNIT ISSUE	INTENDED USE
14	Sound Attenuators Aural	SAE AS23899	4240-00-759-3290	Each	Ear protection while using ultrasonic cleaners. WARNING: Earplugs required in addition to sound attenuators. Contact local medical officer.
15	Coveralls, Green	MIL-C-2202	8405-00-131-6507 8405-00-131-6508 8405-00-131-6509 8405-00-131-6510 8405-00-131-6511	Small Medium Large X-Large XX-Large	Corrosion maintenance personnel.
16	Hot Air Gun, Thermogun MODEL -500A	A-A-59435	4940-00-028-7493	Each	For drying equipment and circuit components in shop. WARNING: Not explosion proof, not authorized as drying tool in aircraft application.
17	Hot Air Gun Raychem	(Part Number HT-900)	(Available from Ray Chem Corp.)	Each	Fo drying equipment and components on aircraft.
18	Spatula	A-A-277	7330-00-680-2636	Each	For application of sealing compound, MIL-PRF-81733, Type II.
19	Mirror, Inspection	GGG-M-350	5120-00-278-9926 5120-01-313-4097	Each, 1-1/4” x 1-1/2’ x Each, 1” x 2” x 9”	For inspecting inaccessible areas for corrosion damage and cleaning solvent residues.
20	Pail, Rubber	A-A-59253	7240-00-246-1097	Each, 3 gal.	For hand cleaning operations.
21	Stencil Marking Sets		7520-00-205-1760 7520-00-272-9680 7520-00-298-7043	1/2” set 1-1/2” set 1” set	For equipment markings.
22	Bottle, Plastic Manual Spray Atomizer		8125-00-488-7952	Each, 1 pint	For manual spray application of cleaners and solvents.
22A	Beaker, Poly-ethylene (600 cc.)		6640-00-889-1834	Each	For mixing primers, paints, and hand cleaning small components by immersion.

Table B-1. Accessories of Avionic Corrosion Control (Continued)

ITEM NO.	NOMEN-CLATURE	SPECIFI-CATION	NATIONAL STOCK NO.	UNIT ISSUE	INTENDED USE
23	Dispenser, Alcohol		3439-00-552-9309	Each	For application of cleaning solvents in microminiature shops and avionic shops. Self-sealing top prevent contaimination of fluid from particles, dust, etc., in the atmosphere.
24	Ultraviolet Light, Portable		6635-00-611-5617	Each	For detecting solder flux on miniature and microminiature circuit boards. WARNING: Use with the filter provoided in the kit. Ultraviolet light can be harmful to the eyes. Do not use a cracked, damaged, or undersized filter.
25	Sealing Machine, Electric Jaw Type, Portable (6” Jaw)		3540-00-293-0377	Each	Used on heat sealable, flexible transparent/translucent packaging films.
26	Booth, Cleaning, Water Base Solvent Spray		4940-00-422-1774	Each	For the removal of dirt, dust, salt spray deposits and light corrosion products. For pre-cleaning of components prior to ultrasonic detergent cleaning. For cleaning and rinsing components after ultrasonic detergent cleaning, abrasive corrosion removal and hand cleaning.
27	Drying Oven, Circulating Air	Model 46	4430-01-009-2371 4430-01-097-5087	Each	For drying avionic equipment and components through circulating air and temperature.
28	Drying Oven, Forced Air		4430-01-097-5087 4430-01-097-5088 4430-01-009-2371 4430-01-010-7052	Each	For drying avionic equipment and components through exhausted forced air and temperature.
28A	Portable Steam Cleaner		4940-01-411-8632 4940-01-409-0149 4940-01-411-3278		Associated accessories, cleaning solutions and rust inhibitors shall be ordered as need. For use in cleaning circuit cards and other PWBs.

Table B-1. Accessories of Avionic Corrosion Control (Continued)

ITEM NO.	NOMEN-CLATURE	SPECIFI-CATION	NATIONAL STOCK NO.	UNIT ISSUE	INTENDED USE
29	Cabinet, Blast, Cleaning		4940-00-242-3631	Each	Provides a shielded enclosure for portable honer operation. Used for abrasive cleaning of rust and corrosion products from avionic equipment structures and housings. CAUTION: Do not use on static sensitive devices and micro-miniature components. Do not use same blast media for removal of corrosion products on ferrous metals and non-ferrous aluminum alloys.
30	Paint Spray Booth			Each	Used to provide an enclosure for paint spray operations.
31	Brush, Cleaning	A-A-2074	7920-00-061-0037	Each	For removal of corrosion products and surface contamination from avionic equipment housings, chassis and covers.
32	Spot Touch-Up Spray Gun Draw Tube and Cap Assembly 6 oz. Cup		4949-00-270-1044 4949-00-222-2675 4949-00-272-7998	6 oz.	Priming and painting avionic cases, housing, etc.
33	Air Brush, Artist Model 200		7520-00-939-6179		Touch-up of paint and use with aerosol power unit.
34	Valve, Angle		4820-00-760-5592		Regulating air flow at spray gun.
35	Air Regulator Assembly with gauge, water and oil separator		4940-00-200-2096		Filtering air and regulating pressure for air drying and application of paint.
36	Sealant Gun, Hand Operated (6 oz.)		5120-00-952-3507	Each	Application of sealants.
37	Nozzle, Sealant Gun		5120-00-801-0949 5120-00-773-3791	1/32” orifice 1/8” orifice	For use with sealant gun.

APPENDIX C
SPECIAL SUPPORT EQUIPMENT

C-1. INTRODUCTION.

This appendix lists the special cleaning and corrosion removal tools for use in the avionic corrosion control work center. Table C-1 lists the special cleaning and corrosion removal tools for use in the avionic corrosion control work center. Pending standardization of support equipment to be used for avionic cleaning and corrosion removal, only equipment that meets the general procedures and limitations of paragraphs 4-5.2.2. through 4-5.2.4. should be used.

Table C-1. Avionic Cleaning/Corrosion Removal Special Support Equipment

ITEM NO.	NOMENCLATURE	CHARACTERISTICS
1	Aqueous Ultrasonic Cleaner	• Tank dimensions: 18” wide x 30” long x 18” deep • Overall dimensions: 20” wide x 32” long x 40” high • Power requirements: Single phase/115V/60 Hz/60A • Operating frequency: 20 to 21 KHz (internally adjusted) at an average power to 1500 watts (RMS) • Operating temperature: 130°F (54°C) • Temperature range: 90°F (32°C) to 150°F (66°C)
2	Solvent Ultrasonic Cleaner	• Ultrasonic tank dimensions: 12”wide x 8” long x 12” deep • Vapor degreaser tank dimensions: 12” wide x 8” long x 12” deep • Overall dimensions: 48” wide x 60” long x 47” high • Power requirements: Single phase/230V/50-60Hz/39A • Operating frequency: 40 KHz (internally set) at an average power of 500 watts (RMS) • Operating temperature: 107°F (42°C) • Temperature range: 90°F (32°C) to 150°F (66°C)
3	Portable Mini-Abrasive Unit	• Dimensions: 15” wide x 14” deep x 15” high • Power requirements: Single phase/115V/60Hz/3A • Air source: 40 PSI (low pressure unregulated)

APPENDIX D
TRACK EIGHT CLEANING PROCEDURES

1. GENERAL.

a. The referenced cleaning equipment is representative for these procedures. Suitable substitutes may be used. Figure 1 shows a representative cleaning line layout and typical space requirements. Also included in this supplement are the associated cleaning procedures. A typical portable washer (CTM4) is offered in both automatic and manual models and requires 1 square meter of shop floor space and a 110 or 220 volt source.

b. Although the information presented in this procedure is based upon the evaluation of CHEM-TECH, International Inc. equipment and associated processes, the Track 8 procedures can be tailored to other commercially available equipment and cleaning agents.

2. CLEANING EQUIPMENT.

Refer to Table 1 for the physical characteristics and facility requirements for the Track 8 cleaning line of equipment.

3. TEST CLEANING AGENTS.

WARNING

Some cleaning chemicals may be toxic and flammable. Avoid contact with skin and eyes. Avoid breathing vapors. Use with adequate ventilation. Keep away from heat, sparks and flame. Avoid contact with strong oxidizing agents. Protection: neoprene gloves and chemical goggles; faceshield and protective clothing required when splashing is possible or expected; half-mask respirator with organic vapor cartridge required in poorly ventilated areas.

CAUTION

Unless designated otherwise by the cognizant field activity or manufacturer, spent cleaning materials shall be segregated and stored as regulated waste for ultimate off-site disposition via licensed contractor.

Cleaning Agents. CT-1 is a water-based multi-purpose cleaning detergent used to clean electromechanical and electronic assemblies. CT-2L ia a single step cleaning agent or supplemental treating agent following CT-1 cleaning. CT-2L is a water displacement agent.

4. AVIONIC EQUIPMENT.

CAUTION

Caution shall be exercised to ensure there will be no adverse effects on avionic equipment performance as a result of the cleaning process.

5. TEST EQUIPMENT. Table 1 lists specific cleaning equipment or the respective equivalent referenced for the Track 8 cleaning process.

6. CLEANING PROCEDURES

6.1 Equipment Preparation. A thorough inspection of the item to be cleaned is important to ensure that the process and cleaning agents are compatible with the manufacturer's recommendations.

6.2 Cleaning Agent Preparation. Prepare cleaning agent in accordance with Table 2.

6.3 Cleaning Procedure. There are two batch type Track 8 cleaning procedures: CT-1/CT-2L Cleaning Process and CT-1/CT-2L Cleaning Process with Ultrasonics.

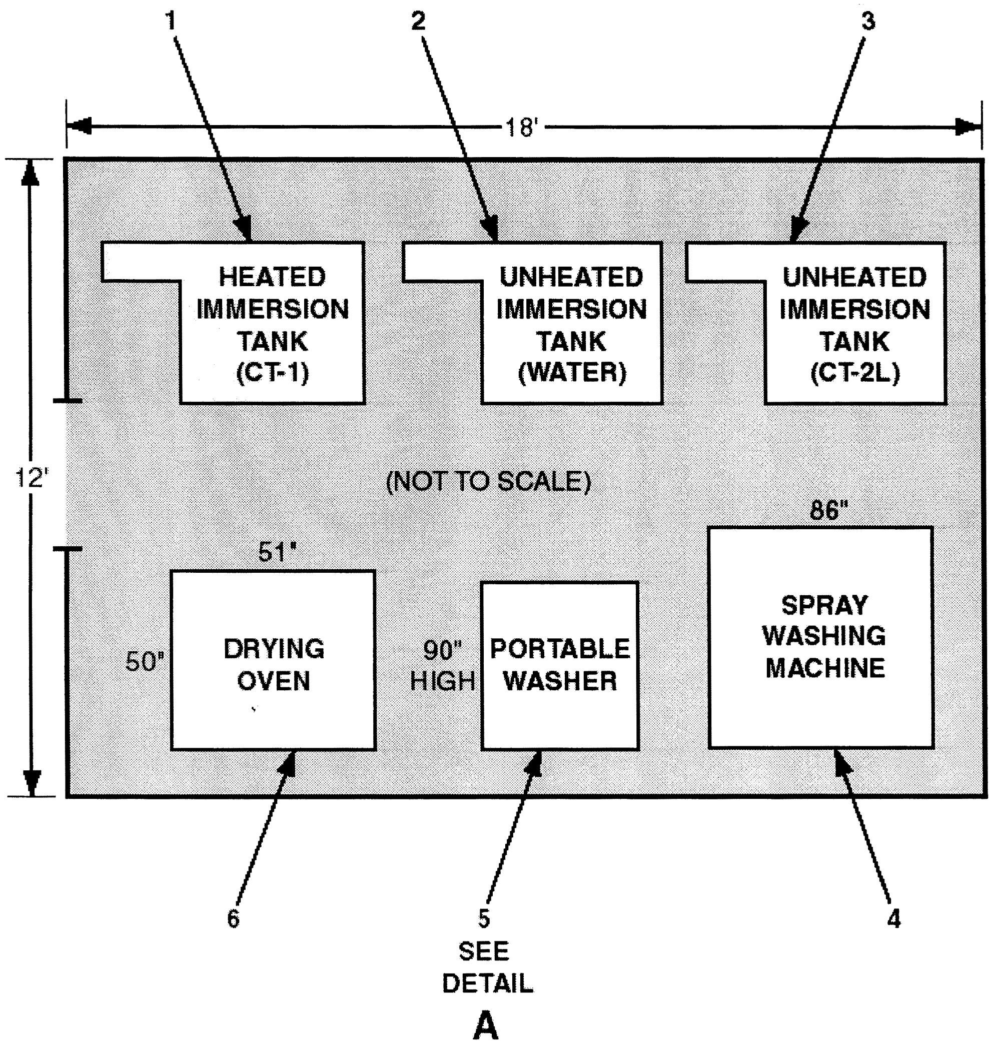
CAUTION

Refer to manufacturer supplied material safety data sheets (MSDS) for applicable usage precautions and appropriate personnel protective equipment.

6.3.1 (CT-1, CT-2L) Cleaning Process.

NOTE

Heated water will accelerate the cleaning process.

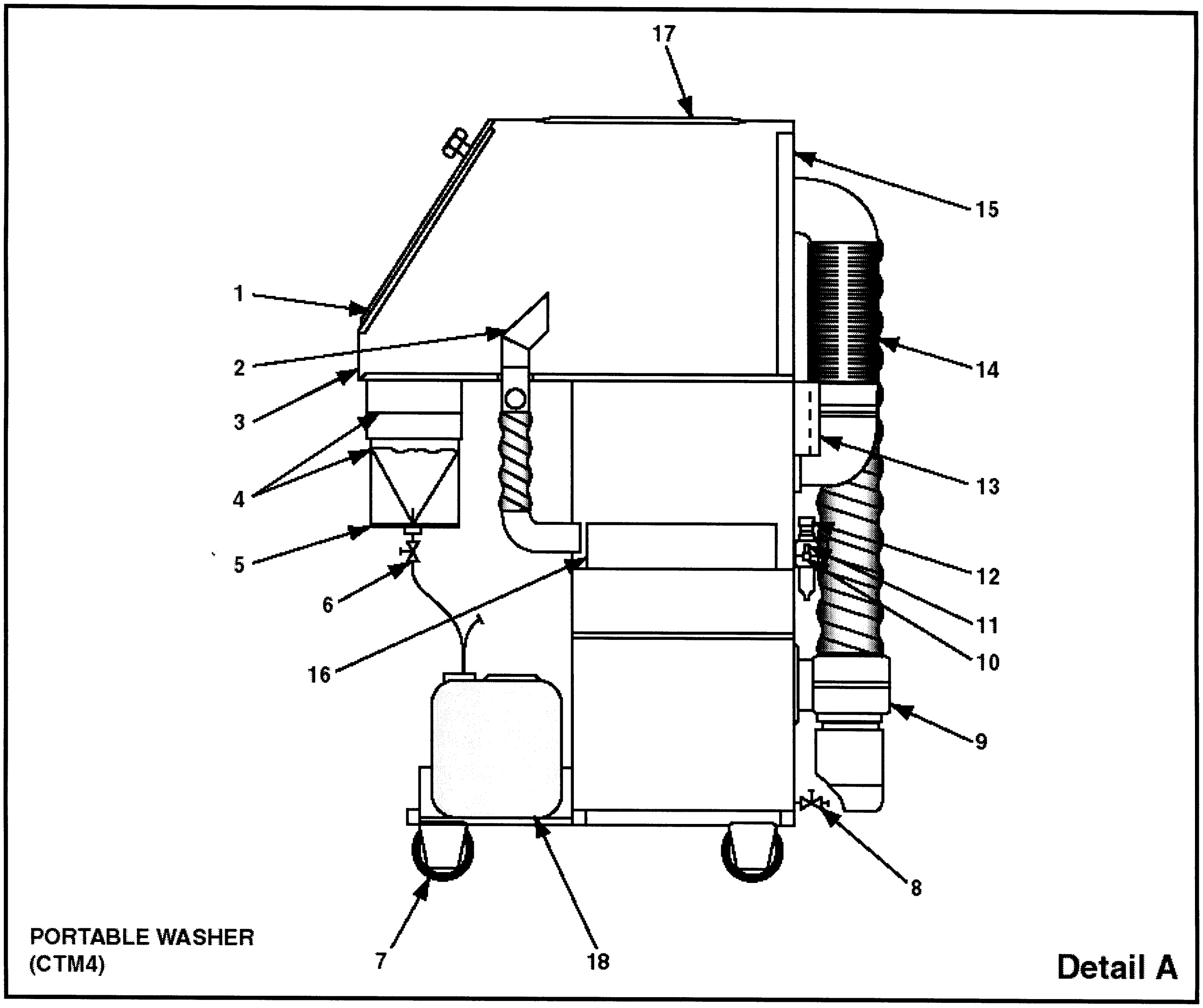


LEGEND:

1. HEATED IMMERSION TANK (CT-1) (CTM1H)
2. UNHEATED IMMERSION TANK (WATER) (CTM1U)
3. UNHEATED IMMERSION TANK (CT-2L) (CTM1U)
4. SPRAY WASHING MACHINE (CTM2)
5. PORTABLE WASHER (CTM4)
6. DRYING OVEN (*CTM444)

*MODEL NUMBER WILL VARY BY SIZE.

Figure 1. Typical Track 8 Equipment Layout



LEGEND:

1. OPENING INFEED/TURN-UP PISTOL WINDOW SHIELD WITH
2. AIR RETURN NOZZLES
3. WORKING SPACE
4. LIQUID FILTER
5. STORAGE TANK
6. DISCHARGE VALVE
7. LOCKING ROLLERS
8. DISCHARGE VALVE
9. BLOWER MOTOR
10. CONNECTION FOR SPRAYING PISTOL
11. CONNECTION FOR AIR
12. WATER SEPARATOR PRESSURE GAUGE
13. PROTECTIVE CIRCUIT BREAKER
14. EXHAUST AIR CHARCOAL FILTER
15. AIR FILTER
16. INSPECTION LID
17. WINDOW SHIELD
18. TANKS FOR CLEANSING AGENTS

Figure 2. Portable Washer (CTM4)

Table 1. Cleaning Equipment

Equipment	CHEM-TECH Model No.	Qty	Width	Depth	Height	Weight	Facility requirements
(Heated) Immersion Tank (CT-1)	CTM1H (See note 1)	1	63 in.	25 in.	37 in.	200 lbs	120 VAC
(Unheated) Rinse Tank (Deionized Water)	CTM1U (See note 1)	1	63 in.	25 in.	37 in.	200 lbs	Fresh Water Hook Up
(Unheated) Immer-sion Tank (CT-2L)	CTM1U (See note 1)	1	63 in.	25 in.	37 in.	200 lbs	N/A
Spray Washing Machine	CTM2 (See note 1) (See note 2)	1	48 in.	34 in.	86 in.	750 lbs	220 VAC, Three Phase Compressed Air Source (90 psi minimum)
Drying Oven	CTM444 (See note 1)	1	55 in.	51 in.	90 in.	800 lbs	220 VAC, Three Phase
Portable Washer (See FIGURE 1, Sheet 2 of 2)	CTM4	1	30 in.	32 in.	55 in.	275 lbs	110 or 220 VAC, Single Phase Compressed Air Source (90 psi min-imum)
NOTE 1. Alternate equipment is commercially available from a range of manufacturers.							
NOTE 2: A facility air exhaust system is recommended to ensure compliance with applicable industrial ventilation and regulatory requirements. State and local air quality requirements may also apply.							

Table 2. Cleaning Agent Preparation

Agent identification	Agent description/test role	Bulk quantity
CT-1	Shipped as concentrate. Mix 1/5 w/deionized water.	1, 5, or 55 gal
CT-2L	No preparation required. Use as supplied	5 or 55 gal

a. Mix CT-1 with five parts water (manufacturer recommended concentration).

b. Heat CT-1 solution to approximately 130°F (55°C). Heating will accelerate the cleaning process.

c. (Light Cleaning) Place component to be cleaned in a basket or on a grate or stand (preferably stainless steel) and submerge in CT-1 solution 1-inch above the bottom of the container for approximately 5 minutes.

d. (Heavy/Corrosion) Place component to be cleaned in a basket or on a grate or stand (preferably stainless steel) and submerge in CT-1 solution 1 inch above the bottom of the container for approximately 30 minutes.

CAUTION

Once the component is submerged into the cleaning agent, it should be checked for effect on any markings after 1 to 3 minutes and verified every 3 to 5 minutes thereafter.

e. When soil appears loose, remove component from tank.

f. Soak or spray with deionized water to remove soil and CT-1.

g. If soil is not removed, lightly scrub and repeat steps c through g.

WARNING

CT-2L is not to be heated or diluted with water. When heated above flash point of 140°F will release vapors. Vapors when mixed with air and exposed to an ignition source can burn in an open environment or explode when confined.

h. (CT-2L Soak Method) Using a grate or stand (preferably stainless steel) in the bottom of the CT-2L container, soak component in the agent for 2 to 5 minutes. Water will drain to the bottom.

i. (CT-2L Spray Method) Spray clean component with CT-2L, paying particular attention to areas where water or loose contaminants may be trapped.

j. If residue is still present, soak or spray again in accordance with steps h or i.

k. Blow off CT-2L in the spray washer (CTM4 or CTM2). This step will decrease drying time and conserve CT-2L.

CAUTION

Compressed air for drying can create airborne particles that may enter the eyes. Pressure shall not exceed 10 psi. Eye protection is required.

l. Dry using a heat lamp, hot air, or a drying oven.

6.3.2 (CT-1, CT-2L) Cleaning Process (Ultrasonics).

WARNING

Ultrasonic cleaning may be harmful to soft tissue or skin. Do not place hands in tank when unit is in operation.

NOTE

Heated water will accelerate the cleaning process.

For initial operation and/or whenever the solution is changed, degassing is required.

Ensure that the ultrasonic frequency is 40 MHZ or higher.

a. (Initial/Changed Solution) Degas solution by activating ultrasonics for 20 to 30 minutes prior to commencing the cleaning process.

b. Mix CT-1 with five parts water (manufacturer recommended concentration).

c. Heat CT-1 solution to approximately 130°F (55°C). Heating will accelerate the cleaning process.

d. (Light Cleaning) Place component to be cleaned in a basket or on a grate or stand (preferably stainless steel). Submerge component in an ultrasonic tank of CT-1 solution 1 inch above the bottom of the container for approximately 1 to 3 minutes.

e. (Heavy/Corrosion) Place component to be cleaned in a basket or on a grate or stand (preferably stainless steel) and submerge in CT-1 solution 1 inch above the bottom of the container for approximately 10 minutes.

CAUTION

Once the component is submerged into the cleaning agent, it should be checked for effect on any markings after 1 to 3 minutes and verified every 3 to 5 minutes thereafter.

NOTE

If component is not cleaned in 10 minutes, component should be removed and inspected to determine whether to resoak in the CT-1 cleaning agent.

f. Soak or spray with deionized water to remove soil and CT-1.

g. If soil is not removed, lightly scrub and repeat steps d through g.

WARNING

CT-2L shall not be heated or diluted with water. When heated above flash point of 140°F will release vapors. Vapors when mixed with air and exposed to an ignition source can burn in an open environment or explode when confined.

h. (CT-2L Soak Method) Using a basket, grate, or stand (preferably stainless steel) in the bottom of the CT-2L container, soak component in the agent for 2 to 5 minutes. Water will drain to the bottom.

i. (CT-2L Spray Method) Spray clean component with CT-2L paying particular attention to areas where water or loose contaminants may be trapped.

j. If residue is still present, soak or spray in accordance with step h or i.

k. Blow off CT-2L in the spray washer (CTM4 or CTM2). This step will decrease drying time and conserve CT-2L.

l. Dry using a heat lamp, hot air, or a drying oven.

7. DISPOSAL.

7.1 CT-1. CT-1 is biodegradable. Disposal depends on the contaminant being removed and the applicable state and local regulations. Landfill solids at permitted sites via licensed contractor in accordance with applicable federal, state and local regulations.

7.2 CT-2L. Landfill solids at permitted sites via licensed contractor. Used products may be classified as hazardous waste (ignitable) due to low flash point and may be incinerated or burned for energy recovery. CT-2L has a heating value of 20156 BTU/lb. Either option must be performed in accordance with federal, state and local regulations.

GLOSSARY

A

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.

Alloy. A combination of two or more metals.

Aqueous. Made from, with, or by water.

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 ion 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 cations 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.

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

B

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

C

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 for each other (surface tension) and those of the solid. The "wicking" of a 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. This results in the nearly complete elimination of corrosion.

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

Caustic Embrittlement. The result of the combined action of tensile stress and corrosion is an alkaline solution that causes embrittlement. This is most frequently encountered in the laps of riveted boilers where the required concentration of alkali in the boiler water occurs.

Cell. In corrosion processes, a cell is a source of electrical current that is responsible for 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.

Chlorides. Certain compounds of chlorine. Many varieties of these are present in seawater and contribute to making the seawater an electrolyte (electrically conductive).

Clear Water. Colorless water containing no visible suspended particles.

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

Corrosion Rate. The speed of corrosion attack. It is usually expressed in terms of weight loss per unit of time.

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

Critical Avionic Components. Miniature or microminiature circuits including the components, printed circuit boards, tunable coils, tuned circuits and devices with gold/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 of corrosion products, the critical humidity will be lowered. For example, steel will not corrode if the relative humidity is less than 30% in a marine atmosphere.

D

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

Desiccant. A drying agent which acts by absorbing the moisture.

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

Durability. Ability of avionics to function and sustain stresses in field service for a specified period of time with economical maintenance. This is measured in terms of minimum acceptable failure free lifetime (MFL) and expected maximum lifetime (EML) including repair.

E

Elastomer. A synthetic material with elastic properties.

Expected Maximum Lifetime (EML). 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 (specified number of repair cycles).

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 electric charges and their orderly movement in solution constitutes a flow of current in the electrolyte.

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

Electronic Countermeasure. An offensive or defensive tactic using electronic or reflecting devices. It is used to reduce the military effectiveness of enemy equipment involving electromagnetic radiation.

Electronic Warfare. Warfare directed at the electronic capabilities of the enemy, to detect and prevent hostile use of the electromagnetic spectrum. Electronic warfare includes electronic countermeasures and counter countermeasures.

Embrittlement. Severe loss of ductility of a metal alloy that results in a brittle fashion.

Emulsified. One liquid dispersed throughout another liquid with which it will not mix to from 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. Examples include jet engine oil (MIL-L-23699) and hydraulic oil (MIL-H-83282). These synthetic oils can attack certain plastics and paints.

Exfoliation. The breaking away of a material from its surface in flakes or layers.

F

Fatigue. Tendency of a material to fracture under repeated cyclic stressing.

Faying Surface. The common surface between mating parts.

Fungus. A group of parasitic lower plants that feed on dead or decaying organic matter. Includes molds, mildews smuts, mushrooms and some bacteria.

G

Galvanic Couple. A closed electric circuit of two connected dissimilar metals joined by an electrolyte.

Galvanic Series. A list of metals and alloys arranged in order of the relative potentials in a given environment. The order of their arrangement in the list may be different in other environments.

H

Hydrogen Embrittlement. Loss of ductibility of a metal caused by the entrance of absorption of hydrogen ions. This results in the pickling of metal.

Hygroscopic. The property of readily absorbing and retaining moisture.

I

Inorganic Coating. A coating composed of matter other than of plant or mineral origin (i.e. electroplate, chemical conversion, 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.

J

K

L

M

Malfunction. A failure causing a flight safety situation, a mission abort, or a failure to accomplish mission.

Microbes. Microscopic living plants or organisms such as germs, molds, bacteria and fungus.

Mil. One one-thousandths of an inch.

Minimum Failure Free Lifetime (MFL). The minimum period of time that an avionics system, subsystem, module or component performs satisfactorily without failure.

N

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. Tubes, tube sockets, resistors, mechanical devices, knobs, various macroelectronic components and hardware.

Non-Destructive Inspection. A method used to check the soundness of a material or a part without impairing or destroying the serviceability of the part.

O

Organic Coating. A coating composed of matter derived from living organisms or carbon containing compounds (i.e., paint, lacquer, plastic, grease, preservative, etc.).

Outgassing. Emission of a gas during the cure or decomposition of organic material, usually increased in rate by higher temperatures.

P

Passivation. The process or processes that cause a metal to become inert to a given corrosive environment.

Phantom Gripe. An intermittent malfunction or failure which cannot be verified/identified for corrective action.

pH. A term used to express the effective hydrogen ion concentration of a solution. Values general range from 0 to 14. A pH of 7 indicates a neutral solution. Values lower than 7 indicate an acidic solution, while values greater than 7 indicate a basic solution.

Pitting. A form of corrosion that develops in highly localized areas on a metal surface that is not attacked elsewhere to any great extent. This results in the 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 with heat) characterized by high impact strength, high electrical resistivity, nontoxic, but is combustible. One of several plastics used for wire coating.

Potting Compound. A poured material which cures to a hard rubber-like consistency and provides moisture resistance and vibration resistance to the item.

Primer Coat. The first coat of a protective paint system. Originally applied to improve adherence of succeeding coat but now usually also contains an inhibitor.

Q

R

Relative Humidity, The ratio, expressed as a percentage, of the concentration of water vapor in the air to the water vapor concentration that it would have if saturated at the same temperature.

Revision. The situation wherein a cured material reverts toward its precure condition, i.e., a cured potting compound reverts to a sticky, liquid-like consistency.

S

Symbols. WARNINGS, CAUTIONS and NOTES - The following definitions apply to WARNINGS, CAUTIONS and NOTES found throughout the manual.

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 health hazards to personnel.

CAUTION

An operating or maintenance procedure, practice, statement, etc., which if not strictly observed, could result in damage/destruction of equipment or loss of mission effectiveness.

NOTE

An operating procedure, practice, or condition, etc., which is essential to emphasize.

T

Total Environment. The circumstances and conditions which surround and influence the equipment. The total environment includes manufacturing, storage, shipping, mission, maintenance and repair.

U

Ultraviolet Light. Light (radiation) is a wavelength band ranging from that shorter than visible light to that longer than X-ray. Longer wavelength UV from the sun causes sunburn. Shorter wavelength unfiltered UV from a UV lamp can cause damage to unprotected eyes.

Unacceptable Response. A detrimental abnormality in system performance.

Undesirable Response. A tolerated interruption of normal performance.

V

W

Wording. The following definitions are adhered to in preparing this manual.

- Shall is used only when a procedure is mandatory.
- Should is used only when a procedure is recommended but not mandatory.
- May is used only when a procedure is optional.
- Will indicates future action but never to indicate a mandatory procedure.

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